




**Presidio**  
**ENGINEERING, INC.**

4582 N. 1<sup>ST</sup> AVENUE, SUITE 120, TUCSON, ARIZONA 85718  
(520) 795-7255 FAX (520) 795-6747

## MEMORANDUM

TO: Paul Baughman, EIT  
Town of Marana

FROM: Tanya Grahn 

DATE: August 29, 2006

SUBJECT: The Pines Phase I Soils Report, ENG0511-015  
Presidio Engineering Job No. 104023-03-0500

COPIES TO: Gerrie Gray, Standard Pacific Homes w/ attachment  
John D. Wood, P.E., Presidio Engineering w/o attachment

In response to your July 14, 2006 memo regarding the above referenced project, please find attached two copies Terracon's August 21, 2006, Addendum 7 to the Geotechnical Engineering Report for review and approval.

Let us know if you have any questions or require additional information.

Attachment

August 21, 2006

Standard Pacific of Tucson  
4578 North First Avenue  
Tucson, Arizona 85718-5748

355 South Euclid, Suite 107  
Tucson, Arizona 85719  
Phone 520.770.1789  
Fax 520.792.2539  
www.terracon.com

Attn: Mr. Bob Storie

**RE: Addendum 7 to Geotechnical Engineering Report  
Phase I Residential Development at the Pines  
At the Pines Golf Course  
North of Cortaro Road and West of Interstate 10  
Marana, Arizona  
Terracon Project No. 63045225, Addendum 7**

Terracon has completed the geotechnical engineering report for the Residential Development at the Pines (Terracon project 63045225 dated December 8, 2004). We have been contacted by John Wood at Presidio Engineering to provide additional information concerning Continental Links Drive for this project. We have previously provided information concerning Continental Links Drive in Addendum 2, dated June 6, 2005.

Based on revised anticipated traffic volumes for Continental Links Drive, considering traffic generated from The Pines Phase I, The Pines Phase II, and the golf course, the anticipated traffic volume will be 3,750 ADT. Revised traffic volumes were provided by Scott Beck of Kimley-Horn associates.

The site soils have a correlated R-value of 49 which equates to a resilient modulus value  $M_r$  of 23,385 psi using a seasonal variation factor of 1.7 for Marana. Based on an ADT of 3,750 we estimate 1,112,246 design ESAL's. Using this data and ADOT/AASHTO design procedures a required structural number of 2.20 is calculated. A minimum pavement section consisting of 3.5 inches of asphalt (PAG Mix No. 2) over 6 inches of aggregate base course has a structural number of 2.20 and is recommended for design. Alternatively, a pavement section of 3.0 inches of asphalt over 8 inches of aggregate base course has a structural number of 2.20 and may also be used.

Materials and construction of pavements for the project should be in accordance with the requirements and specifications of the Pima County/City of Tucson Standard Specifications for Public Improvements.

AUG 24 2006



# Design Traffic Analysis

◆ All Truck Factors are 18-kip equivalents per vehicle per ADOT

## Initial Data

### PROJECT DATA

Project name: The Pines  
 Location: Marana, Arizona  
 TCW Project No. 63045225

### STREET DATA

Street Name: Continental Links Drive - Revision 1  
 Design Average Daily Traffic (ADT): 3,750  
 Design Period (years): 20  
 Number of Traffic Lanes (2, 4 or 6): 2

## Equivalent 18-kip Axle Load Analysis

| Vehicle Type                       | % of Traffic  | No. of Vehicles/Day | 18-kip Factor | Design Years | Equivalent Axle Loads |
|------------------------------------|---------------|---------------------|---------------|--------------|-----------------------|
| <b>Non-Commercial Vehicles</b>     |               |                     |               |              |                       |
| Automobiles                        | 66.0%         | 2,475               | 0.0008        | 20.00        | 14,454                |
| Buses                              | 0.0%          | 0                   | 0.2500        | 20.00        | 0                     |
| <b>All Non-Commercial Vehicles</b> | <b>66.0%</b>  | <b>2,475</b>        |               |              | <b>14,454</b>         |
| <b>Commercial Vehicles</b>         |               |                     |               |              |                       |
| Light Trucks (LT)                  | 31.0%         | 1,163               | 0.0100        | 20.00        | 84,863                |
| Medium Trucks                      | 1.5%          | 56                  | 0.4000        | 20.00        | 164,250               |
| Tractor and Semi-Trailer (TS)      | 1.5%          | 56                  | 2.0668        | 20.00        | 848,680               |
| Truck and Trailer (TT)             | 0.0%          | 0                   | 2.0227        | 20.00        | 0                     |
| Tractor and Semi-Trailer (TST)     | 0.0%          | 0                   | 3.1506        | 20.00        | 0                     |
| <b>All Commercial Vehicles</b>     | <b>34.0%</b>  | <b>1,275</b>        |               |              | <b>1,097,792</b>      |
| <b>All Vehicles</b>                | <b>100.0%</b> | <b>3,750</b>        |               |              | <b>1,112,246</b>      |

## Traffic Summary

### TOTALS

|                               |                  |
|-------------------------------|------------------|
| Equivalent Axle Loads (EAL's) | 1,112,246        |
| Directional Factor            | 1.00             |
| Lane Factor                   | 1.00             |
| Design Equivalent Axle Loads  | <b>1,112,246</b> |
| Design Traffic Number (DTN)   | <b>152</b>       |



# Flexible Pavement Design Analysis

## Design Criteria

Project Name: Continental Links Drive - Revision 1  
 Project Number: 66045225

### PROJECT DATA

|                            |           |
|----------------------------|-----------|
| Design Life (years)        | 20        |
| Equivalent Axle Loads/Day  | **        |
| Total EAL's                | 1,112,246 |
| Seasonal Variation Factor  | 1.6       |
| Reliability                | 90%       |
| Overall Standard Deviation | 0.35      |

### SUBGRADE CONDITIONS

|                            |        |
|----------------------------|--------|
| AASHTO Classification      | **     |
| % Passing #200 Sieve       | **     |
| Plasticity Index           | **     |
| Correlated R-Value         | 49     |
| Resilient Modulus MR (psi) | 23,385 |
| Design Modulus (psi)       | 23,385 |

### SERVICEABILITY

|                       |     |
|-----------------------|-----|
| Present (2.5 to 5.0)  | 4.1 |
| Terminal (1.5 to 4.1) | 2.6 |

### LAYER COEFFICIENTS

|                                   | Structural | Drainage |
|-----------------------------------|------------|----------|
| Asphalt Rubber Asphaltic Concrete | 0.55       | N/A      |
| Asphalt Concrete Surface Course   | 0.44       | N/A      |
| Aggregate Base Course             | 0.12       | 0.92     |
| Cement or Bituminous Subgrade     | 0.23       | 1.00     |
| Cement or Bituminous Treated Base | 0.28       | 1.00     |

## Design Calculations

Target Structural Number SN: 2.20

| Alternative | Recommended Pavement Section Thickness |                          |                       |                             |       | Total Structural Number |
|-------------|--|--------------------------|-----------------------|-----------------------------|-------|-------------------------|
|             | Inches                                 |                          |                       |                             |       |                         |
|             | Asphalt Rubber Concrete                | Asphalt Concrete Surface | Aggregate Base Course | Plant-Mixed Bituminous Base | Total |                         |
| A           |  | 3.0                      | 6                     |                             | 9.0   | 1.98                    |
| B           |  | 3.5                      | 6.0                   |                             | 9.5   | 2.20                    |
| C           |  | 3.0                      | 8                     |                             | 11.0  | 2.20                    |



355 South Euclid, Suite 107  
Tucson, Arizona 85719  
Phone 520.770.1789  
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September 29, 2004

Standard Pacific of Tucson  
4578 North First Avenue  
Suite 160  
Tucson, Arizona 85718-5748

Attn: Mr. Bob Storie

**RE: Preliminary Geotechnical Site Evaluation  
Proposed Phase II Residential Developments at the Pines Golf Course  
North of Cortaro Road and West of Interstate 10  
Marana, Arizona  
Terracon Project No. 63045195**

Terracon Consultants, Inc. (Terracon) has completed our preliminary review of the proposed Phase II Residential Development at the Pines Golf Course. Our preliminary evaluation was performed in general accordance with our proposal number D6304220, dated September 24, 2004.

#### **Introduction**

We understand the proposed project consists of Phase II of the area presently known as the Pines Golf Course. Phase II covers about 56 acres and is planned for both single and multi-family housing. Phase II was formerly a golf course.

Presidio Engineering has provided us with a geotechnical report for the Phase II area (performed by Pattison Evanoff Engineering). We have also been provided with a preliminary site exhibit for Phase I (prepared by WLB).

#### **Work Performed**

We visited the site on September 27, 2004 and reviewed the site conditions. We reviewed the preliminary site exhibit and geotechnical report provided to us.

#### **Preliminary Findings and Conclusions**

This site is surrounded by an existing golf course. The site had previously been a golf course and some of the golf course features are still visible. The geotechnical report we reviewed appeared fairly comprehensive and the field and laboratory work performed appeared typical of the level of work to provide recommendations for a residential subdivision at this site. The

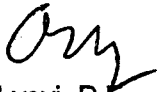
SUBMITTAL NO. \_\_\_\_\_

report provided recommendations for the design of foundations, floor slabs, pavements, and earthwork. The report identified existing fills and recommended further evaluation to help better identify the vertical and lateral extents of those fills. We believe this may be accomplished by performing shallow backhoe test pits, focusing on areas around where existing fills were identified in the soil borings. Any existing site slopes steeper than about 2 to 1 (horizontal to vertical) will likely need to be flattened.

If you have any questions regarding this preliminary evaluation, please contact us.

Sincerely,

**TERRACON CONSULTANTS, INC.**



Oleg B. Lysyj, P.E.  
Geotechnical Services Manager

**FOLLOW-UP TO PRELIMINARY  
GEOTECHNICAL SITE EVALUATION**

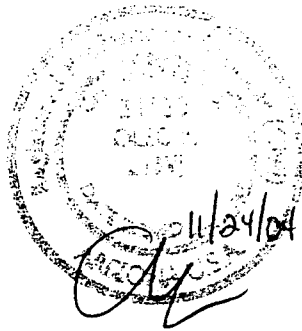
**PROPOSED PHASE II RESIDENTIAL DEVELOPMENTS  
AT THE PINES GOLF COURSE  
CONTINENTAL LINKS AND ARIZONA PAVILIONS ROAD  
MARANA, ARIZONA**

**TERRACON PROJECT NO. 63045218  
NOVEMBER 24, 2003**

*Prepared for:*

**STANDARD PACIFIC OF TUCSON  
4578 NORTH FIRST AVENUE  
SUITE 160  
TUCSON, ARIZONA 85718**

**ATTN: MR. BOB STORIE**



*Prepared by:*

**TERRACON  
355 SOUTH EUCLID AVENUE, SUITE 107  
TUCSON, ARIZONA 85719  
Phone (520) 770-1789 Fax (520) 792-2539**

**SUBMITTAL NO.** 1

**PRV - 05154**

**Terracon**

November 24, 2004

Standard Pacific of Tucson  
4578 North First Avenue  
Suite 160  
Tucson, Arizona 85718-5748

Attn: Mr. Bob Storie

**RE: Follow-Up to Preliminary Geotechnical Site Evaluation  
Proposed Phase II Residential Developments at the Pines Golf Course  
Continental Links and Arizona Pavilions Road  
Marana, Arizona  
Terracon Project No. 63045218**

Terracon Consultants, Inc. (Terracon) has completed the follow-up investigation to our preliminary review of the proposed Phase II Residential Development at the Pines Golf Course. Our follow-up investigation was performed in general accordance with our proposal number D6304242, dated September 24, 2004, also reference Terracon Report 63055195 dated September 29, 2004.

### **Introduction**

We understand the proposed project consists of Phase II of the area presently known as the Pines Golf Course. Phase II covers about 56 acres and is planned for both single and multi-family housing. Phase II was formerly a golf course.

Presidio Engineering has provided us with a geotechnical report for the Phase II area (performed by Pattison Evanoff Engineering). We have also been provided with a preliminary site exhibit for Phase I (prepared by WLB).

The original geotechnical report (performed by Pattison Evanoff Engineering) identified existing fill in one area of the golf course. The purpose of this investigation is to evaluate the extents, both in depth and laterally, of existing fills at the site, evaluate slope areas and recommend geometry for cut and fill slopes, and determine the applicability of the original recommendations for portions of the site now planned for multi-family housing.

### **Work Performed**

On November 4 and 8, 2004 we performed 17 test pits with a John Deere 310G tractor mounted backhoe using an 18-inch wide bucket. The test pits were extended to depths of approximately 5 feet below existing grade at the locations shown on the Site Plan, Figure 1.

The test-pits were located in the field by measurements from property lines and existing site features. The accuracy of test-pit locations should only be assumed to the level implied by the methods used to determine each.

Continuous lithologic logs of each test-pit were recorded by the geotechnical engineer during the excavation. At selected test-pits, samples of the subsurface materials were obtained from excavated trench material.

Groundwater conditions were evaluated in each boring at the time of site exploration.

### **Findings and Conclusions**

This site is surrounded by an existing golf course. The site had previously been a golf course and some of the golf course features are still visible. The geotechnical report we reviewed appeared fairly comprehensive and the field and laboratory work performed appeared typical of the level of work to provide recommendations for a residential subdivision at this site. The report appears to have provided adequate recommendations for the design of foundations, floor slabs, pavements, and earthwork.

Although it was difficult to delineate the existing fill from the native material, it appears that the hill features created during the sculpting of the old golf course contain a minimum of three to four feet of fill material, therefore we recommend the high points be removed. It appears that most of these features will be taken down for the construction of house pads and grading for site drainage.

For permanent slopes in compacted fill and cut native areas, recommended maximum configurations for on-site materials are 2 to 1 (horizontal to vertical). Slopes steeper than 3 to 1 (horizontal to vertical) should be re-vegetated to help reduce surface erosion.

**Proposed Phase II Residential Developments  
At The Pines Golf Course  
Terracon Project No. 63045218**

3

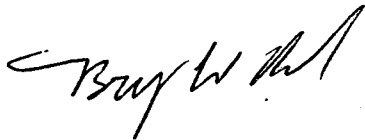
The face of all slopes should be compacted to the minimum specification for fill embankments. Alternately, fill slopes can be over-built and trimmed to compacted material. If any slope in cut or fill will exceed 25 feet in height, the grading plan should include mid-height benches to intercept surface drainage and divert flow from the face of the embankment.

Slopes with inclinations between 2 to 1, and 1 to 1 may be constructed provided they are surfaced with grouted rip-rap or grout at least 6-inches thick, and integrated with a vertical toe-down. The grout toe-down should extend to depths of 1 foot below the base of the slope for slopes 0-5 feet high, 2 feet for slopes 5 to 10 feet high, and 3 feet for slopes 10 to 15 feet high.

If you have any questions regarding this preliminary evaluation, please contact us.

Sincerely,

**TERRACON CONSULTANTS, INC.**



Bryan W. Reed, E.I.T.  
Project Manager



Oleg B. Lysyj, P.E.  
Geotechnical Services Manager



**LEGEND**


 APPROXIMATE TEST-PIT LOCATION



DIAGRAM IS FOR GENERAL LOCATION ONLY,  
AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

| <b>SITE PLAN AND BORING LOCATIONS</b><br><b>THE PINES - PHASE II</b><br>CONTINENTAL LINKS AND ARIZONA PAVILIONS ROAD<br>MARANA, ARIZONA<br>STANDARD PACIFIC OF TUCSON |     |   |             |          |
|---|-----|---|-------------|----------|
| Project Mngr:   | BWR | <br>355 South Euclid, Suite 107<br>Tucson, Arizona 85719 | Project No. | 63045218 |
| Designed By:  |     |   | Scale:      | None     |
| Checked By:   |     |   | Date:       | 11-22-04 |
| Approved By:  | OBL |   | Drawn By:   | BWR(63)  |
| File Name: n:\public\04\georept\63045218\63045218.dwg   |     | L(Layout1)  | Figure No.  | 1        |



# LOG OF TEST PIT NO. TP-01

|  |  |   |             |         |      |               |           |                  |                 |              |                  |
|--|--|---|-------------|---------|------|---------------|-----------|------------------|-----------------|--------------|------------------|
| CLIENT<br><b>Standard Pacific of Tucson</b>              |  |   |             |         |      |               |           |                  |                 |              |                  |
| SITE<br><b>The Pines Golf Course<br/>Marana, Arizona</b> |  | PROJECT<br><b>Phase II Residential Developments</b> |             |         |      |               |           |                  |                 |              |                  |
| GRAPHIC LOG  | DESCRIPTION  | DEPTH, ft.  | USCS SYMBOL | SAMPLES |      |               |           | TESTS            |                 |              |                  |
|  |  |   |             | NUMBER  | TYPE | RECOVERY (in) | BLOWS/FT. | WATER CONTENT, % | DRY DENSITY pcf | Liquid Limit | PLASTICITY INDEX |
| 3  | <b>FILL: SANDY CLAY/SILT</b> ; dark brown, low plasticity fines, moist |   | CL-ML       | 1       | BS   |               |           |                  |                 |              |                  |
| 5  | <b>SANDY CLAY SILT</b> ; brown, low plasticity fines, moist            |   | CL          |         |      |               |           |                  |                 |              |                  |
|  | Bottom of Test Pit   | 5   |             |         |      |               |           |                  |                 |              |                  |

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.


**WATER LEVEL OBSERVATIONS, ft**

|    |                            |           |
|----|----------------------------|-----------|
| WL | ∇ None WD                  | ∇ None AB |
| WL | ∇                          | ∇         |
| WL | Backfilled Upon Completion |           |



|                  |         |                |
|------------------|---------|----------------|
| BORING STARTED   |         | 11-4-04        |
| BORING COMPLETED |         | 11-4-04        |
| RIG              | JD 310G | FOREMAN BWR    |
| Approved         | OBL     | JOB # 63045218 |

# LOG OF TEST PIT NO. TP-02

|  |   |   |             |         |      |               |           |                  |                 |              |                  |
|--|---|---|-------------|---------|------|---------------|-----------|------------------|-----------------|--------------|------------------|
| CLIENT<br><b>Standard Pacific of Tucson</b>              |   |   |             |         |      |               |           |                  |                 |              |                  |
| SITE<br><b>The Pines Golf Course<br/>Marana, Arizona</b> |   | PROJECT<br><b>Phase II Residential Developments</b> |             |         |      |               |           |                  |                 |              |                  |
| GRAPHIC LOG  | DESCRIPTION   | DEPTH, ft.  | USCS SYMBOL | SAMPLES |      |               |           | TESTS            |                 |              |                  |
|  |   |   |             | NUMBER  | TYPE | RECOVERY (in) | BLOWS/FT. | WATER CONTENT, % | DRY DENSITY pcf | Liquid Limit | PLASTICITY INDEX |
| 5  | <p><b>SILTY SAND;</b> light brown, non-plastic fines, moist</p>  | 5   | SM          | 1       | BS   |               |           |                  |                 |              |                  |
|  | Bottom of Test Pit  |   |             |         |      |               |           |                  |                 |              |                  |

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

**WATER LEVEL OBSERVATIONS, ft**

|    |   |                            |   |         |
|----|---|----------------------------|---|---------|
| WL | ▽ | None WD                    | ▽ | None AB |
| WL | ▽ |                            | ▽ |         |
| WL |   | Backfilled Upon Completion |   |         |



|                  |         |         |          |
|------------------|---------|---------|----------|
| BORING STARTED   |         | 11-4-04 |          |
| BORING COMPLETED |         | 11-4-04 |          |
| RIG              | JD 310G | FOREMAN | BWR      |
| Approved         | OBL     | JOB #   | 63045218 |

# LOG OF TEST PIT NO. TP-03

|  |  |   |             |         |      |               |           |                  |                 |              |                  |      |  |
|--|--|---|-------------|---------|------|---------------|-----------|------------------|-----------------|--------------|------------------|------|--|
| CLIENT<br><b>Standard Pacific of Tucson</b>              |  |   |             |         |      |               |           |                  |                 |              |                  |      |  |
| SITE<br><b>The Pines Golf Course<br/>Marana, Arizona</b> |  | PROJECT<br><b>Phase II Residential Developments</b> |             |         |      |               |           |                  |                 |              |                  |      |  |
| GRAPHIC LOG  | DESCRIPTION  | DEPTH, ft.  | USCS SYMBOL | SAMPLES |      |               |           | TESTS            |                 |              |                  |      |  |
|  |  |   |             | NUMBER  | TYPE | RECOVERY (in) | BLOWS/FT. | WATER CONTENT, % | DRY DENSITY pcf | Liquid Limit | PLASTICITY INDEX | -200 |  |
| 5  | <b>SANDY CLAY/SILT</b> ; low plasticity fines, moist | 5   | CL-ML       | 1       | BS   |               |           |                  |                 |              |                  |      |  |
|  | Bottom of Test Pit                                   |   |             |         |      |               |           |                  |                 |              |                  |      |  |

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

**WATER LEVEL OBSERVATIONS, ft**

|    |                            |         |  |
|----|----------------------------|---------|--|
| WL | None WD                    | None AB |  |
| WL |                            |         |  |
| WL | Backfilled Upon Completion |         |  |



|                  |         |         |          |
|------------------|---------|---------|----------|
| BORING STARTED   |         | 11-4-04 |          |
| BORING COMPLETED |         | 11-4-04 |          |
| RIG              | JD 310G | FOREMAN | BWR      |
| Approved         | OBL     | JOB #   | 63045218 |

# LOG OF TEST PIT NO. TP-04

|  |   |   |             |         |      |               |           |                  |                    |              |                  |      |  |
|--|---|---|-------------|---------|------|---------------|-----------|------------------|--------------------|--------------|------------------|------|--|
| CLIENT<br><b>Standard Pacific of Tucson</b>              |   |   |             |         |      |               |           |                  |                    |              |                  |      |  |
| SITE<br><b>The Pines Golf Course<br/>Marana, Arizona</b> |   | PROJECT<br><b>Phase II Residential Developments</b> |             |         |      |               |           |                  |                    |              |                  |      |  |
| GRAPHIC LOG  | DESCRIPTION   | DEPTH, ft.  | USCS SYMBOL | SAMPLES |      |               |           | TESTS            |                    |              |                  |      |  |
|  |   |   |             | NUMBER  | TYPE | RECOVERY (in) | BLOWS/FT. | WATER CONTENT, % | DRY DENSITY<br>pcf | Liquid Limit | PLASTICITY INDEX | -200 |  |
| 5  | <b>SANDY CLAY/SILT</b> ; brown, low plasticity fines, moist | 5   | CL-ML       | 1       | BS   |               |           |                  |                    |              |                  |      |  |
|  | Bottom of Test Pit  |   |             |         |      |               |           |                  |                    |              |                  |      |  |

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

**WATER LEVEL OBSERVATIONS, ft**

|    |   |                            |   |         |
|----|---|----------------------------|---|---------|
| WL | ∇ | None WD                    | ∇ | None AB |
| WL | ∇ |                            | ∇ |         |
| WL |   | Backfilled Upon Completion |   |         |



|                  |         |         |          |
|------------------|---------|---------|----------|
| BORING STARTED   |         | 11-4-04 |          |
| BORING COMPLETED |         | 11-4-04 |          |
| RIG              | JD 310G | FOREMAN | BWR      |
| Approved         | OBL     | JOB #   | 63045218 |

# LOG OF TEST PIT NO. TP-05

| CLIENT<br><b>Standard Pacific of Tucson</b>              |   |   |             |         |      |               |           |                  |                    |              |                  |      |  |
|--|---|---|-------------|---------|------|---------------|-----------|------------------|--------------------|--------------|------------------|------|--|
| SITE<br><b>The Pines Golf Course<br/>Marana, Arizona</b> |   | PROJECT<br><b>Phase II Residential Developments</b> |             |         |      |               |           |                  |                    |              |                  |      |  |
| GRAPHIC LOG  | DESCRIPTION   | DEPTH, ft.  | USCS SYMBOL | SAMPLES |      |               |           | TESTS            |                    |              |                  |      |  |
|  |   |   |             | NUMBER  | TYPE | RECOVERY (in) | BLOWS/FT. | WATER CONTENT, % | DRY DENSITY<br>pcf | Liquid Limit | PLASTICITY INDEX | -200 |  |
| 5  | <b>SILTY SAND</b> ; light brown, non-plastic fines, moist | 5   | SM          | 1       | BS   |               |           |                  |                    |              |                  |      |  |
|  | Bottom of Test Pit  |   |             |         |      |               |           |                  |                    |              |                  |      |  |

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

BOREHOLE 2000 63045218.GPJ TERR2000.GDT 11/23/04

| WATER LEVEL OBSERVATIONS, ft                   |   |
|--|---|
| WL <input checked="" type="checkbox"/> None WD | <input checked="" type="checkbox"/> None AB |
| WL <input checked="" type="checkbox"/>         | <input checked="" type="checkbox"/>         |
| WL Backfilled Upon Completion                  |   |



|                  |         |         |          |
|------------------|---------|---------|----------|
| BORING STARTED   |         | 11-4-04 |          |
| BORING COMPLETED |         | 11-4-04 |          |
| RIG              | JD 310G | FOREMAN | BWR      |
| Approved         | OBL     | JOB #   | 63045218 |

# LOG OF TEST PIT NO. TP-06

|  |  |   |             |         |      |               |           |                  |                 |              |                  |
|--|--|---|-------------|---------|------|---------------|-----------|------------------|-----------------|--------------|------------------|
| CLIENT<br><b>Standard Pacific of Tucson</b>              |  |   |             |         |      |               |           |                  |                 |              |                  |
| SITE<br><b>The Pines Golf Course<br/>Marana, Arizona</b> |  | PROJECT<br><b>Phase II Residential Developments</b> |             |         |      |               |           |                  |                 |              |                  |
| GRAPHIC LOG  | DESCRIPTION  | DEPTH, ft.  | USCS SYMBOL | SAMPLES |      |               |           | TESTS            |                 |              |                  |
|  |  |   |             | NUMBER  | TYPE | RECOVERY (in) | BLOWS/FT. | WATER CONTENT, % | DRY DENSITY pcf | Liquid Limit | PLASTICITY INDEX |
| 3  | <b>SANDY CLAY/SILT</b> ; brown, low plasticity fines, moist            |   | CL-ML       | 1       | BS   |               |           |                  |                 |              |                  |
| 5  | <b>SILTY SAND TRACE GRAVEL</b> ; light brown, non-plastic fines, moist |   | SM          |         |      |               |           |                  |                 |              |                  |
|  | Bottom of Test Pit   | 5   |             |         |      |               |           |                  |                 |              |                  |

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

|                              |                            |           |  |
|------------------------------|----------------------------|-----------|--|
| WATER LEVEL OBSERVATIONS, ft |                            |           |  |
| WL                           | ∇ None WD                  | ∇ None AB |  |
| WL                           | ∇                          | ∇         |  |
| WL                           | Backfilled Upon Completion |           |  |



|                  |         |         |          |
|------------------|---------|---------|----------|
| BORING STARTED   |         | 11-4-04 |          |
| BORING COMPLETED |         | 11-4-04 |          |
| RIG              | JD 310G | FOREMAN | BWR      |
| Approved         | OBL     | JOB #   | 63045218 |

BOREHOLE 2000 63045218.GPJ TERR2000.GDT 11/23/04

# LOG OF TEST PIT NO. TP-07

|  |   |   |             |         |      |               |           |                  |                 |              |                  |      |  |
|--|---|---|-------------|---------|------|---------------|-----------|------------------|-----------------|--------------|------------------|------|--|
| CLIENT<br><b>Standard Pacific of Tucson</b>              |   |   |             |         |      |               |           |                  |                 |              |                  |      |  |
| SITE<br><b>The Pines Golf Course<br/>Marana, Arizona</b> |   | PROJECT<br><b>Phase II Residential Developments</b> |             |         |      |               |           |                  |                 |              |                  |      |  |
| GRAPHIC LOG  | DESCRIPTION   | DEPTH, ft.  | USCS SYMBOL | SAMPLES |      |               |           | TESTS            |                 |              |                  |      |  |
|  |   |   |             | NUMBER  | TYPE | RECOVERY (in) | BLOWS/FT. | WATER CONTENT, % | DRY DENSITY pcf | Liquid Limit | PLASTICITY INDEX | -200 |  |
| 4  | <b>SANDY CLAY/SILT</b> ; brown, low plasticity fines, moist |   | CL-ML       | 1       | BS   |               |           |                  |                 |              |                  |      |  |
| 5  | <b>SILTY SAND</b> ; non-plastic fines, moist                |   | SM          |         |      |               |           |                  |                 |              |                  |      |  |
|  | Bottom of Test Pit  | 5   |             |         |      |               |           |                  |                 |              |                  |      |  |

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

**WATER LEVEL OBSERVATIONS, ft**

|                               |           |
|-------------------------------|-----------|
| WL ▽ None WD                  | ▽ None AB |
| WL ▽                          | ▽         |
| WL Backfilled Upon Completion |           |



|                  |         |         |          |
|------------------|---------|---------|----------|
| BORING STARTED   |         | 11-4-04 |          |
| BORING COMPLETED |         | 11-4-04 |          |
| RIG              | JD 310G | FOREMAN | BWR      |
| Approved         | OBL     | JOB #   | 63045218 |

# LOG OF TEST PIT NO. TP-08

|  |   |   |             |         |      |               |           |                  |                    |              |                  |
|--|---|---|-------------|---------|------|---------------|-----------|------------------|--------------------|--------------|------------------|
| CLIENT<br><b>Standard Pacific of Tucson</b>              |   |   |             |         |      |               |           |                  |                    |              |                  |
| SITE<br><b>The Pines Golf Course<br/>Marana, Arizona</b> |   | PROJECT<br><b>Phase II Residential Developments</b> |             |         |      |               |           |                  |                    |              |                  |
| GRAPHIC LOG  | DESCRIPTION   | DEPTH, ft.  | USCS SYMBOL | SAMPLES |      |               |           | TESTS            |                    |              |                  |
|  |   |   |             | NUMBER  | TYPE | RECOVERY (in) | BLOWS/FT. | WATER CONTENT, % | DRY DENSITY<br>pcf | Liquid Limit | PLASTICITY INDEX |
| 5  | <b>SANDY CLAY/SILT</b> ; brown, low plasticity fines, moist | 5   | CL-ML       | 1       | BS   |               |           |                  |                    |              |                  |
|  | Bottom of Test Pit  |   |             |         |      |               |           |                  |                    |              |                  |

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

**WATER LEVEL OBSERVATIONS, ft**

|    |                            |           |
|----|----------------------------|-----------|
| WL | ∇ None WD                  | ∇ None AB |
| WL | ∇                          | ∇         |
| WL | Backfilled Upon Completion |           |



|                  |         |         |          |
|------------------|---------|---------|----------|
| BORING STARTED   |         | 11-4-04 |          |
| BORING COMPLETED |         | 11-4-04 |          |
| RIG              | JD 310G | FOREMAN | BWR      |
| Approved         | OBL     | JOB #   | 63045218 |

BOREHOLE 2000\_63045218.GPJ TERR2000.GDT 11/23/04



# LOG OF TEST PIT NO. TP-09

|  |  |   |             |         |      |               |           |                  |                    |              |                  |
|--|--|---|-------------|---------|------|---------------|-----------|------------------|--------------------|--------------|------------------|
| CLIENT<br><b>Standard Pacific of Tucson</b>              |  |   |             |         |      |               |           |                  |                    |              |                  |
| SITE<br><b>The Pines Golf Course<br/>Marana, Arizona</b> |  | PROJECT<br><b>Phase II Residential Developments</b> |             |         |      |               |           |                  |                    |              |                  |
| GRAPHIC LOG  | DESCRIPTION  | DEPTH, ft.  | USCS SYMBOL | SAMPLES |      |               |           | TESTS            |                    |              |                  |
|  |  |   |             | NUMBER  | TYPE | RECOVERY (in) | BLOWS/FT. | WATER CONTENT, % | DRY DENSITY<br>pcf | Liquid Limit | PLASTICITY INDEX |
| 2  | <b>SANDY SILT WITH ORGANIC MATERIAL</b> ; loose, non-plastic fines, moist, roots and grass | 1   | ML          | BS      |      |               |           |                  |                    |              |                  |
| 2.5  | <b>SILTY SAND</b> ; very loose, non-plastic fines, moist                                   |   | SM          |         |      |               |           |                  |                    |              |                  |
| 5  | <b>SANDY LEAN CLAY</b> ; brown, loose to medium dense, medium plasticity fines, moist      |   | CL          |         |      |               |           |                  |                    |              |                  |
|  | Bottom of Test Pit   | 5   |             |         |      |               |           |                  |                    |              |                  |

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

**WATER LEVEL OBSERVATIONS, ft**

|    |                            |           |  |
|----|----------------------------|-----------|--|
| WL | ∇ None WD                  | ∇ None AB |  |
| WL | ∇                          | ∇         |  |
| WL | Backfilled Upon Completion |           |  |



|                  |         |         |          |
|------------------|---------|---------|----------|
| BORING STARTED   |         | 11-8-04 |          |
| BORING COMPLETED |         | 11-8-04 |          |
| RIG              | JD 310G | FOREMAN | BWR      |
| Approved         | OBL     | JOB #   | 63045218 |

BOREHOLE 2000 63045218.GPJ TERR2000.GDT 11/23/04

# LOG OF TEST PIT NO. TP-10

|  |   |   |             |         |      |               |           |                  |                 |              |                  |
|--|---|---|-------------|---------|------|---------------|-----------|------------------|-----------------|--------------|------------------|
| CLIENT<br><b>Standard Pacific of Tucson</b>              |   |   |             |         |      |               |           |                  |                 |              |                  |
| SITE<br><b>The Pines Golf Course<br/>Marana, Arizona</b> |   | PROJECT<br><b>Phase II Residential Developments</b> |             |         |      |               |           |                  |                 |              |                  |
| GRAPHIC LOG  | DESCRIPTION   | DEPTH, ft.  | USCS SYMBOL | SAMPLES |      |               |           | TESTS            |                 |              |                  |
|  |   |   |             | NUMBER  | TYPE | RECOVERY (in) | BLOWS/FT. | WATER CONTENT, % | DRY DENSITY pcf | Liquid Limit | PLASTICITY INDEX |
| 1.5  | <b>SANDY SILT WITH ORGANIC MATERIAL</b> ; loose, low plasticity fines, moist          | ML  | 1           | BS      |      |               |           |                  |                 |              |                  |
| 5  | <b>SANDY LEAN CLAY</b> ; brown, loose to medium dense, medium plasticity fines, moist | CL  |             |         |      |               |           |                  |                 |              |                  |
|  | Bottom of Test Pit  | 5   |             |         |      |               |           |                  |                 |              |                  |

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

**WATER LEVEL OBSERVATIONS, ft**

|    |                            |           |
|----|----------------------------|-----------|
| WL | ▽ None WD                  | ▽ None AB |
| WL | ▽                          | ▽         |
| WL | Backfilled Upon Completion |           |



|                  |         |         |          |
|------------------|---------|---------|----------|
| BORING STARTED   |         | 11-8-04 |          |
| BORING COMPLETED |         | 11-8-04 |          |
| RIG              | JD 310G | FOREMAN | BWR      |
| Approved         | OBL     | JOB #   | 63045218 |

BOREHOLE 2000 63045218.GPJ TERR2000.GDT 11/23/04

# LOG OF TEST PIT NO. TP-11

| CLIENT<br><b>Standard Pacific of Tucson</b>              |   |   |             |         |      |               |           |                  |                 |              |                  |      |  |  |
|--|---|---|-------------|---------|------|---------------|-----------|------------------|-----------------|--------------|------------------|------|--|--|
| SITE<br><b>The Pines Golf Course<br/>Marana, Arizona</b> |   | PROJECT<br><b>Phase II Residential Developments</b> |             |         |      |               |           |                  |                 |              |                  |      |  |  |
| GRAPHIC LOG  | DESCRIPTION   | DEPTH, ft.  | USCS SYMBOL | SAMPLES |      |               |           | TESTS            |                 |              |                  |      |  |  |
|  |   |   |             | NUMBER  | TYPE | RECOVERY (in) | BLOWS/FT. | WATER CONTENT, % | DRY DENSITY pcf | Liquid Limit | PLASTICITY INDEX | -200 |  |  |
| 2  | <b>SANDY SILT WITH ORGANIC MATERIAL</b> ; loose, medium plasticity fines, moist       | 1   | CL          | 1       | BS   |               |           |                  |                 |              |                  |      |  |  |
| 5  | <b>SANDY LEAN CLAY</b> ; brown, loose to medium dense, medium plasticity fines, moist | 5   | CL          |         |      |               |           |                  |                 |              |                  |      |  |  |
|  | Bottom of Test Pit  | 5   |             |         |      |               |           |                  |                 |              |                  |      |  |  |

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

| WATER LEVEL OBSERVATIONS, ft |                            |    |        |
|------------------------------|----------------------------|----|--------|
| WL                           | ∇ None                     | WD | ∇ None |
| WL                           | ∇                          |    | ∇      |
| WL                           | Backfilled Upon Completion |    |        |



|                  |         |         |          |
|------------------|---------|---------|----------|
| BORING STARTED   |         | 11-8-04 |          |
| BORING COMPLETED |         | 11-8-04 |          |
| RIG              | JD 310G | FOREMAN | BWR      |
| Approved         | OBL     | JOB #   | 63045218 |

BOREHOLE 2000 63045218.GPJ TERR2000.GDT 11/23/04

# LOG OF TEST PIT NO. TP-12

| CLIENT<br><b>Standard Pacific of Tucson</b>              |  |   |             |         |      |               |           |                  |                 |              |                  |      |  |
|--|--|---|-------------|---------|------|---------------|-----------|------------------|-----------------|--------------|------------------|------|--|
| SITE<br><b>The Pines Golf Course<br/>Marana, Arizona</b> |  | PROJECT<br><b>Phase II Residential Developments</b> |             |         |      |               |           |                  |                 |              |                  |      |  |
| GRAPHIC LOG  | DESCRIPTION  | DEPTH, ft.  | USCS SYMBOL | SAMPLES |      |               |           | TESTS            |                 |              |                  |      |  |
|  |  |   |             | NUMBER  | TYPE | RECOVERY (in) | BLOWS/FT. | WATER CONTENT, % | DRY DENSITY pcf | Liquid Limit | PLASTICITY INDEX | -200 |  |
| 0.5  | <b>SANDY SILT WITH ORGANIC MATERIAL</b> ; medium plasticity fines, moist |   | CL          | 1       | BS   |               |           |                  |                 |              |                  |      |  |
| 5  | <b>SANDY LEAN CLAY</b> ; medium plasticity fines, moist                  |   | CL          |         |      |               |           |                  |                 |              |                  |      |  |
|  | Bottom of Test Pit   | 5   |             |         |      |               |           |                  |                 |              |                  |      |  |

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

BOREHOLE 2000 63045218.GPJ TERR2000.GDT 11/23/04

| WATER LEVEL OBSERVATIONS, ft |                            |           |
|------------------------------|----------------------------|-----------|
| WL                           | ∇ None WD                  | ∇ None AB |
| WL                           | ∇                          | ∇         |
| WL                           | Backfilled Upon Completion |           |



|                  |         |         |          |
|------------------|---------|---------|----------|
| BORING STARTED   |         | 11-8-04 |          |
| BORING COMPLETED |         | 11-8-04 |          |
| RIG              | JD 310G | FOREMAN | BWR      |
| Approved         | OBL     | JOB #   | 63045218 |

# LOG OF TEST PIT NO. TP-13

|  |  |   |            |             |         |      |               |           |                     |                    |                 |                     |
|--|--|---|------------|-------------|---------|------|---------------|-----------|---------------------|--------------------|-----------------|---------------------|
| CLIENT<br><b>Standard Pacific of Tucson</b>              |  |   |            |             |         |      |               |           |                     |                    |                 |                     |
| SITE<br><b>The Pines Golf Course<br/>Marana, Arizona</b> |  | PROJECT<br><b>Phase II Residential Developments</b>                       |            |             |         |      |               |           |                     |                    |                 |                     |
| GRAPHIC LOG  |  | DESCRIPTION   | DEPTH, ft. | USCS SYMBOL | SAMPLES |      |               |           | TESTS               |                    |                 |                     |
|  |  |   |            |             | NUMBER  | TYPE | RECOVERY (in) | BLOWS/FT. | WATER<br>CONTENT, % | DRY DENSITY<br>pcf | Liquid<br>Limit | PLASTICITY<br>INDEX |
| 1  |  | <b>SANDY SILT WITH ORGANIC MATERIAL</b> ; loose, non-plastic fines, moist | 1          | ML          | 1       | BS   |               |           |                     | 0                  | 0               | 60                  |
| 5  |  | <b>SANDY SILT</b> ; loose, non-plastic fines, moist                       | 5          | ML          |         |      |               |           |                     |                    |                 |                     |
|  |  | Bottom of Test Pit  | 5          |             |         |      |               |           |                     |                    |                 |                     |

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

**WATER LEVEL OBSERVATIONS, ft**

|    |                            |    |        |    |
|----|----------------------------|----|--------|----|
| WL | ▽ None                     | WD | ▽ None | AB |
| WL | ▽                          |    | ▽      |    |
| WL | Backfilled Upon Completion |    |        |    |



|                  |         |         |          |
|------------------|---------|---------|----------|
| BORING STARTED   |         | 11-8-04 |          |
| BORING COMPLETED |         | 11-8-04 |          |
| RIG              | JD 310G | FOREMAN | BWR      |
| Approved         | OBL     | JOB #   | 63045218 |

BOREHOLE 2000 63045218.GPJ TERR2000.GDT 11/23/04

# LOG OF TEST PIT NO. TP-14

|  |   |   |            |             |         |      |               |           |                  |                 |              |                  |      |  |
|--|---|---|------------|-------------|---------|------|---------------|-----------|------------------|-----------------|--------------|------------------|------|--|
| CLIENT<br><b>Standard Pacific of Tucson</b>              |   |   |            |             |         |      |               |           |                  |                 |              |                  |      |  |
| SITE<br><b>The Pines Golf Course<br/>Marana, Arizona</b> |   | PROJECT<br><b>Phase II Residential Developments</b>                       |            |             |         |      |               |           |                  |                 |              |                  |      |  |
| GRAPHIC LOG  |   | DESCRIPTION   | DEPTH, ft. | USCS SYMBOL | SAMPLES |      |               |           |                  | TESTS           |              |                  |      |  |
|  |   |   |            |             | NUMBER  | TYPE | RECOVERY (in) | BLOWS/FT. | WATER CONTENT, % | DRY DENSITY pcf | Liquid Limit | PLASTICITY INDEX | -200 |  |
|  | 1 | <b>SANDY SILT WITH ORGANIC MATERIAL</b> ; loose, non-plastic fines, moist | 1          | ML          | 1       | BS   |               |           |                  |                 |              |                  |      |  |
|  |   | <b>SANDY LEAN CLAY</b> ; loose to medium dense, non-plastic fines, moist  | 5          | ML          |         |      |               |           |                  |                 |              |                  |      |  |
|  | 5 | Bottom of Test Pit  | 5          |             |         |      |               |           |                  |                 |              |                  |      |  |

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

**WATER LEVEL OBSERVATIONS, ft**

|    |                            |         |
|----|----------------------------|---------|
| WL | None WD                    | None AB |
| WL |                            |         |
| WL | Backfilled Upon Completion |         |



|                  |         |         |          |
|------------------|---------|---------|----------|
| BORING STARTED   |         | 11-8-04 |          |
| BORING COMPLETED |         | 11-8-04 |          |
| RIG              | JD 310G | FOREMAN | BWR      |
| Approved         | OBL     | JOB #   | 63045218 |

BOREHOLE 2000 63045218.GPJ TERR2000.GDT 11/23/04

# LOG OF TEST PIT NO. TP-15

|  |  |   |             |         |      |               |           |                  |                 |              |                  |      |    |
|--|--|---|-------------|---------|------|---------------|-----------|------------------|-----------------|--------------|------------------|------|----|
| CLIENT<br><b>Standard Pacific of Tucson</b>              |  |   |             |         |      |               |           |                  |                 |              |                  |      |    |
| SITE<br><b>The Pines Golf Course<br/>Marana, Arizona</b> |  | PROJECT<br><b>Phase II Residential Developments</b> |             |         |      |               |           |                  |                 |              |                  |      |    |
| GRAPHIC LOG  | DESCRIPTION  | DEPTH, ft.  | USCS SYMBOL | SAMPLES |      |               |           | TESTS            |                 |              |                  |      |    |
|  |  |   |             | NUMBER  | TYPE | RECOVERY (in) | BLOWS/FT. | WATER CONTENT, % | DRY DENSITY pcf | Liquid Limit | PLASTICITY INDEX | -200 |    |
| 2  | <b>SANDY SILT WITH ORGANIC MATERIAL</b> ; loose, low plasticity fines, moist |   | ML          | 1       | BS   |               |           |                  |                 |              | 28               | 6    | 79 |
| 5  | <b>SANDY SILT</b> ; loose to medium dense, low plasticity fines, moist       |   | ML          |         |      |               |           |                  |                 |              |                  |      |    |
|  | Bottom of Test Pit   | 5   |             |         |      |               |           |                  |                 |              |                  |      |    |

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

**WATER LEVEL OBSERVATIONS, ft**

|    |                            |         |  |
|----|----------------------------|---------|--|
| WL | None WD                    | None AB |  |
| WL |                            |         |  |
| WL | Backfilled Upon Completion |         |  |



|                  |         |         |          |
|------------------|---------|---------|----------|
| BORING STARTED   |         | 11-8-04 |          |
| BORING COMPLETED |         | 11-8-04 |          |
| RIG              | JD 310G | FOREMAN | BWR      |
| Approved         | OBL     | JOB #   | 63045218 |

BOREHOLE 2000 63045218.GPJ TERR2000.GDT 11/23/04

# LOG OF TEST PIT NO. TP-16

| CLIENT<br><b>Standard Pacific of Tucson</b>              |   |   |             |         |      |               |           |                  |                 |              |                  |      |  |
|--|---|---|-------------|---------|------|---------------|-----------|------------------|-----------------|--------------|------------------|------|--|
| SITE<br><b>The Pines Golf Course<br/>Marana, Arizona</b> |   | PROJECT<br><b>Phase II Residential Developments</b> |             |         |      |               |           |                  |                 |              |                  |      |  |
| GRAPHIC LOG  | DESCRIPTION   | DEPTH, ft.  | USCS SYMBOL | SAMPLES |      |               |           | TESTS            |                 |              |                  |      |  |
|  |   |   |             | NUMBER  | TYPE | RECOVERY (in) | BLOWS/FT. | WATER CONTENT, % | DRY DENSITY pcf | Liquid Limit | PLASTICITY INDEX | -200 |  |
| 1  | <b>SANDY SILT WITH ORGANIC MATERIAL</b> ; loose, non-plastic fines, moist             |   | ML          | 1       | BS   |               |           |                  |                 |              |                  |      |  |
| 5  | <b>SANDY LEAN CLAY</b> ; brown, loose to medium dense, medium plasticity fines, moist |   | CL          |         |      |               |           |                  |                 |              |                  |      |  |
|  | Bottom of Test Pit  | 5   |             |         |      |               |           |                  |                 |              |                  |      |  |

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

**WATER LEVEL OBSERVATIONS, ft**

|    |                            |         |
|----|----------------------------|---------|
| WL | None WD                    | None AB |
| WL |                            |         |
| WL | Backfilled Upon Completion |         |



|                  |         |         |          |
|------------------|---------|---------|----------|
| BORING STARTED   |         | 11-8-04 |          |
| BORING COMPLETED |         | 11-8-04 |          |
| RIG              | JD 310G | FOREMAN | BWR      |
| Approved         | OBL     | JOB #   | 63045218 |

BOREHOLE 2000 63045218.GPJ TERR2000.GDT 11/23/04



# LOG OF TEST PIT NO. TP-17

|  |   |   |             |         |      |               |           |                  |                 |              |                  |
|--|---|---|-------------|---------|------|---------------|-----------|------------------|-----------------|--------------|------------------|
| CLIENT<br><b>Standard Pacific of Tucson</b>              |   |   |             |         |      |               |           |                  |                 |              |                  |
| SITE<br><b>The Pines Golf Course<br/>Marana, Arizona</b> |   | PROJECT<br><b>Phase II Residential Developments</b> |             |         |      |               |           |                  |                 |              |                  |
| GRAPHIC LOG  | DESCRIPTION   | DEPTH, ft.  | USCS SYMBOL | SAMPLES |      |               |           | TESTS            |                 |              |                  |
|  |   |   |             | NUMBER  | TYPE | RECOVERY (in) | BLOWS/FT. | WATER CONTENT, % | DRY DENSITY pcf | Liquid Limit | PLASTICITY INDEX |
| 1.5  | <p><b>SANDY CLAY WITH ORGANIC MATERIAL</b>; loose top soil, low plasticity fines, moist</p> | ML  | 1           | BS      |      |               |           |                  | 25              | 10           | 65               |
| 5  | <p><b>SANDY LEAN CLAY</b>; loose to medium dense, medium plasticity fines, moist</p>        | CL  |             |         |      |               |           |                  |                 |              |                  |
|  | <p>Bottom of Test Pit</p>   | 5   |             |         |      |               |           |                  |                 |              |                  |

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

**WATER LEVEL OBSERVATIONS, ft**

|    |                            |           |
|----|----------------------------|-----------|
| WL | ∇ None WD                  | ∇ None AB |
| WL | ∇                          | ∇         |
| WL | Backfilled Upon Completion |           |



|                  |         |         |          |
|------------------|---------|---------|----------|
| BORING STARTED   |         | 11-8-04 |          |
| BORING COMPLETED |         | 11-8-04 |          |
| RIG              | JD 310G | FOREMAN | BWR      |
| Approved         | OBL     | JOB #   | 63045218 |


BOREHOLE 2000 63045218.GPJ TERR2000.GDT 11/24/04



| Borehole No. | Depth (ft.) | USCS Soil Class. | In-Situ Properties |                   | Classification         |    |    |    | Remolded Expansion |                   |                 |               | Corrosivity |                      |                           |                | Remarks |  |
|--------------|-------------|------------------|--------------------|-------------------|------------------------|----|----|----|--------------------|-------------------|-----------------|---------------|-------------|----------------------|---------------------------|----------------|---------|--|
|              |             |                  | Dry Density (pcf)  | Water Content (%) | Passing #200 Sieve (%) | LL | PL | PI | Dry Density (pcf)  | Water Content (%) | Surcharge (psf) | Expansion (%) | pH          | Resistivity (ohm-cm) | Water Soluble Salts (ppm) | Sulfates (ppm) |         |  |
| TP-13        | 0.0         | ML               |                    |                   | 60                     | NP | NP | NP |                    |                   |                 |               |             |                      |                           |                |         |  |
| TP-15        | 0.0         | CL-ML            |                    |                   | 79                     | 28 | 22 | 6  |                    |                   |                 |               |             |                      |                           |                |         |  |
| TP-17        | 0.0         | CL               |                    |                   | 65                     | 25 | 15 | 10 |                    |                   |                 |               |             |                      |                           |                |         |  |

**REMARKS**

1. Dry density and/or moisture determined from one or more rings of a multi-ring sample.
2. Visual Classification.
3. Submerged to approximate saturation.
4. Compacted density (approximately 95% of ASTM D698 maximum density at moisture content slightly below optimum).



**SUMMARY OF LABORATORY RESULTS**

Project: Phase II Residential Developments  
 Site: The Pines Golf Course Marana, Arizona  
 Job #: 63045218  
 Date: 11-23-04

## GENERAL NOTES

### DRILLING & SAMPLING SYMBOLS:

|     |  |     |                           |
|-----|--|-----|---------------------------|
| SS: | Split Spoon - 1-3/8" I.D., 2" O.D., unless otherwise noted | HS: | Hollow Stem Auger         |
| ST: | Thin-Walled Tube - 2" O.D., unless otherwise noted         | PA: | Power Auger               |
| RS: | Ring Sampler - 2.42" I.D., 3" O.D., unless otherwise noted | HA: | Hand Auger                |
| DB: | Diamond Bit Coring - 4", N, B                              | RB: | Rock Bit                  |
| BS: | Bulk Sample or Auger Sample                                | WB: | Wash Boring or Mud Rotary |

The number of blows required to advance a standard 2-inch O.D. split-spoon sampler (SS) the last 12 inches of the total 18-inch penetration with a 140-pound hammer falling 30 inches is considered the "Standard Penetration" or "N-value". For 3" O.D. ring samplers (RS) the penetration value is reported as the number of blows required to advance the sampler 12 inches using a 140-pound hammer falling 30 inches, reported as "blows per foot," and is not considered equivalent to the "Standard Penetration" or "N-value".

### WATER LEVEL MEASUREMENT SYMBOLS:

|      |              |      |                       |      |                 |
|------|--------------|------|-----------------------|------|-----------------|
| WL:  | Water Level  | WS:  | While Sampling        | N/E: | Not Encountered |
| WCI: | Wet Cave in  | WD:  | While Drilling        |      |                 |
| DCI: | Dry Cave in  | BCR: | Before Casing Removal |      |                 |
| AB:  | After Boring | ACR: | After Casing Removal  |      |                 |

Water levels indicated on the boring logs are the levels measured in the borings at the times indicated. Groundwater levels at other times and other locations across the site could vary. In pervious soils, the indicated levels may reflect the location of groundwater. In low permeability soils, the accurate determination of groundwater levels may not be possible with only short-term observations.

**DESCRIPTIVE SOIL CLASSIFICATION:** Soil classification is based on the Unified Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

#### CONSISTENCY OF FINE-GRAINED SOILS

| <u>Unconfined<br/>Compressive<br/>Strength, Qu, psf</u> | <u>Standard<br/>Penetration or<br/>N-value (SS)<br/>Blows/Ft.</u> | <u>Consistency</u> |
|---|---|--------------------|
| < 500   | <2  | Very Soft          |
| 500 - 1,000   | 2-3   | Soft               |
| 1,001 - 2,000   | 4-6   | Medium Stiff       |
| 2,001 - 4,000   | 7-12  | Stiff              |
| 4,001 - 8,000   | 13-26   | Very Stiff         |
| 8,000+  | 26+   | Hard               |

#### RELATIVE DENSITY OF COARSE-GRAINED SOILS

| <u>Standard<br/>Penetration or<br/>N-value (SS)<br/>Blows/Ft.</u> | <u>Ring Sampler (RS)<br/>Blows/Ft.</u> | <u>Relative Density</u> |
|---|--|-------------------------|
| 0 - 3   | 0-6                                    | Very Loose              |
| 4 - 9   | 7-18                                   | Loose                   |
| 10 - 29   | 19-58                                  | Medium Dense            |
| 30 - 49   | 59-98                                  | Dense                   |
| 50+   | 99+                                    | Very Dense              |

#### RELATIVE PROPORTIONS OF SAND AND GRAVEL

| <u>Descriptive Term(s) of other<br/>constituents</u> | <u>Percent of<br/>Dry Weight</u> |
|--|----------------------------------|
| Trace  | < 15                             |
| With   | 15 - 29                          |
| Modifier   | > 30                             |

#### GRAIN SIZE TERMINOLOGY

| <u>Major Component<br/>of Sample</u> | <u>Particle Size</u>                 |
|--------------------------------------|--------------------------------------|
| Boulders                             | Over 12 in. (300mm)                  |
| Cobbles                              | 12 in. to 3 in. (300mm to 75 mm)     |
| Gravel                               | 3 in. to #4 sieve (75mm to 4.75 mm)  |
| Sand                                 | #4 to #200 sieve (4.75mm to 0.075mm) |
| Silt or Clay                         | Passing #200 Sieve (0.075mm)         |

#### RELATIVE PROPORTIONS OF FINES

| <u>Descriptive Term(s) of other<br/>constituents</u> | <u>Percent of<br/>Dry Weight</u> |
|--|----------------------------------|
| Trace  | < 5                              |
| With   | 5 - 12                           |
| Modifiers  | > 12                             |

#### PLASTICITY DESCRIPTION

| <u>Term</u> | <u>Plasticity Index</u> |
|-------------|-------------------------|
| Non-plastic | 0                       |
| Low         | 1-10                    |
| Medium      | 11-30                   |
| High        | 30+                     |

# Terracon

# UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests<sup>A</sup>

|   |   |   |   | Soil Classification |  |      |
|---|---|---|---|---------------------|--|------|
|   |   |   |   | Group Symbol        | Group Name <sup>B</sup>  |      |
| Coarse Grained Soils<br>More than 50% retained on No. 200 sieve | Gravels<br>More than 50% of coarse fraction retained on No. 4 sieve | Clean Gravels<br>Less than 5% fines <sup>C</sup>          | $Cu \geq 4$ and $1 \leq Cc \leq 3^E$  | GW                  | Well-graded gravel <sup>F</sup>                                    |      |
|   |   | Gravels with Fines<br>More than 12% fines <sup>C</sup>    | Fines classify as ML or MH<br>Fines classify as CL or CH  | GP                  | Poorly graded gravel <sup>F</sup>                                  |      |
|   |   |   |   | GM                  | Silty gravel <sup>F,G,H</sup>                                      |      |
|   | Sands<br>50% or more of coarse fraction passes No. 4 sieve          | Clean Sands<br>Less than 5% fines <sup>D</sup>            | $Cu \geq 6$ and $1 \leq Cc \leq 3^E$  | SW                  | Well-graded sand <sup>I</sup>                                      |      |
|   |   | Sands with Fines<br>More than 12% fines <sup>D</sup>      | Fines classify as ML or MH<br>Fines Classify as CL or CH  | SP                  | Poorly graded sand <sup>I</sup>                                    |      |
|   |   |   |   | SM                  | Silty sand <sup>G,H,I</sup>  |      |
| Fine-Grained Soils<br>50% or more passes the No. 200 sieve      | Silt and Clays<br>Liquid limit less than 50                         | inorganic   | $PI > 7$ and plots on or above "A" line <sup>J</sup><br>$PI < 4$ or plots below "A" line <sup>J</sup> | CL                  | Lean clay <sup>K,L,M</sup>   |      |
|   |   | organic   | Liquid limit - oven dried < 0.75<br>Liquid limit - not dried  | OL                  | Organic clay <sup>K,L,M,N</sup><br>Organic silt <sup>K,L,M,O</sup> |      |
|   |   | inorganic   | PI plots on or above "A" line<br>PI plots below "A" line  | CH                  | Fat clay <sup>K,L,M</sup>  |      |
|   |   | organic   | Liquid limit - oven dried < 0.75<br>Liquid limit - not dried  | OH                  | Organic clay <sup>K,L,M,P</sup><br>Organic silt <sup>K,L,M,O</sup> |      |
|   |   |   |   | MH                  | Elastic Silt <sup>K,L,M</sup>                                      |      |
|   | Silt and Clays<br>Liquid limit 50 or more                           | inorganic   | PI plots on or above "A" line<br>PI plots below "A" line  | CH                  | Fat clay <sup>K,L,M</sup>  |      |
|   |   | organic   | Liquid limit - oven dried < 0.75<br>Liquid limit - not dried  | OH                  | Organic clay <sup>K,L,M,P</sup><br>Organic silt <sup>K,L,M,O</sup> |      |
|   | Highly organic soils  | Primarily organic matter, dark in color, and organic odor |   |                     | PT   | Peat |

<sup>A</sup>Based on the material passing the 3-in. (75-mm) sieve

<sup>B</sup>If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

<sup>C</sup>Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

<sup>D</sup>Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay

$$^E C_u = D_{60}/D_{10} \quad C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$$

<sup>F</sup>If soil contains  $\geq 15\%$  sand, add "with sand" to group name.

<sup>G</sup>If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

<sup>H</sup>If fines are organic, add "with organic fines" to group name.

<sup>I</sup>If soil contains  $\geq 15\%$  gravel, add "with gravel" to group name.

<sup>J</sup>If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

<sup>K</sup>If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

<sup>L</sup>If soil contains  $\geq 30\%$  plus No. 200 predominantly sand, add "sandy" to group name.

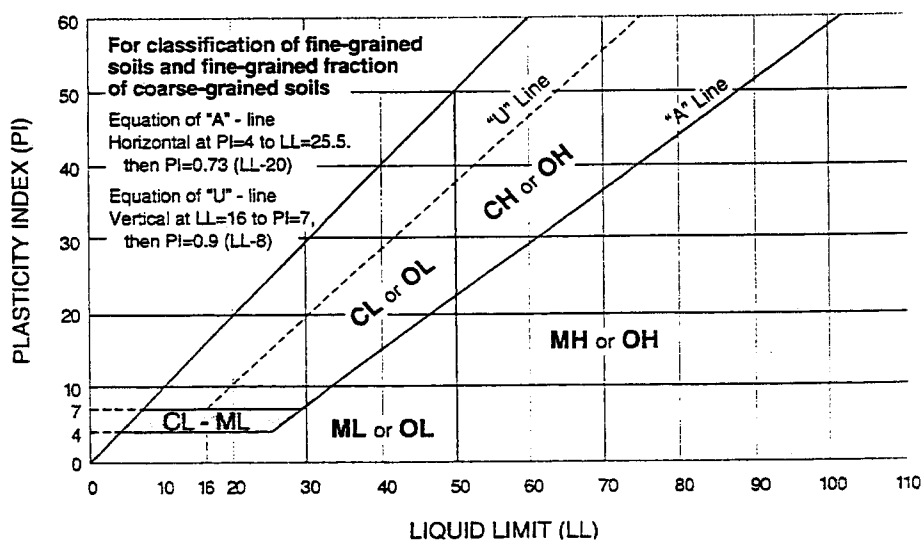
<sup>M</sup>If soil contains  $\geq 30\%$  plus No. 200, predominantly gravel, add "gravelly" to group name.

<sup>N</sup> $PI \geq 4$  and plots on or above "A" line.

<sup>O</sup> $PI < 4$  or plots below "A" line.

<sup>P</sup>PI plots on or above "A" line.

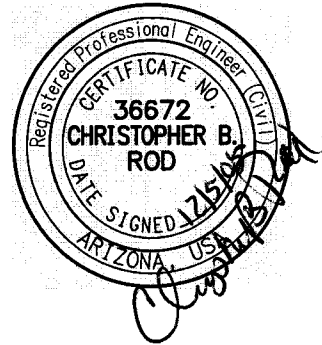
<sup>Q</sup>PI plots below "A" line.



# Terracon

HYDROLOGY AND HYDRAULICS  
REPORT  
FOR  
THE PINES II

PRV - 05154



December 2, 2005

Prepared by:

MMLA Psomas  
800 E. Wetmore Road, Suite 110  
Tucson, AZ 85719

MMLA Psomas: 05082-78

SUBMITTAL NO. 1

HYDROLOGY AND HYDRAULICS REPORT  
FOR  
THE PINES II

Location:

The proposed site is located in the  
SE ¼ of Section 22, NE ¼ of Section 27, NW ¼ of Section 26,  
Township 12 South, Range 12 East  
In Marana, Arizona

*Prepared for:*  
BCIF Group, LLC  
6262 N. Swan Road, Suite 125  
Tucson, AZ 85718



Submitted  
December 2, 2005

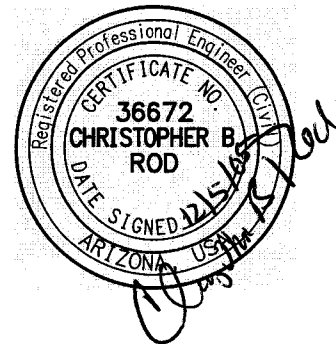
*Drainage Report Pursuant to Tentative Plat Approval*

Prepared by:  
MMLA Psomas  
800 E. Wetmore Road, Suite 110  
Tucson, AZ 85719

**MMLA Psomas 05082-78**

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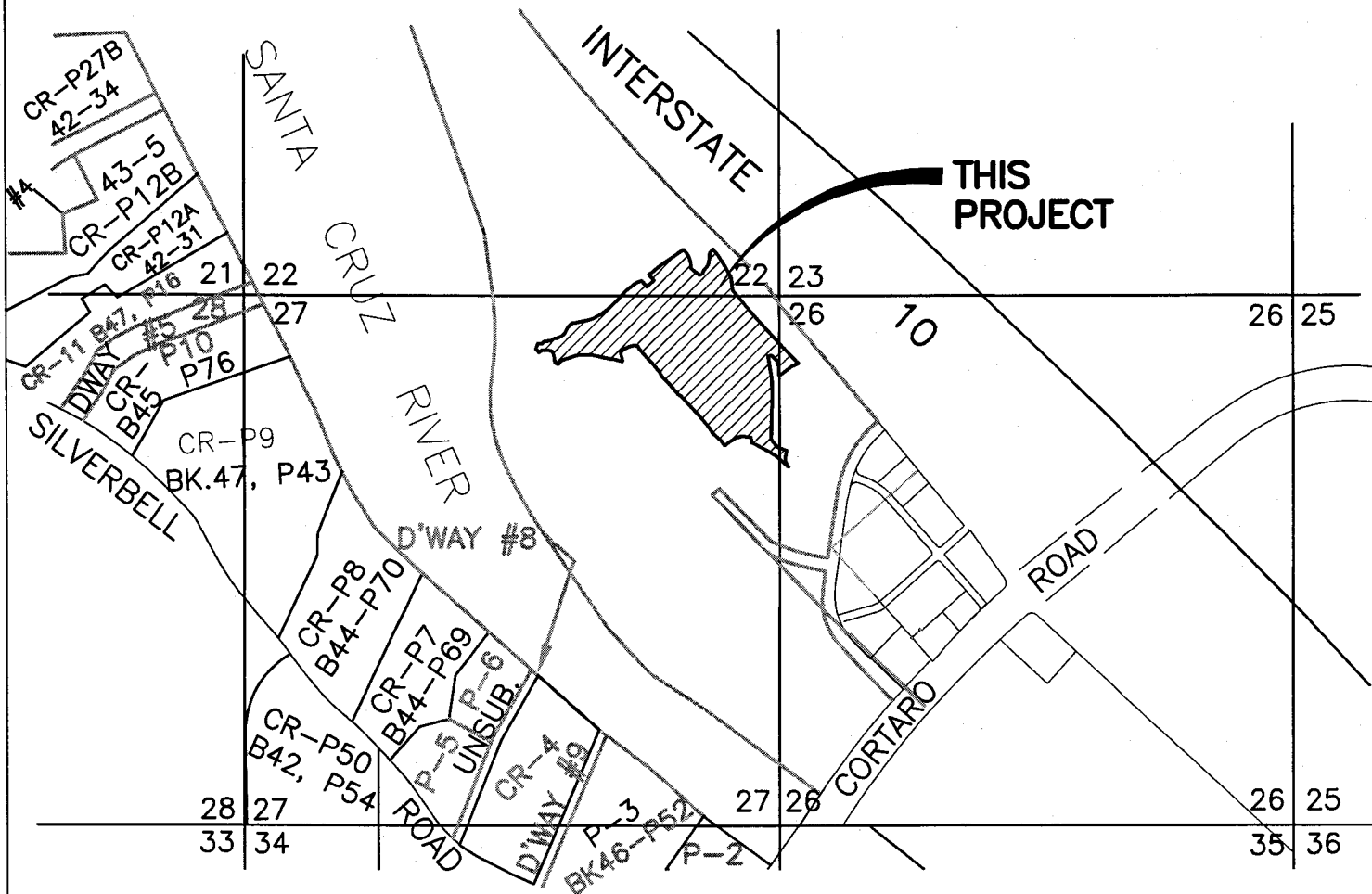
List of Appendices

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| <u>Appendix</u> | <u>Title</u>  |
|-----------------|---|
| 1               | Hydrologic Analysis (Existing & Developed Conditions) |
| 2               | Hydraulic Analysis (Developed Conditions)             |
| 3               | Hydraulic Structures (Existing Conditions)            |

## 1.0 INTRODUCTION

The following text will serve as the Drainage Report for The Pines II. The subdivision, proposed by Southern Pacific Homes will consists of 280 single-family detached homes encompassing 55.3 acres. The overall project will have a density of 5.1 houses per acre. The Pines II will be situated within Continental Reserve Master Planned Community. The Parcel lies with the southeast  $\frac{1}{4}$  of Section 22 and the northwest  $\frac{1}{4}$  of Section 26 and the northeast  $\frac{1}{4}$  of Section 27 all within Township 12 South, Range 12 East. The parcel is bordered along the northern boundary by the I-10 Frontage Road. The Santa Cruz River lies south of the project, though it does not form an actual boundary with the parcel. A golf course immediately borders the development area on all sides. A location map (Figure 1) is provided on Page 2.



**FIGURE 1  
LOCATION MAP**

SCALE 3" = 1 mile



BEING A PORTION OF THE SOUTH 1/2 OF SECTION 22,  
THE WEST 1/2 OF SECTION 26, AND THE EAST 1/2 OF  
SECTION 27, T12S, R12E, G&SRB&M, TOWN OF MARANA,  
PIMA COUNTY, ARIZONA

## 2.0 OBJECTIVES

As implied in Section 1.0, the proposed subdivision is part of a large master planned community, Continental Reserve. As such previous studies have been submitted and approved by the Town of Marana and needed to be incorporated into the design concept. In addition the design needed to provide a drainage scheme to convey storm runoff safely and efficiently through the property limits.

The following tasks were completed as part of the drainage study for Pines II:

- The peak discharges were calculated as part of the Developed Conditions Analysis outlined in the "Master Drainage Report for Marana Golf, Blocks 1, 3, 4, & 5 and San Xavier Aggregate Pit, Block 2 at Continental Ranch" (Reference 3). These discharges were reviewed and recreated to assure accuracy.
- An on-site field investigation of the drainage structures was performed. This investigation was combined with a review of previous study for the I-10 Corridor to obtain the peak flow entering the property from these sources (Reference 1).
- The peak discharges generated by the development of on-site watersheds were quantified.
- Drainage structures were located and sized for the safe and efficient conveyance of on-site runoff.

The remainder of this report describes the proposed drainage for the site and off-site drainage systems impacted by the proposed project. Maps depicting existing and developed conditions are provided in the pocket folders at the end of the text and supporting calculations are contained within the appendix. This report is being submitted pursuant to Tentative Plat approval.

### 3.0 EXISTING CONDITIONS

#### 3.1 Hydrologic Analysis

The upper bound of the 90% confidence interval point precipitation frequency estimates from NOAA Atlas 14 was used (Appendix 1) to generate the hydrologic analysis, both existing and developed conditions. Discharge values were obtained using the Pima County Methodology. Initial results illustrated zero cfs for the 2-year event. In order to produce feasible discharges, the 2-year, 6-hour rainfall was increased from 1.38" to 1.43". This modification was utilized in all hydrologic calculations.

The existing conditions scenario presented in this report was recreated to match the previously calculated peak discharges (Reference 2). Due to different values for the input parameters, the generated peak discharges differ between those produced by MMLA Psomas and those from the previous study. Table 1 summarizes the results for the onsite existing conditions hydrology. The offsite hydrology analysis for Pines II was derived from a previous study (Reference 1). Watershed maps from Reference 1 have been reproduced for this report to match the current site conditions and project boundary limits Figure 2. Per these reports, runoff from two off-site culverts impact the project area. The culvert outlets are located at NR3 and NR4. Flow entering the site from NR3 was determined from Reference 1. The maximum capacity for the culvert at NR4 was used to predict the runoff entering the site from this source. Details regarding the existing hydraulic structures are supplied in Appendix 3.

**Table 1: Summary of Hydrologic Analysis (Existing Conditions)**

| Concentration Point | Contributing Watersheds | Area (ac) | Channel Length (ft) | Length to Centroid (ft) | Basin Factor | % Impervious | Mean Slope (%) | Soil Type | T <sub>c</sub> (min) | 100-year Discharge (cfs) |
|---------------------|-------------------------|-----------|---------------------|-------------------------|--------------|--------------|----------------|-----------|----------------------|--------------------------|
| 5                   | 5                       | 25.52     | 1843                | 922                     | 0.031        | 45           | 1.3            | 100%B     | 7                    | 86                       |
| 5*                  | 5                       | 23.80     | 1160                | 580                     | 0.031        | 45           | 0.7            | 100%B     | 7.5                  | 146                      |
| 6                   | 6                       | 31.44     | 2480                | 1240                    | 0.025        | 69           | 0.7            | 100%B     | 11                   | 130                      |
| 6*                  | 6                       | 49.4      | 2800                | 1400                    | 0.025        | 69           | 0.5            | 100%B     | 12                   | 300                      |
| 9                   | 9                       | 12.72     | 2406                | 1203                    | 0.033        | 26           | 0.9            | 100%B     | 16                   | 32                       |
| 9*                  | 9                       | 16.35     | 2400                | 1200                    | 0.033        | 26           | 0.5            | 100%B     | 16                   | 71                       |

\*Reference 2

### **3.2 Existing Drainage Structures**

Two drainage structures and one drainage channel exists within the project limits. One 24" RCP culvert outlet exists at CP NR-4. The capacity of the culvert is 26 cfs. The second existing structure is a 2 cell 6'x3' RCBC located at NR3. The peak flow of the culvert, in breakout conditions, is 1101 cfs. The northeast property boundary has been modified into an earthen drainage swale to direct sheet-flow in the direction of the existing off-site culverts located at NR-1 and NR-3. These structures are described in detail in References 1 and 2, and structure designations are consistent with those assigned in References 1 and 2.

### **3.3 Existing Floodplains and Erosion Hazard Setbacks**

Per the Federal Emergency Management Agency (FEMA), Pines II is located within Zone X (shaded) and Zone X (unshaded) (FIRM Panel 04019C1605 K, February 8, 1999). Zone X (shaded) denotes areas of the 500-year flood; areas of the 100-year flood with average depths of less than one-foot or drainage areas less than one square-mile; and areas protected by levees from the 100-year flood. Zone X (unshaded) denotes areas determined to be outside the 500-year floodplain. Approximately the southwest third of the project area is within Zone X (shaded) and is associated with the Santa Cruz River floodplain limits. The FEMA limits are depicted on Figure 4, FIMA FIRM Panel.

There are no other FIMA floodplains located within the project limits. The main channel (Channel 8, 18, 22) carries 1101 cfs, previously defined by the Hydrologic and Hydraulic Report for the I-10 Corridor Study – Pima County Ruthrauff Road to Tangerine Road (Reference #), is controlled by the 2-6'x3' RCBC located at NR3. The flow is conveyed from the upstream watershed and will be contained within the channel banks and adequate freeboard has been provided.



#### 4.0 DEVELOPED CONDITIONS

##### 4.1 On-site Hydrology

The project was divided into nineteen onsite watersheds (Watershed D1-D6, D8-D12, D14, D15, D17-D22) and six offsite watersheds (Watershed OS-1 – OS-6). In general, the runoff from these watersheds will be conveyed in the streets and within storm drain systems. The runoff will be transitioned from the street to the drainage structures via sidewalk scuppers and into various constructed drainage ways. The Pima County Rational Method was used to calculate peak discharges from onsite watersheds and at successive concentration points. The delineated watersheds and concentration points are shown on Figure 3. Appendix 2 contains supporting calculations. Table 3 summarizes the 100-year peak discharges under developed conditions.

**Table 2: Summary of Hydrologic Analysis (Developed Conditions)**

| Concentration Point | Contributing Watersheds | Area (ac)  | Channel Length (ft) | Length to Centroid (ft) | Basin Factor | % Impervious | Mean Slope (%) | Soil Type | T <sub>c</sub> (min) | 100-year Discharge (cfs) |
|---------------------|-------------------------|--|---------------------|-------------------------|--------------|--------------|----------------|-----------|----------------------|--------------------------|
| D1                  | D1                      | 6.87   | 967                 | 484                     | 0.022        | 60           | 0.5            | 100%B     | 6                    | 34                       |
| D2                  | D2                      | 0.44   | 136                 | 69                      | 0.035        | 0            | 0.5            | 100%B     | 5                    | 1.3                      |
| D2                  | D1,D2,OS-1, NR-4*       | 16.36  | 2066                | 1033                    | 0.029        | 25           | 0.5            | 100%B     | 16                   | 66                       |
| D3                  | D3                      | 0.26   | 288                 | 144                     | 0.035        | 0            | 0.5            | 100%B     | 6                    | 0.7                      |
| D4                  | D4                      | 4.04   | 546                 | 273                     | 0.022        | 60           | 0.5            | 100%B     | 5                    | 21                       |
| D4                  | D3,D4, OS-6             | 4.53   | 843                 | 422                     | 0.027        | 54           | 0.5            | 100%B     | 7                    | 20                       |
| D5                  | D5                      | 0.50   | 435                 | 218                     | 0.035        | 0            | 0.5            | 100%B     | 8                    | 1.2                      |
| D5                  | D3,D4,D5, OS-6          | 5.03   | 1278                | 639                     | 0.030        | 48           | 0.5            | 100%B     | 11                   | 18                       |
| D6                  | D6                      | 5.04   | 821                 | 411                     | 0.022        | 60           | 0.5            | 100%B     | 5                    | 26                       |
| D7                  | D3,D4,D5,D6, OS-6       | 10.07  | 1529                | 764                     | 0.033        | 54           | 0.5            | 100%B     | 13                   | 35                       |
| D8                  | D8                      | 1.65   | 475                 | 238                     | 0.035        | 0            | 0.5            | 100%B     | 8                    | 4                        |
| D8                  | NR-3                    | Based on Results Listed in the I-10 Corridor Study |                     |                         |              |              |                |           |                      | 1101                     |
| D9                  | D9                      | 0.51   | 320                 | 160                     | 0.025        | 100          | 0.5            | 100%B     | 5                    | 3                        |
| D10                 | D10                     | 2.44   | 516                 | 258                     | 0.022        | 60           | 0.5            | 100%B     | 5                    | 13                       |
| D11                 | D11                     | 0.34   | 230                 | 115                     | 0.035        | 0            | 0.5            | 100%B     | 5                    | 1.0                      |
| D11                 | D10,D11                 | 2.78   | 746                 | 373                     | 0.026        | 53           | 0.5            | 100%B     | 6                    | 13                       |
| D12                 | D12                     | 2.81   | 591                 | 296                     | 0.022        | 60           | 0.5            | 100%B     | 5                    | 15                       |
| D13                 | D10,D11,D12             | 5.59   | 956                 | 478                     | 0.025        | 56           | 0.5            | 100%B     | 7                    | 26                       |
| D14                 | D14                     | 3.25   | 497                 | 249                     | 0.022        | 60           | 0.5            | 100%B     | 5                    | 17                       |
| D15                 | D15                     | 5.26   | 888                 | 444                     | 0.022        | 60           | 0.5            | 100%B     | 6                    | 26                       |
| D15                 | D15,OS-2                | 5.72   | 1033                | 517                     | 0.024        | 55           | 0.5            | 100%B     | 7                    | 26                       |
| D16                 | D14, D15, OS-2          | 8.97   | 1117                | 559                     | 0.025        | 57           | 0.5            | 100%B     | 8                    | 39                       |
| D17                 | D17                     | 3.60   | 627                 | 314                     | 0.022        | 60           | 0.5            | 100%B     | 5                    | 19                       |



| Concentration Point | Contributing Watersheds | Area (ac)  | Channel Length (ft) | Length to Centroid (ft) | Basin Factor | % Impervious | Mean Slope (%) | Soil Type | T <sub>c</sub> (min) | 100-year Discharge (cfs) |
|---------------------|-------------------------|--|---------------------|-------------------------|--------------|--------------|----------------|-----------|----------------------|--------------------------|
| D17                 | D17, OS-5               | 4.04   | 924                 | 463                     | 0.026        | 53           | 0.5            | 100%B     | 7                    | 18                       |
| D18                 | D18                     | 3.91   | 1156                | 578                     | 0.035        | 0            | 0.5            | 100%B     | 15                   | 7                        |
| D18                 | NR-3                    | Based on Results Listed in the I-10 Corridor Study                     |                     |                         |              |              |                |           |                      | 1101                     |
| D19                 | D19                     | 3.43   | 902                 | 451                     | 0.022        | 60           | 0.5            | 100%B     | 6                    | 17                       |
| D20                 | D20                     | 5.40   | 587                 | 294                     | 0.022        | 60           | 0.5            | 100%B     | 5                    | 28                       |
| D21                 | D21                     | 0.32   | 132                 | 66                      | 0.035        | 0            | 0.5            | 100%B     | 5                    | 0.9                      |
| D21                 | D20, D21                | 5.72   | 719                 | 360                     | 0.024        | 57           | 0.5            | 100%B     | 5                    | 29                       |
| D22                 | D22                     | 0.79   | 244                 | 122                     | 0.035        | 0            | 0.5            | 100%B     | 5                    | 2                        |
| D22                 | NR-3                    | Based on Results Listed in the I-10 Corridor Study                     |                     |                         |              |              |                |           |                      | 1101                     |
| OS-1                | OS-1                    | 9.05   | 963                 | 482                     | 0.035        | 0            | 0.5            | 100%B     | 13                   | 18                       |
| OS-1                | OS-1, NR-4*             | 9.05   | 963                 | 482                     | 0.035        | 0            | 0.5            | 100%B     | 13                   | 44                       |
| OS-2                | OS-2                    | 0.46   | 145                 | 73                      | 0.035        | 0            | 0.5            | 100%B     | 5                    | 1.3                      |
| OS-3                | OS-3                    | 6.62   | 903                 | 452                     | 0.035        | 0            | 0.5            | 100%B     | 13                   | 13                       |
| OS-3                | NR-3                    | Based on Results Listed in the I-10 Corridor Study                     |                     |                         |              |              |                |           |                      | 1101                     |
| OS-4                | OS-4                    | 1.65   | 870                 | 435                     | 0.035        | 0            | 0.5            | 100%B     | 13                   | 3                        |
| OS-5                | OS-5                    | 0.44   | 297                 | 149                     | 0.035        | 0            | 0.5            | 100%B     | 6                    | 1.2                      |
| OS-6                | OS-6                    | 0.23   | 101                 | 51                      | 0.035        | 0            | 0.5            | 100%B     | 6                    | 0.6                      |
| NR-4                | NR-4                    | Based on the Culvert Capacity (Assuming 4-feet of Available Headwater) |                     |                         |              |              |                |           |                      | 26                       |

## 4.2 Roadway Design

Approximately 2.00 miles of paved roadway will be constructed with the project. The typical 55-foot right-of-way will include two 16-foot travel lanes, 5-inch high rolled curbs and a 5-foot sidewalk. The typical roadway will consist of super-elevated sections with a continuous 1% cross-slope.

To demonstrate that the roads have sufficient capacity to convey the 100-year runoff for a variety of slopes, rating tables were created for the typical street sections. The rating table and a typical cross-section are included in Appendix 2. Where storm water approaches a low point from two directions, the runoff component on each side was determined independently to verify adequate street capacity.

## 4.3 Inlet Design

As part of the drainage design, runoff from the roadways will be discharged into drainage channel via ten concrete sidewalk scuppers and four depressed curbs. These structures, located within the interior of the project, were sized to convey the entire 100-year event below the curb line using the weir equation and assuming a 6-inch total opening height.

Table 4 summarizes the hydraulic analysis for the inlets. The locations of the scuppers and depressed curb listed in Table 3 are indicated by concentration points on Figure 4. The widths for scuppers listed in Table 3 represent the width of the effective opening. The final inlet sizes will be shown on both paving and grading plans. Calculations for the required effective opening length are included in Appendix 2.

**Table 3: Summary of Proposed Inlet Design**

| Concentration Point | Q <sub>des</sub> (cfs) | Depth of Opening (ft) | Type of Opening | Effective Opening (ft) |
|---------------------|------------------------|-----------------------|-----------------|------------------------|
| D1                  | 34                     | 0.50                  | Scupper         | 15                     |
| D3                  | 1                      | 0.50                  | Depressed Curb  | 1                      |
| D4                  | 20                     | 0.50                  | Scupper         | 9                      |
| D6                  | 26                     | 0.50                  | Scupper         | 12                     |
| D9                  | 3                      | 0.50                  | Depressed Curb  | 4                      |
| D10                 | 13                     | 0.50                  | Scupper         | 6                      |
| D12                 | 15                     | 0.50                  | Scupper         | 7                      |
| D14                 | 17                     | 0.42                  | Catch Basin     | 14                     |
| D15                 | 26                     | 0.50                  | Scupper         | 12                     |
| D17                 | 18                     | 0.50                  | Scupper         | 8                      |
| D19                 | 17                     | 0.50                  | Scupper         | 8                      |
| D20                 | 28                     | 0.50                  | Scupper         | 13                     |
| OS-2                | 1                      | 0.50                  | Depressed Curb  | 1                      |
| OS-4                | 3                      | 0.50                  | Depressed Curb  | 4                      |
| OS-5                | 1                      | 0.50                  | Depressed Curb  | 1                      |
| OS-6                | 1                      | 0.50                  | Depressed Curb  | 1                      |

#### 4.4 Channel Design

Twelve channels will be constructed within the project limits as part of the drainage design. The channels were sized using Manning's Equation. Four of the channels will be rock-lined with Filter Fabric. Table 5 summarizes the hydraulic analysis for channels designated by the concentration points shown on Figure 3. Calculation sheets and freeboard calculations are provided in Appendix 2.

**Table 4: Summary of Proposed Channel Design**

| Channel | Concentration Point | 100-year Discharge (cfs) | Flow Depth (ft) | Manning's "N" | Slope (%) | Side Slope (H:V) | Channel Depth (ft) | Channel Bottom Width (ft) | Channel Top Width (ft) | Flow Velocity (fps) |
|---------|---------------------|--------------------------|-----------------|---------------|-----------|------------------|--------------------|---------------------------|------------------------|---------------------|
| 1*      | OS-1                | 44                       | 1.75            | 0.035         | 0.5       | 3:1              | 2.0                | 3                         | 15                     | 3.05                |
| 2       | D3                  | 1                        | 0.29            | 0.030         | 0.5       | 12:1             | 0.5                | 0                         | 7                      | 0.97                |
| 3       | D2                  | 66                       | 1.61            | 0.030         | 1.0       | 6:1              | 1.75               | 0                         | 21                     | 4.25                |
| 4       | D5                  | 18                       | 0.76            | 0.030         | 1.0       | 12:1             | 1.0                | 0                         | 24                     | 2.59                |
| 5*      | D7                  | 35                       | 1.34            | 0.035         | 1.0       | 3:1              | 1.75               | 3                         | 13.5                   | 3.72                |
| 6       | D11                 | 13                       | 0.67            | 0.030         | 1.0       | 12:1             | 1.0                | 0                         | 24                     | 2.39                |
| 7       | OS-5                | 1                        | 0.29            | 0.030         | 0.5       | 12:1             | 0.5                | 0                         | 6                      | 0.97                |
| 8*      | D13                 | 26                       | 1.16            | 0.035         | 1.0       | 3:1              | 1.5                | 3                         | 12                     | 3.44                |
| 9*      | D16                 | 39                       | 1.41            | 0.035         | 1.0       | 3:1              | 1.75               | 3                         | 13.5                   | 3.83                |
| 10*     | D17                 | 18                       | 0.97            | 0.035         | 1.0       | 3:1              | 1.5                | 3                         | 12                     | 3.12                |
| 11      | D21                 | 29                       | 0.91            | 0.030         | 0.5       | 12:1             | 1.25               | 0                         | 30                     | 2.92                |
| 12      | D8                  | 1101                     | 2.32            | 0.030         | 0.39      | 8:1              | 2.80               | 80                        | 125                    | 4.82                |
| 12      | D18                 | 1101                     | 2.32            | 0.030         | 0.39      | 8:1              | 2.80               | 80                        | 125                    | 4.82                |
| 12      | D22                 | 1101                     | 2.32            | 0.030         | 0.39      | 8:1              | 2.80               | 80                        | 125                    | 4.82                |

\*Rock Lined - D50 = 6" T = 1' with Filter Fabric

#### 4.5 Culvert Design

Three culvert crossings will be constructed as part of the drainage design to convey runoff from the constructed channels beneath proposed roadways. The first culvert will be constructed at CP D5 to convey runoff to the rock-lined channel at CP D7. The second will be constructed at CP D8 to convey runoff to the earthen channel u/s of CP D18. The third will be constructed at CP D18 to convey runoff to the earthen channel u/s of CP D22. The hydraulic analysis of these culverts is included in Appendix 2 and is summarized in Table 6. Rip-rap bank protection will be placed at the outfall of Culverts 2 and 3, as discussed in Section 4.6 (Erosion Protection). Culvert hydraulics were analyzed using a computer program based on methods presented in the Federal Highway Administration Hydraulic Design Series No. 5 (HDS-5).

**Table 5: Summary of Proposed Culvert Design**

| Culvert | Conc. Point u/s Location | Culvert Type    | Q <sub>des.</sub> (cfs) | Slope (%) | Length (ft) | Req. HW (ft) | Vel. (fps) |
|---------|--------------------------|-----------------|-------------------------|-----------|-------------|--------------|------------|
| 1       | D5                       | 1-24 RCP        | 18                      | 1.0       | 65          | 2.64         | 7.99       |
| 2       | D8                       | 5-10' x 4' RCBC | 1101                    | 0.71      | 55          | 3.78         | 11.48      |
| 3       | D18                      | 5-10' x 4' RCBC | 1101                    | 0.71      | 55          | 3.78         | 11.48      |

#### 4.6 Erosion Protection

To prevent scour at the outlets of the various drainage structures located within the project limits, additional erosion protection will be constructed within the drainage channels and basins constructed as part of the infrastructure. A total of twelve splash pads will be constructed at scupper, culvert, storm drain and channel outlets.

Using West Consultant's software program based on the Army Corps of Engineers HEC-11 design package, the minimum rock size for the splash pads is 6 inches. The splash pads are summarized in Table 7 and depicted on Figure 4. The calculation sheets are provided in Appendix 2.

**Table 6: Summary of Proposed Splash Pad Design**

| Splash Pad ID | Conc. Point(s) | Q <sub>des</sub> (cfs) | Depth of Opening (ft) | Type of Opening           | Mean Rock Size (d <sub>50</sub> ) | Width of Splash Pad (ft) | Length of Splash Pad (ft) | Thickness of Splash Pad (ft) |
|---------------|----------------|------------------------|-----------------------|---------------------------|-----------------------------------|--------------------------|---------------------------|------------------------------|
| 1             | D1             | 44                     | 3                     | 3' RCP, Scupper           | 6"                                | 30                       | 26                        | 1.0                          |
| 2             | D2             | 40                     | 0.5                   | Channel                   | 6"                                | 42                       | 9                         | 1.0                          |
| 3             | D4             | 20                     | 0.5                   | Scupper                   | 6"                                | 27                       | 10                        | 1.0                          |
| 4             | D7             | 35                     | 1.34                  | Channel                   | 6"                                | 33                       | 9                         | 1.0                          |
| 5             | D8, D9         | 1101                   | 4                     | 5 - 4' x 10 RCBC          | 9"                                | 120                      | 33                        | 1.5                          |
| 6             | D10            | 13                     | 0.5                   | Scupper                   | 6"                                | 39                       | 5                         | 1.0                          |
| 7             | D13            | 13                     | 2                     | 2' RCP                    | 6"                                | 6                        | 14                        | 1.0                          |
| 8             | D16            | 17                     | 2                     | 2' RCP                    | 6"                                | 6                        | 18                        | 1.0                          |
| 9             | D17            | 18                     | 0.5                   | Scupper                   | 6"                                | 36                       | 5                         | 1.0                          |
| 10            | D18, D19       | 1101                   | 4                     | 5 - 4' x 10 RCBC, Scupper | 9"                                | 120                      | 33                        | 1.0                          |
| 11            | D20            | 28                     | 0.5                   | Scupper                   | 6"                                | 56                       | 5                         | 1.0                          |
| 12            | D22            | 1101                   | 2.32                  | Channel                   | 6"                                | 250                      | 18                        | 1.0                          |

Note: All splash pads will be underlined with filter fabric.  
Smaller Rock may be used, with a minimum d<sub>50</sub> equal to 6", if the splash pad is wire tied.

#### 4.7 Storm Drain Design

As part of the drainage design, three storm drain systems will be constructed within the project limits. The preliminary storm drain calculations assumed a consistent slope of 0.5% and 1.0-foot of cover. Table 8 summarizes the storm drain design.

System 1 will capture the runoff at CP OS-1. The system includes a headwall at the inlet and four 36" segments. The second segment will have a curvature radius of 532.9'. The flow will be conveyed west then north and is ultimately discharged d/s of CP D1 onto a splash pad.

System 2 will capture the runoff at CP D11. The system includes a headwall at the inlet and two 24" segments. The flow will be conveyed west then south and is ultimately discharged u/s of CP D13 onto a rock-lined channel.

System 3 will capture the runoff at CP D14. The system includes a catch basin at the inlet and three 24" segments. The flow will be conveyed southwest then northwest and is ultimately discharged u/s of CP D16 onto a rock-lined channel.

**Table 7: Summary of Proposed Storm Drain Design**

| Pipe                    | C.P. Downstream | C.P. Upstream | Pipe Diameter | Pipe Length | Inlet Length | Q <sub>des</sub> (cfs) | Slope (%) | V <sub>pipe</sub> (fps) |
|-------------------------|-----------------|---------------|---------------|-------------|--------------|------------------------|-----------|-------------------------|
| System 1 CP OS-1/CP D1  |                 |               |               |             |              |                        |           |                         |
| SD1                     | CP D1 (Outlet)  | MH1           | 36            | 15          | --           | 44                     | 0.5       | 6.23                    |
| SD2                     | MH1             | MH2           | 36            | 305         | --           | 44                     | 0.5       | 6.23                    |
| SD3                     | MH2             | MH3           | 36            | 89          | --           | 44                     | 0.5       | 6.23                    |
| SD4                     | MH4             | OS-1          | 36            | 27          | --           | 44                     | 0.5       | 6.23                    |
| System 2 CP D11/ CP D13 |                 |               |               |             |              |                        |           |                         |
| SD5                     | CP D13 (Outlet) | MH 5          | 24            | 15          | --           | 13                     | 0.5       | 4.14                    |
| SD6                     | MH 5            | CP D11        | 24            | 110         | --           | 13                     | 0.5       | 4.14                    |
| System 3 CP D16/ CP D14 |                 |               |               |             |              |                        |           |                         |
| SD14                    | CP D16 (Outlet) | MH 6          | 24            | 34          | --           | 17                     | 0.5       | 5.41                    |
| SD15                    | MH 6            | MH 7          | 24            | 261         | --           | 17                     | 0.5       | 5.41                    |
| SD16                    | MH 7            | CP D14        | 24            | 372         | 15'          | 17                     | 0.5       | 5.41                    |

#### **4.8 Retention/Detention Design**

Due to the close proximity of the project to a major river, no detention/retention structures will be constructed as part of the development of Pines II. It is the intent of this development to discharge all flows to Santa Cruz River before the peak discharge from the upstream watershed approaches the development. By not disturbing the peak discharge of the upstream watershed, designated by the U.S. Army Corps of Engineers. Per this designation, it was determined that development will not disturb any jurisdictional waters.

#### **4.9 401/404 Application**

There are no jurisdictional watercourses for the Pines II, designated by the U.S. Army Corps of Engineers. Per this designation, it was determined that development will not disturb any jurisdictional waters.

As part of NPDES processes, a SWPPP will be submitted to The Town of Marana prior to the commencement of the construction portion of this project for review. A copy of the NOI will be submitted to both the Arizona Department of Environmental Quality and the Town of Marana.

## 5.0 CONCLUSION

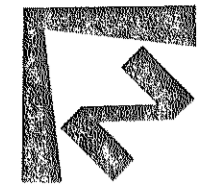
The Pines II is located southwest of the Interstate-10 and northeast of the Santa Cruz River, near the intersection of Sections 22, 26, and 27 of Township 12S, Range 12E. The development will have an approximate density of 3.7 houses per acre and approximately 2.00 miles of paved roadway.

The hydrology and hydraulics have been analyzed and designed such that storm runoff off will be conveyed safely and effectively through the development area. Interior streets will convey storm water to scuppers, depressed curbs or catch basins which will discharge into constructed channels. The channels will be earthen or rock-lined, with side-slopes ranging from 3:1 to 12:1, and bottom widths of 0', 3' and 80'. Three storm drain systems and three culverts will be utilized to convey flow through the development. All flow generated by Pines II will discharge through concentration point D22 and ultimately into the Santa Cruz River. The measures discussed in this report and presented on the Tentative Plat were designed in accordance with Town of Marana Standards.

6.0 REFERENCES

- 1) Arizona Department of Transportation, Hydrologic and Hydraulic Report for I-10 Corridor Study – Pima County, Ruthrauff Road to Tangerince Road, March 1991
- 2) The WLB Group, Inc., Master Drainage Report for Marana Golf, Block 1, 3, 4 & 5, and The San Xavier Aggregate Pit, Block 2 at Continental Ranch.
- 3) Pima County Department of Transportation and Flood Control District; Hydrology Manual for Engineering Design and Floodplain Management within Pima County, Arizona, September 1979.





SCALE 1:100

SUMMARY OF HYDROLOGIC ANALYSIS OF DEVELOPED CONDITIONS

| Concentration Point | Contributing Watershed | Area (sq ft) | Channel Length (ft) | Length to Control (ft) | Run Factor | % Impervious | Mean Slope (%) | Soil Type | T <sub>c</sub> (min) | 100-year Discharge (cfs) |
|---------------------|------------------------|--------------|---------------------|------------------------|------------|--------------|----------------|-----------|----------------------|--------------------------|
| 5                   | 5                      | 2552         | 1843                | 922                    | 0.011      | 45           | 1.3            | 100/50    | 7                    | 86                       |
| 5*                  | 5                      | 2380         | 1146                | 580                    | 0.011      | 45           | 0.7            | 100/50    | 7.5                  | 146                      |
| 6                   | 6                      | 3144         | 2430                | 1200                   | 0.025      | 69           | 0.7            | 100/50    | 11                   | 130                      |
| 6*                  | 6                      | 494          | 2800                | 1400                   | 0.025      | 69           | 0.5            | 100/50    | 12                   | 300                      |
| 9                   | 9                      | 1272         | 2886                | 1200                   | 0.033      | 26           | 0.9            | 100/50    | 16                   | 32                       |
| 9*                  | 9                      | 1635         | 2500                | 1200                   | 0.033      | 26           | 0.5            | 100/50    | 16                   | 71                       |



**LEGEND**

- EXISTING WATERSHED BOUNDARY
- EXISTING CONCENTRATION POINTS
- PROPERTY BOUNDARY

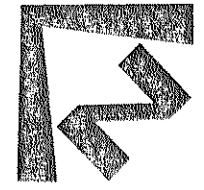
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FIGURE 2  
 EXISTING CONDITIONS MAP  
 FOR  
**THE PINES II**

PROJ NO: 05082-78      SCALE: HORIZ 1" = 100'  
 DATE: 12/02/05      VERT 1" = N/A      1 OF 1

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SCALE: 1:100

**SUMMARY OF HYDROLOGIC ANALYSIS OF DEVELOPED CONDITIONS**

| Concentration Point | Contributing Watersheds | Area (ac) | Channel Length (ft) | Length to Control (ft) | Rain Factor | % Impervious | Mean Slope (%) | Soil Type | T <sub>c</sub> (min) | 100-year Discharge (cfs) |
|---------------------|-------------------------|-----------|---------------------|------------------------|-------------|--------------|----------------|-----------|----------------------|--------------------------|
| D1                  | D1                      | 6.87      | 907                 | 484                    | 0.022       | 60           | 0.5            | 1005B     | 6                    | 34                       |
| D2                  | D2                      | 0.44      | 136                 | 40                     | 0.035       | 0            | 0.5            | 1005B     | 5                    | 1.8                      |
| D2                  | D1,D2,OS-1              | 16.36     | 2066                | 1033                   | 0.029       | 21           | 0.5            | 1005B     | 16                   | 66                       |
| D3                  | D3                      | 0.26      | 288                 | 144                    | 0.035       | 0            | 0.5            | 1005B     | 6                    | 0.7                      |
| D4                  | D4                      | 4.04      | 546                 | 273                    | 0.022       | 60           | 0.5            | 1005B     | 5                    | 21                       |
| D5                  | D5                      | 0.50      | 435                 | 218                    | 0.035       | 0            | 0.5            | 1005B     | 8                    | 1.2                      |
| D6                  | D6                      | 5.80      | 1278                | 639                    | 0.030       | 48           | 0.5            | 1005B     | 11                   | 18                       |
| D7                  | D7                      | 1.65      | 820                 | 410                    | 0.022       | 60           | 0.5            | 1005B     | 5                    | 26                       |
| D8                  | D8                      | 1.65      | 475                 | 238                    | 0.035       | 0            | 0.5            | 1005B     | 8                    | 4                        |
| D9                  | D9                      | 0.51      | 320                 | 160                    | 0.022       | 100          | 0.5            | 1005B     | 5                    | 101                      |
| D10                 | D10                     | 2.44      | 516                 | 258                    | 0.022       | 60           | 0.5            | 1005B     | 5                    | 13                       |
| D11                 | D11                     | 0.78      | 290                 | 145                    | 0.035       | 0            | 0.5            | 1005B     | 5                    | 1.0                      |
| D11                 | D10,D11                 | 2.78      | 546                 | 273                    | 0.022       | 60           | 0.5            | 1005B     | 6                    | 13                       |
| D12                 | D12                     | 2.81      | 401                 | 200                    | 0.022       | 60           | 0.5            | 1005B     | 5                    | 15                       |
| D13                 | D13                     | 5.96      | 806                 | 403                    | 0.022       | 60           | 0.5            | 1005B     | 6                    | 26                       |
| D14                 | D14                     | 3.35      | 497                 | 249                    | 0.022       | 60           | 0.5            | 1005B     | 5                    | 17                       |
| D15                 | D15                     | 5.72      | 1013                | 507                    | 0.024       | 55           | 0.5            | 1005B     | 7                    | 28                       |
| D16                 | D16                     | 8.97      | 1117                | 559                    | 0.025       | 57           | 0.5            | 1005B     | 7                    | 39                       |
| D17                 | D17                     | 3.80      | 427                 | 214                    | 0.022       | 60           | 0.5            | 1005B     | 5                    | 19                       |
| D18                 | D18                     | 4.04      | 524                 | 262                    | 0.022       | 60           | 0.5            | 1005B     | 5                    | 19                       |
| D19                 | D19                     | 3.91      | 1156                | 578                    | 0.035       | 0            | 0.5            | 1005B     | 15                   | 18                       |
| D20                 | D20                     | 3.43      | 902                 | 451                    | 0.022       | 60           | 0.5            | 1005B     | 6                    | 17                       |
| D21                 | D21                     | 5.40      | 827                 | 414                    | 0.022       | 60           | 0.5            | 1005B     | 6                    | 28                       |
| D22                 | D22                     | 0.32      | 132                 | 66                     | 0.035       | 0            | 0.5            | 1005B     | 5                    | 0.9                      |
| D23                 | D23                     | 0.79      | 244                 | 122                    | 0.035       | 0            | 0.5            | 1005B     | 5                    | 2                        |
| D22                 | D22                     | 0.79      | 244                 | 122                    | 0.035       | 0            | 0.5            | 1005B     | 5                    | 2                        |
| D22                 | D22                     | 0.79      | 244                 | 122                    | 0.035       | 0            | 0.5            | 1005B     | 5                    | 2                        |
| OS-1                | OS-1                    | 9.65      | 903                 | 452                    | 0.035       | 0            | 0.5            | 1005B     | 13                   | 18                       |
| OS-1                | OS-1,NR-4*              | 9.65      | 963                 | 482                    | 0.035       | 0            | 0.5            | 1005B     | 13                   | 44                       |
| OS-2                | OS-2                    | 0.46      | 145                 | 73                     | 0.045       | 0            | 0.5            | 1005B     | 5                    | 1.3                      |
| OS-3                | OS-3                    | 6.62      | 903                 | 452                    | 0.035       | 0            | 0.5            | 1005B     | 13                   | 13                       |
| OS-3                | OS-3                    | 6.62      | 903                 | 452                    | 0.035       | 0            | 0.5            | 1005B     | 13                   | 13                       |
| OS-4                | OS-4                    | 1.65      | 830                 | 415                    | 0.035       | 0            | 0.5            | 1005B     | 13                   | 101                      |
| OS-5                | OS-5                    | 0.44      | 201                 | 100                    | 0.035       | 0            | 0.5            | 1005B     | 6                    | 1.2                      |
| OS-6                | OS-6                    | 0.23      | 101                 | 51                     | 0.035       | 0            | 0.5            | 1005B     | 6                    | 0.6                      |
| NR-4                | NR-4                    |           |                     |                        |             |              |                |           |                      | 26                       |

\*Calculated by directly summing the flow from OS-1 with the culvert capacity of existing 24" RCP at NR-4 cap=26 cfs)

**SUMMARY OF PROPOSED CHANNEL ANALYSIS**

| Channel Point | 100-year Concentration | 100-year Discharge | Flow Depth (ft) | Side Slope | Manning's n | Channel Slope (%) | Channel Depth (ft) | Channel Bottom Width (ft) | Channel Top Width (ft) | Flow Velocity (ft/s) |
|---------------|------------------------|--------------------|-----------------|------------|-------------|-------------------|--------------------|---------------------------|------------------------|----------------------|
| 1             | OS-1                   | 44                 | 1.75            | 0.035      | 0.5         | 3.1               | 2.0                | 3                         | 15                     | 3.05                 |
| 2             | D1                     | 35                 | 0.80            | 0.030      | 0.5         | 12.1              | 0.5                | 0                         | 6                      | 0.97                 |
| 3             | D2                     | 66                 | 1.41            | 0.030      | 1.0         | 6.1               | 1.75               | 0                         | 21                     | 4.25                 |
| 4             | D3                     | 0.7                | 0.26            | 0.030      | 1.0         | 12.1              | 1.0                | 0                         | 24                     | 2.50                 |
| 5*            | D7                     | 15                 | 1.34            | 0.035      | 1.0         | 5.1               | 1.75               | 3                         | 13                     | 3.72                 |
| 6             | D8                     | 15                 | 0.67            | 0.030      | 1.0         | 12.1              | 1.0                | 0                         | 24                     | 2.50                 |
| 7             | OS-1                   | 1                  | 0.28            | 0.030      | 0.5         | 12.1              | 0.5                | 0                         | 6                      | 0.97                 |
| 8*            | D10                    | 26                 | 1.16            | 0.035      | 1.0         | 3.1               | 1.5                | 3                         | 12                     | 3.44                 |
| 9*            | D16                    | 39                 | 1.41            | 0.035      | 1.0         | 3.1               | 1.5                | 3                         | 12                     | 3.44                 |
| 10*           | D17                    | 18                 | 0.97            | 0.035      | 1.0         | 3.1               | 1.5                | 3                         | 12                     | 3.12                 |
| 11            | D20                    | 29                 | 0.91            | 0.030      | 0.5         | 12.1              | 1.0                | 0                         | 30                     | 2.92                 |
| 12            | D8                     | 1101               | 2.32            | 0.030      | 0.39        | 8.1               | 2.80               | 80                        | 125                    | 4.82                 |
| 12            | D18                    | 1101               | 2.32            | 0.030      | 0.39        | 8.1               | 2.80               | 80                        | 125                    | 4.82                 |
| 12            | D22                    | 1101               | 2.32            | 0.030      | 0.39        | 8.1               | 2.80               | 80                        | 125                    | 4.82                 |

\*Rock lined - 150# - 6" x 1" with filter fabric.

**SUMMARY OF PROPOSED SPLASH PAD DESIGN**

| Splash Pad ID | Conc. Point | Flow Depth (ft) | Depth of Opening (ft) | Type of Opening               | Mean Rock Size (ft) | Width of Splash Pad (ft) | Length of Splash Pad (ft) | Thickness of Splash Pad (ft) |
|---------------|-------------|-----------------|-----------------------|-------------------------------|---------------------|--------------------------|---------------------------|------------------------------|
| 1             | D1          | 44              | 3                     | 3" RCP, Scooper               | 6"                  | 30                       | 26                        | 1.0                          |
| 2             | D2          | 66              | 1.75                  | Channel                       | 6"                  | 42                       | 8                         | 1.0                          |
| 3             | D3          | 0.7             | 0.26                  | Scooper                       | 6"                  | 27                       | 10                        | 1.0                          |
| 4             | D7          | 15              | 1.34                  | Channel                       | 6"                  | 33                       | 9                         | 1.0                          |
| 5             | D8, D9      | 1101            | 4                     | 5 cell 4" x 8" R/C/C          | 9"                  | 120                      | 33                        | 1.5                          |
| 6             | D10         | 15              | 0.8                   | Scooper                       | 6"                  | 39                       | 5                         | 1.0                          |
| 7             | D13         | 26              | 1.5                   | Channel                       | 6"                  | 36                       | 4                         | 1.0                          |
| 8             | D16         | 39              | 1.75                  | Channel                       | 6"                  | 27                       | 7                         | 1.0                          |
| 9             | D17         | 18              | 0.65                  | Scooper                       | 6"                  | 36                       | 5                         | 1.0                          |
| 10            | D20, D19    | 1101            | 4                     | 5 cell 4" x 8" R/C/C, Scooper | 9"                  | 120                      | 33                        | 1.5                          |
| 11            | D20         | 28              | 0.5                   | Scooper                       | 6"                  | 56                       | 5                         | 1.0                          |
| 12            | D22         | 1101            | 2.32                  | Channel                       | 6"                  | 230                      | 18                        | 1.0                          |

Note: All splash pads will be underlain with filter fabric. Smaller Rock may be used, with a minimum of 50 equal to 6", if the splash pad is wire tied.

**SUMMARY OF PROPOSED INLET DESIGN**

| Conc. Point | Flow Depth (ft) | Depth of Opening (ft) | Type of Opening | Effective Opening (ft) |
|-------------|-----------------|-----------------------|-----------------|------------------------|
| D1          | 34              | 0.50                  | Scooper         | 15                     |
| D3          | 1               | 0.50                  | Depressed Curb  | 1                      |
| D4          | 20              | 0.50                  | Scooper         | 9                      |
| D6          | 26              | 0.50                  | Scooper         | 12                     |
| D9          | 3               | 0.50                  | Depressed Curb  | 4                      |
| D10         | 15              | 0.50                  | Scooper         | 6                      |
| D12         | 15              | 0.50                  | Scooper         | 7                      |
| D14         | 17              | 0.42                  | Catch Basin     | 14                     |
| D15         | 26              | 0.50                  | Scooper         | 12                     |
| D17         | 18              | 0.50                  | Scooper         | 8                      |
| D19         | 17              | 0.50                  | Scooper         | 8                      |
| D20         | 28              | 0.50                  | Scooper         | 13                     |
| OS-2        | 1               | 0.50                  | Depressed Curb  | 1                      |
| OS-4        | 3               | 0.50                  | Depressed Curb  | 1                      |
| OS-5        | 1               | 0.50                  | Depressed Curb  | 1                      |
| OS-6        | 1               | 0.50                  | Depressed Curb  | 1                      |

**SUMMARY OF PROPOSED STORM DRAIN DESIGN**

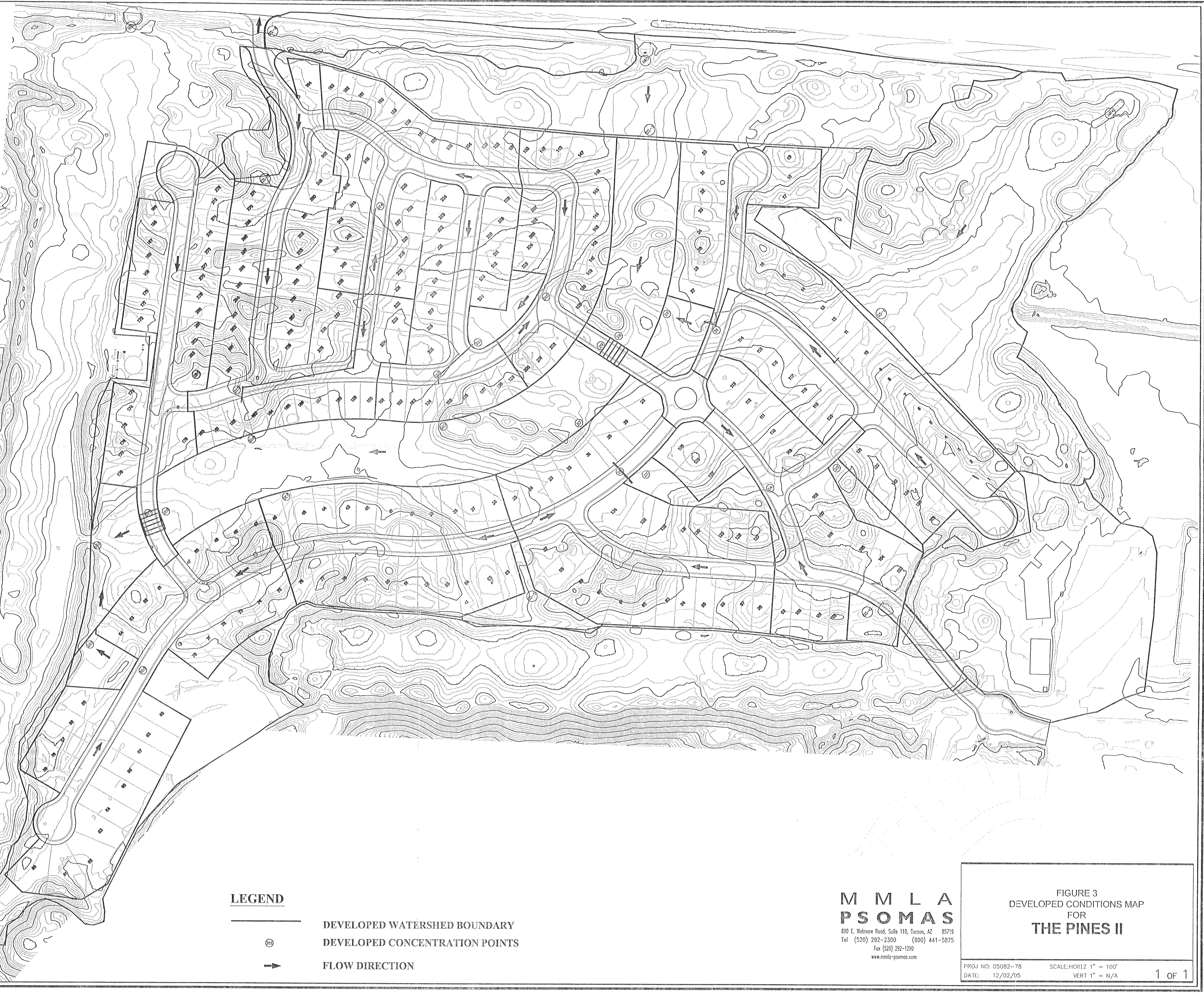
| Pipe  | Downstream      | Upstream | Diameter (in) | Length (ft) | Slope (%) | Veloc. (ft/s) |
|-------|-----------------|----------|---------------|-------------|-----------|---------------|
| SD1   | CP D1 (Outlet)  | MH1      | 18            | 15          | 44        | 0.5 6.23      |
| SD2   | MH1             | MH2      | 36            | 305         | 44        | 0.5 6.23      |
| SD3   | MH2             | MH3      | 36            | 80          | 44        | 0.5 6.23      |
| SD4   | MH3             | OS-1     | 36            | 27          | 44        | 0.5 6.23      |
| SD5   | CP D3 (Outlet)  | MH1      | 18            | 15          | 13        | 0.5 4.14      |
| SD6   | MH1             | CP D11   | 24            | 110         | 13        | 0.5 4.14      |
| SD1-4 | CP D16 (Outlet) | MH1      | 24            | 34          | 17        | 0.5 5.41      |
| SD15  | MH1             | MH7      | 24            | 268         | 17        | 0.5 5.41      |
| SD16  | MH7             | CP D14   | 24            | 372         | 17        | 0.5 5.41      |

**SUMMARY OF PROPOSED CULVERT DESIGN**

| Culvert | Conc. Point | Location         | Culvert Type | Flow Depth (ft) | Flow Velocity (ft/s) | Flow Rate (cfs) | Flow Area (sq ft) | Flow Velocity (ft/s) |
|---------|-------------|------------------|--------------|-----------------|----------------------|-----------------|-------------------|----------------------|
| 1       | D5          | 1-24 RCP         | 18           | 1.0             | 65                   | 2.64            | 7.99              | 4                    |
| 2       | D8          | 5.10' x 4' R/C/C | 1101         | 0.71            | 55                   | 3.78            | 11.88             | 10                   |
| 3       | D18         | 5.10' x 4' R/C/C | 1101         | 0.71            | 55                   | 3.78            | 11.88             | 10                   |

**LEGEND**

- DEVELOPED WATERSHED BOUNDARY
- DEVELOPED CONCENTRATION POINTS
- FLOW DIRECTION



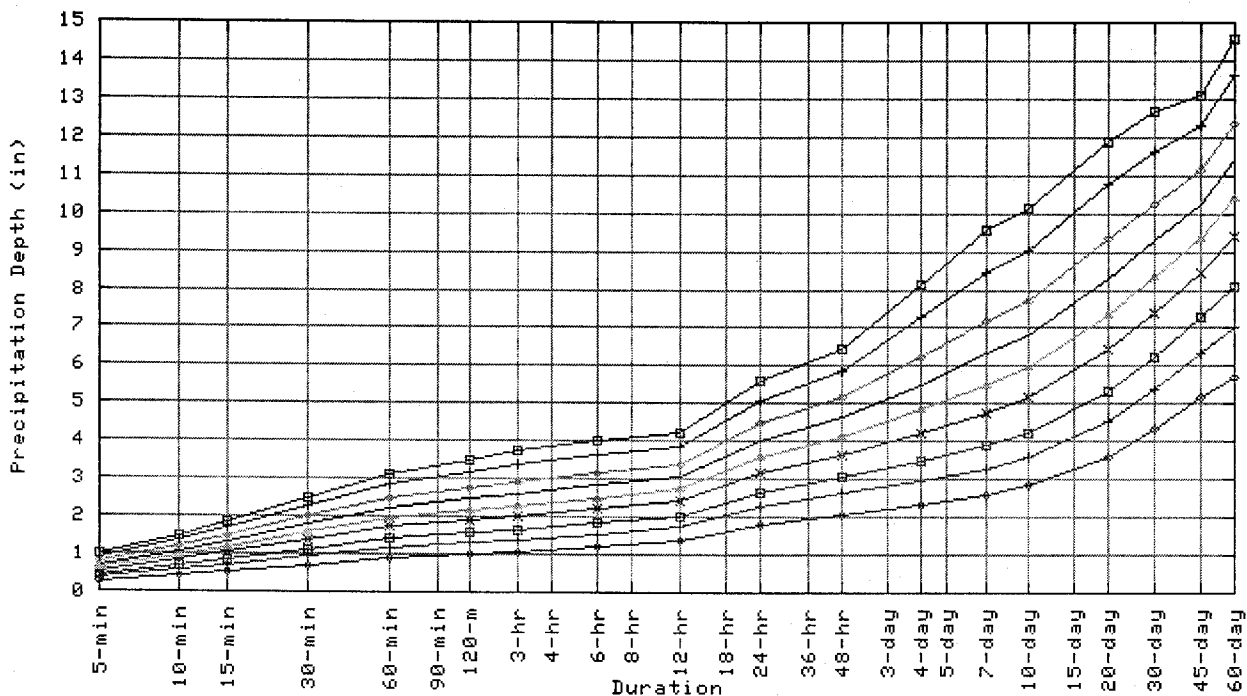
**M M L A  
P S O M A S**  
800 E. Wellmore Road, Suite 110, Tucson, AZ 85719  
Tel (520) 292-2300 (800) 441-8575  
Fax (520) 292-1290  
www.mmla-psomas.com

FIGURE 3  
DEVELOPED CONDITIONS MAP  
FOR  
**THE PINES II**



**RAINFALL DATA**

Partial duration based Point Precipitation Frequency Estimates Version: 3  
 32.3647 N 111.1001 W 2198 ft



Tue Nov 22 17:42:29 2005

| Average Recurrence Interval (years) |   |
|-------------------------------------|---|
| 1 in 2                              | ◆ |
| 1 in 5                              | + |
| 1 in 10                             | □ |
| 1 to 25                             | × |
| 1 in 50                             | ▲ |
| 1 in 100                            | — |
| 1 in 200                            | ◆ |
| 1 in 500                            | + |
| 1 in 1000                           | □ |

**Confidence Limits -**

| * Upper bound of the 90% confidence interval<br>Precipitation Frequency Estimates (inches) |       |        |        |        |        |         |      |      |       |       |       |       |       |        |        |        |        |        |
|--|-------|--------|--------|--------|--------|---------|------|------|-------|-------|-------|-------|-------|--------|--------|--------|--------|--------|
| ARI** (years)  | 5 min | 10 min | 15 min | 30 min | 60 min | 120 min | 3 hr | 6 hr | 12 hr | 24 hr | 48 hr | 4 day | 7 day | 10 day | 20 day | 30 day | 45 day | 60 day |
| 2  | 0.32  | 0.49   | 0.60   | 0.81   | 1.01   | 1.15    | 1.21 | 1.55 | 2.16  | 2.43  | 2.65  | 2.99  | 3.27  | 4.10   | 4.81   | 5.67   | 6.27   |        |
| 5  | 0.42  | 0.65   | 0.80   | 1.08   | 1.33   | 1.50    | 1.56 | 1.74 | 1.94  | 2.71  | 3.05  | 3.36  | 3.79  | 4.13   | 5.18   | 5.97   | 7.00   | 7.72   |
| 10   | 0.50  | 0.77   | 0.95   | 1.28   | 1.58   | 1.77    | 1.84 | 2.04 | 2.25  | 3.15  | 3.57  | 3.96  | 4.47  | 4.87   | 6.07   | 6.92   | 8.01   | 8.83   |
| 25   | 0.61  | 0.94   | 1.16   | 1.56   | 1.93   | 2.15    | 2.24 | 2.46 | 2.68  | 3.78  | 4.28  | 4.82  | 5.51  | 5.95   | 7.33   | 8.22   | 9.33   | 10.31  |
| 50   | 0.70  | 1.07   | 1.32   | 1.78   | 2.21   | 2.45    | 2.56 | 2.80 | 3.04  | 4.28  | 4.87  | 5.54  | 6.42  | 6.86   | 8.36   | 9.26   | 10.32  | 11.43  |
| 100  | 0.80  | 1.21   | 1.50   | 2.02   | 2.50   | 2.77    | 2.91 | 3.40 | 3.90  | 5.46  | 6.32  | 7.40  | 7.88  | 9.52   | 10.39  | 11.34  | 12.55  |        |
| 200  | 0.89  | 1.36   | 1.68   | 2.27   | 2.81   | 3.10    | 3.29 | 3.56 | 3.81  | 5.38  | 6.09  | 7.20  | 8.48  | 8.97   | 10.72  | 11.53  | 12.36  | 13.66  |
| 500  | 1.03  | 1.56   | 1.94   | 2.61   | 3.23   | 3.59    | 3.85 | 4.15 | 4.37  | 6.18  | 6.96  | 8.48  | 10.06 | 10.58  | 12.48  | 13.14  | 13.74  | 15.20  |
| 1000   | 1.13  | 1.72   | 2.13   | 2.87   | 3.56   | 3.98    | 4.30 | 4.64 | 4.84  | 6.80  | 7.71  | 9.57  | 11.47 | 12.02  | 13.97  | 14.47  | 14.81  | 16.37  |

\* The upper bound of the confidence interval at 90% confidence level is the value which 5% of the simulated quantile values for a given frequency are greater than.

\*\* These precipitation frequency estimates are based on a partial duration series. ARI is the Average Recurrence Interval.

Please refer to the documentation for more information. NOTE: Formatting prevents estimates near zero to appear as zero.

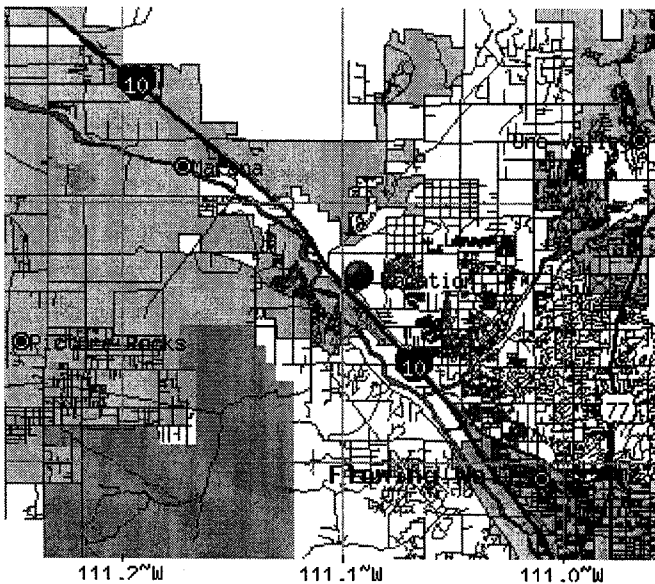
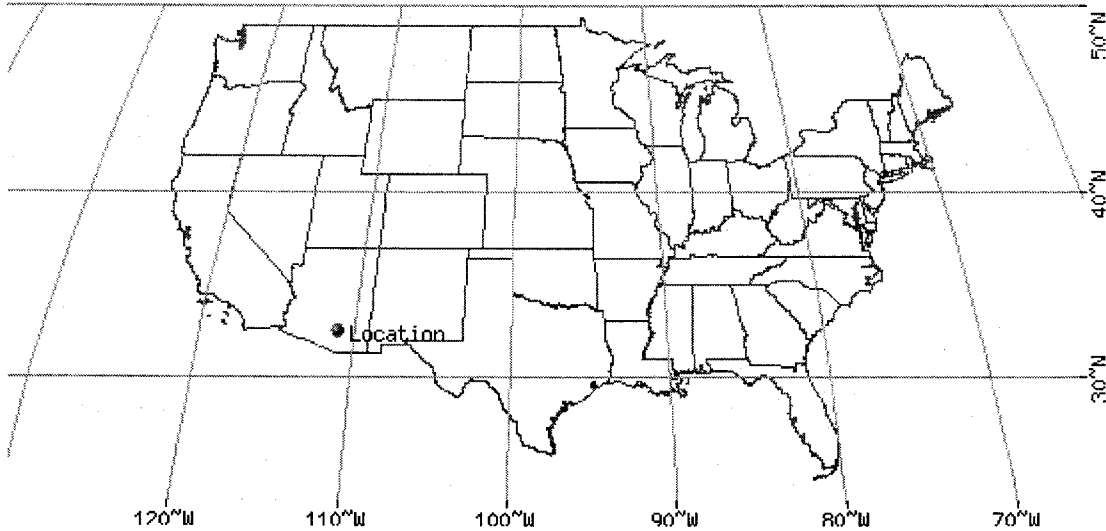
| * Lower bound of the 90% confidence interval<br>Precipitation Frequency Estimates (inches) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|
|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|

| ARI**<br>(years) | 5<br>min | 10<br>min | 15<br>min | 30<br>min | 60<br>min | 120<br>min | 3<br>hr | 6<br>hr | 12<br>hr | 24<br>hr | 48<br>hr | 4<br>day | 7<br>day | 10<br>day | 20<br>day | 30<br>day | 45<br>day | 60<br>day |
|------------------|----------|-----------|-----------|-----------|-----------|------------|---------|---------|----------|----------|----------|----------|----------|-----------|-----------|-----------|-----------|-----------|
| 2                | 0.25     | 0.38      | 0.47      | 0.64      | 0.79      | 0.91       | 0.96    | 1.10    | 1.26     | 1.58     | 1.83     | 2.04     | 2.27     | 2.49      | 3.20      | 3.92      | 4.69      | 5.22      |
| 5                | 0.33     | 0.51      | 0.63      | 0.84      | 1.05      | 1.19       | 1.24    | 1.39    | 1.57     | 1.96     | 2.29     | 2.59     | 2.88     | 3.14      | 4.03      | 4.85      | 5.76      | 6.42      |
| 10               | 0.39     | 0.60      | 0.74      | 1.00      | 1.24      | 1.40       | 1.45    | 1.62    | 1.82     | 2.28     | 2.65     | 3.04     | 3.39     | 3.69      | 4.70      | 5.61      | 6.57      | 7.35      |
| 25               | 0.47     | 0.72      | 0.90      | 1.21      | 1.49      | 1.68       | 1.75    | 1.93    | 2.15     | 2.71     | 3.13     | 3.66     | 4.12     | 4.45      | 5.62      | 6.62      | 7.62      | 8.54      |
| 50               | 0.53     | 0.81      | 1.01      | 1.35      | 1.68      | 1.89       | 1.96    | 2.17    | 2.39     | 3.04     | 3.52     | 4.17     | 4.72     | 5.07      | 6.35      | 7.38      | 8.39      | 9.39      |
| 100              | 0.59     | 0.90      | 1.12      | 1.50      | 1.86      | 2.10       | 2.18    | 2.40    | 2.63     | 3.38     | 3.90     | 4.68     | 5.35     | 5.73      | 7.11      | 8.14      | 9.13      | 10.24     |
| 200              | 0.65     | 0.99      | 1.23      | 1.65      | 2.04      | 2.30       | 2.40    | 2.64    | 2.88     | 3.72     | 4.30     | 5.22     | 6.01     | 6.41      | 7.89      | 8.95      | 9.84      | 11.04     |
| 500              | 0.72     | 1.10      | 1.36      | 1.83      | 2.27      | 2.56       | 2.69    | 2.95    | 3.19     | 4.18     | 4.83     | 5.95     | 6.92     | 7.32      | 8.90      | 9.93      | 10.74     | 12.05     |
| 1000             | 0.77     | 1.18      | 1.46      | 1.96      | 2.43      | 2.75       | 2.91    | 3.19    | 3.42     | 4.53     | 5.21     | 6.50     | 7.64     | 8.04      | 9.66      | 10.66     | 11.38     | 12.74     |

\* The lower bound of the confidence interval at 90% confidence level is the value which 5% of the simulated quantile values for a given frequency are less than.  
 \*\* These precipitation frequency estimates are based on a partial duration maxima series. ARI is the Average Recurrence Interval.

Please refer to the documentation for more information. NOTE: Formatting prevents estimates near zero to appear as zero.

Maps -



These maps were produced using a direct map request from the U.S. Census Bureau Mapping and Cartographic Resources Tiger Map Server.

Please read disclaimer for more information.

LEGEND

- State
- County
- Indian Resv
- Lake/Pond/Ocean
- Street
- Expressway
- Highway
- Connector
- Stream
- Military Area
- National Park
- Other Park
- City
- County

Scale 1:228583  
 \*average--true scale depends on monitor resolution



## POINT PRECIPITATION FREQUENCY ESTIMATES FROM NOAA ATLAS 14



**Arizona 32.3647 N 111.1001 W 2198 feet**

from "Precipitation-Frequency Atlas of the United States" NOAA Atlas 14, Volume 1, Version 3  
G.M. Bonnin, D. Todd, B. Lin, T. Parzybok, M. Yekta, and D. Riley  
NOAA, National Weather Service, Silver Spring, Maryland, 2003

Extracted: Tue Nov 22 2005

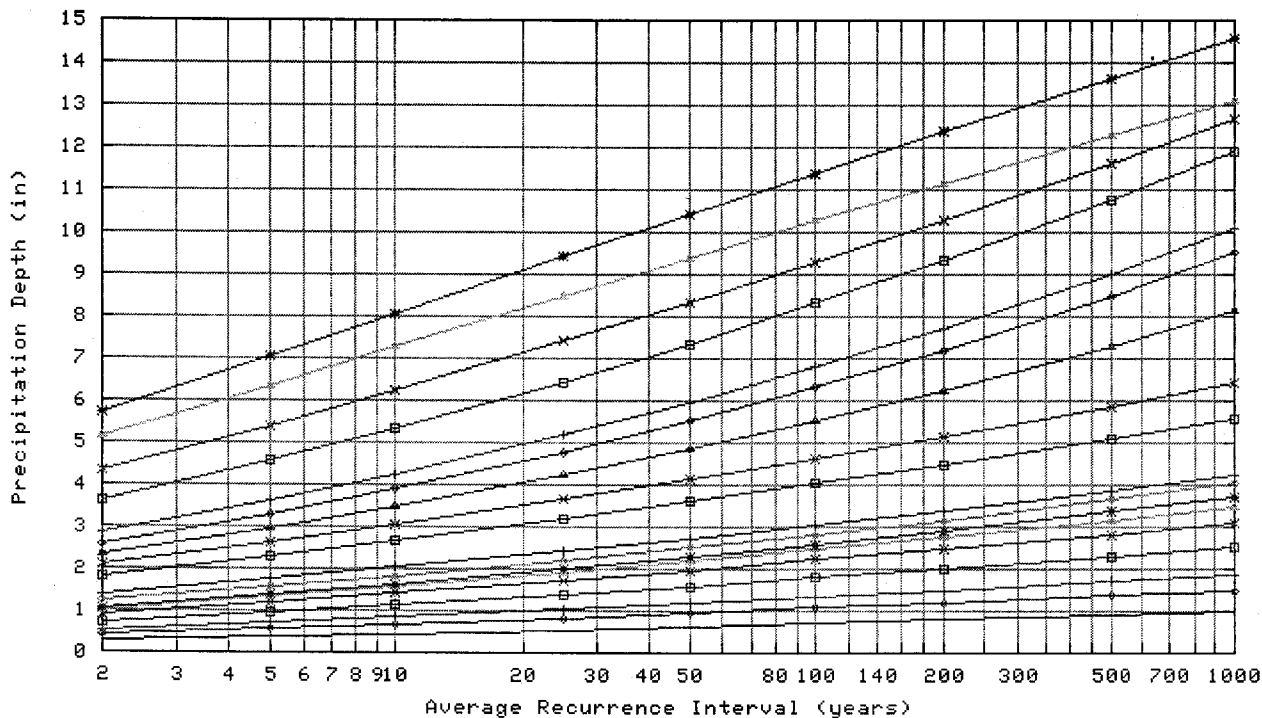
|                   |             |               |            |          |      |      |   |
|-------------------|-------------|---------------|------------|----------|------|------|---|
| Confidence Limits | Seasonality | Location Maps | Other Info | GIS data | Maps | Help | D |
|-------------------|-------------|---------------|------------|----------|------|------|---|

| Precipitation Frequency Estimates (inches) |          |           |           |           |           |            |         |         |          |          |          |          |          |           |           |           |           |           |
|--|----------|-----------|-----------|-----------|-----------|------------|---------|---------|----------|----------|----------|----------|----------|-----------|-----------|-----------|-----------|-----------|
| ARI*<br>(years)                            | 5<br>min | 10<br>min | 15<br>min | 30<br>min | 60<br>min | 120<br>min | 3<br>hr | 6<br>hr | 12<br>hr | 24<br>hr | 48<br>hr | 4<br>day | 7<br>day | 10<br>day | 20<br>day | 30<br>day | 45<br>day | 60<br>day |
| <b>2</b>                                   | 0.28     | 0.43      | 0.53      | 0.71      | 0.88      | 1.02       | 1.07    | 1.23    | 1.39     | 1.82     | 2.08     | 2.32     | 2.59     | 2.85      | 3.61      | 4.33      | 5.15      | 5.71      |
| <b>5</b>                                   | 0.38     | 0.57      | 0.71      | 0.95      | 1.18      | 1.33       | 1.38    | 1.55    | 1.74     | 2.29     | 2.62     | 2.94     | 3.29     | 3.60      | 4.56      | 5.38      | 6.35      | 7.04      |
| <b>10</b>                                  | 0.45     | 0.68      | 0.84      | 1.14      | 1.41      | 1.57       | 1.64    | 1.83    | 2.02     | 2.67     | 3.05     | 3.47     | 3.89     | 4.24      | 5.34      | 6.24      | 7.27      | 8.06      |
| <b>25</b>                                  | 0.55     | 0.83      | 1.03      | 1.39      | 1.72      | 1.92       | 2.00    | 2.21    | 2.42     | 3.19     | 3.66     | 4.22     | 4.77     | 5.17      | 6.45      | 7.41      | 8.47      | 9.41      |
| <b>50</b>                                  | 0.62     | 0.95      | 1.18      | 1.58      | 1.96      | 2.19       | 2.28    | 2.51    | 2.73     | 3.60     | 4.14     | 4.84     | 5.51     | 5.95      | 7.36      | 8.33      | 9.37      | 10.41     |
| <b>100</b>                                 | 0.70     | 1.07      | 1.33      | 1.79      | 2.22      | 2.47       | 2.59    | 2.83    | 3.06     | 4.03     | 4.63     | 5.51     | 6.32     | 6.80      | 8.31      | 9.28      | 10.27     | 11.39     |
| <b>200</b>                                 | 0.79     | 1.20      | 1.49      | 2.00      | 2.48      | 2.76       | 2.91    | 3.17    | 3.39     | 4.48     | 5.16     | 6.24     | 7.20     | 7.71      | 9.33      | 10.26     | 11.14     | 12.37     |
| <b>500</b>                                 | 0.90     | 1.37      | 1.70      | 2.28      | 2.83      | 3.16       | 3.37    | 3.64    | 3.86     | 5.09     | 5.86     | 7.28     | 8.47     | 9.02      | 10.75     | 11.60     | 12.28     | 13.63     |
| <b>1000</b>                                | 0.98     | 1.50      | 1.86      | 2.50      | 3.10      | 3.47       | 3.73    | 4.04    | 4.23     | 5.58     | 6.42     | 8.13     | 9.55     | 10.12     | 11.90     | 12.65     | 13.12     | 14.56     |

Text version of table

\* These precipitation frequency estimates are based on a partial duration series. ARI is the Average Recurrence Interval. Please refer to the documentation for more information. NOTE: Formatting forces estimates near zero to appear as zero.

Partial duration based Point Precipitation Frequency Estimates Version: 3  
 32.3647 N 111.1001 W 2198 ft



Tue Nov 22 17:42:29 2005

| Duration |         |        |        |
|----------|---------|--------|--------|
| 5-min    | 120-min | 48-hr  | 30-day |
| 10-min   | 3-hr    | 4-day  | 45-day |
| 15-min   | 6-hr    | 7-day  | 60-day |
| 30-min   | 12-hr   | 10-day |        |
| 60-min   | 24-hr   | 20-day |        |



# HYDROLOGIC CALCULATIONS



**EXISTING CONDITIONS**



PROJECT NAME AND LOCATION: THE PINES II (Existing Conditions)

DRAINAGE CONCENTRATION POINT: 6 (WS 6)

WATERSHED AREA (A): 31.44 acres

LENGTH OF WATERCOURSE (Lc): 2480. ft

LENGTH TO CENTER OF GRAVITY (Lca): 1240. ft

INCREMENTAL CHANGE IN LENGTH (Li) - ft      INCREMENTAL CHANGE IN ELEV (Hi) - ft

2480.

17.0

MEAN SLOPE (Sc): .0069 ft      BASIN FACTOR (Nb): .0250

WATERSHED TYPE(S): Existing

RAINFALL VALUES

|     | EVENT |      |       |       |       |        |
|-----|-------|------|-------|-------|-------|--------|
|     | 2-YR  | 5-YR | 10-YR | 25-YR | 50-YR | 100-YR |
| P 1 | .88   | 1.17 | 1.36  | 1.61  | 1.84  | 2.06   |
| P 2 | 1.07  | 1.40 | 1.63  | 1.91  | 2.18  | 2.43   |
| P 3 | 1.19  | 1.56 | 1.80  | 2.12  | 2.40  | 2.69   |
| P 6 | 1.43  | 1.85 | 2.14  | 2.50  | 2.83  | 3.16   |
| P24 | 2.16  | 2.81 | 3.25  | 3.81  | 4.32  | 4.82   |

SOIL GROUPS

76. % B, CN= 82, COVER TYPE= DESERT BRUSH , COVER DENSITY= 25 %  
24. % B, CN= 74, COVER TYPE= URBAN LAWNS , COVER DENSITY= 80 %

IMPERVIOUS COVER= 69. %

RAINFALL/RUNOFF AND PEAK DISCHARGE DATA

|                           | EVENT |       |       |       |       |        |
|---------------------------|-------|-------|-------|-------|-------|--------|
|                           | 2-YR  | 5-YR  | 10-YR | 25-YR | 50-YR | 100-YR |
| RUNOFF SUPPLY RATE (q/i): | .606  | .648  | .678  | .712  | .740  | .763   |
| Tc ( FUNCTION OF i ) :    | 23.77 | 23.14 | 22.73 | 22.29 | 21.95 | 21.68  |
| SOLUTION OF Tc (MINUTES): | 19    | 16    | 14    | 13    | 12    | 11     |
| RAINFL INT. @ Tc (IN/HR): | 1.797 | 2.596 | 3.230 | 3.929 | 4.627 | 5.372  |
| RUNOFF RATE @ Tc (IN/HR): | 1.090 | 1.683 | 2.189 | 2.799 | 3.422 | 4.099  |
| PEAK DISCHARGE (CFS) :    | 35.   | 53.   | 69.   | 89.   | 108.  | 130.   |

PROJECT NAME AND LOCATION: THE PINES II (Existing Conditions)

DRAINAGE CONCENTRATION POINT: 9 (WS 9)

WATERSHED AREA (A): 12.72 acres

LENGTH OF WATERCOURSE (Lc): 2406. ft

LENGTH TO CENTER OF GRAVITY (Lca): 1203. ft

INCREMENTAL CHANGE IN LENGTH (Li) - ft      INCREMENTAL CHANGE IN ELEV (Hi) - ft

2406.

21.0

MEAN SLOPE (Sc): .0087 ft      BASIN FACTOR (Nb): .0330

WATERSHED TYPE(S): Existing

RAINFALL VALUES

|     | EVENT |      |       |       |       |        |
|-----|-------|------|-------|-------|-------|--------|
|     | 2-YR  | 5-YR | 10-YR | 25-YR | 50-YR | 100-YR |
| P 1 | .88   | 1.17 | 1.36  | 1.61  | 1.84  | 2.06   |
| P 2 | 1.07  | 1.40 | 1.63  | 1.91  | 2.18  | 2.43   |
| P 3 | 1.19  | 1.56 | 1.80  | 2.12  | 2.40  | 2.69   |
| P 6 | 1.43  | 1.85 | 2.14  | 2.50  | 2.83  | 3.16   |
| P24 | 2.16  | 2.81 | 3.25  | 3.81  | 4.32  | 4.82   |

SOIL GROUPS

100. % B, CN= 82, COVER TYPE= DESERT BRUSH , COVER DENSITY= 25 %

IMPERVIOUS COVER= 26. %

RAINFALL/RUNOFF AND PEAK DISCHARGE DATA

|                           | EVENT |       |       |       |       |        |
|---------------------------|-------|-------|-------|-------|-------|--------|
|                           | 2-YR  | 5-YR  | 10-YR | 25-YR | 50-YR | 100-YR |
| RUNOFF SUPPLY RATE (q/i): | .235  | .309  | .366  | .435  | .491  | .539   |
| Tc ( FUNCTION OF i ) :    | 40.89 | 36.65 | 34.24 | 31.94 | 30.44 | 29.33  |
| SOLUTION OF Tc (MINUTES): | 38    | 28    | 24    | 20    | 18    | 16     |
| RAINFL INT. @ Tc (IN/HR): | 1.198 | 1.918 | 2.453 | 3.205 | 3.856 | 4.569  |
| RUNOFF RATE @ Tc (IN/HR): | .281  | .592  | .897  | 1.394 | 1.893 | 2.461  |
| PEAK DISCHARGE (CFS) :    | 3.60  | 7.59  | 11.51 | 17.88 | 24.27 | 31.56  |

**DEVELOPED CONDITIONS**

PROJECT NAME AND LOCATION: THE PINES II (Developed Conditions)

DRAINAGE CONCENTRATION POINT: D1 (WS D1)

WATERSHED AREA (A): 6.87 acres

LENGTH OF WATERCOURSE (Lc): 967. ft

LENGTH TO CENTER OF GRAVITY (Lca): 484. ft

INCREMENTAL CHANGE IN LENGTH (Li) - ft      INCREMENTAL CHANGE IN ELEV (Hi) - ft  
967.      4.8

MEAN SLOPE (Sc): .0050 ft      BASIN FACTOR (Nb): .0220

WATERSHED TYPE(S): Moderate Urban

RAINFALL VALUES

|     | EVENT |      |       |       |       |        |
|-----|-------|------|-------|-------|-------|--------|
|     | 2-YR  | 5-YR | 10-YR | 25-YR | 50-YR | 100-YR |
| P 1 | .88   | 1.17 | 1.36  | 1.61  | 1.84  | 2.06   |
| P 2 | 1.07  | 1.40 | 1.63  | 1.91  | 2.18  | 2.43   |
| P 3 | 1.19  | 1.56 | 1.80  | 2.12  | 2.40  | 2.69   |
| P 6 | 1.43  | 1.85 | 2.14  | 2.50  | 2.83  | 3.16   |
| P24 | 2.16  | 2.81 | 3.25  | 3.81  | 4.32  | 4.82   |

SOIL GROUPS

100. % B, CN= 82, COVER TYPE= DESERT BRUSH , COVER DENSITY= 25 %

IMPERVIOUS COVER= 60. %

RAINFALL/RUNOFF AND PEAK DISCHARGE DATA

|                           | EVENT |       |       |       |       |        |
|---------------------------|-------|-------|-------|-------|-------|--------|
|                           | 2-YR  | 5-YR  | 10-YR | 25-YR | 50-YR | 100-YR |
| RUNOFF SUPPLY RATE (q/i): | .529  | .582  | .619  | .662  | .696  | .725   |
| Tc ( FUNCTION OF i ) :    | 14.25 | 13.71 | 13.38 | 13.02 | 12.76 | 12.56  |
| SOLUTION OF Tc (MINUTES): | 10    | 8     | 8     | 7     | 6     | 6      |
| RAINFL INT. @ Tc (IN/HR): | 2.378 | 3.497 | 4.074 | 5.073 | 6.096 | 6.833  |
| RUNOFF RATE @ Tc (IN/HR): | 1.257 | 2.035 | 2.521 | 3.357 | 4.241 | 4.952  |
| PEAK DISCHARGE (CFS) :    | 8.71  | 14.09 | 17.46 | 23.25 | 29.37 | 34.29  |

PROJECT NAME AND LOCATION: THE PINES II (Developed Conditions)

DRAINAGE CONCENTRATION POINT: D1 (WS D1, OS-1)

WATERSHED AREA (A): 15.92 acres

LENGTH OF WATERCOURSE (Lc): 1930. ft

LENGTH TO CENTER OF GRAVITY (Lca): 966. ft

INCREMENTAL CHANGE IN LENGTH (Li) - ft      INCREMENTAL CHANGE IN ELEV (Hi) - ft

967.      4.8

963.      4.8

MEAN SLOPE (Sc): .0050 ft      BASIN FACTOR (Nb): .0280

WATERSHED TYPE(S): Moderate Urban

RAINFALL VALUES

|     | EVENT |      |       |       |       |        |
|-----|-------|------|-------|-------|-------|--------|
|     | 2-YR  | 5-YR | 10-YR | 25-YR | 50-YR | 100-YR |
| P 1 | .88   | 1.17 | 1.36  | 1.61  | 1.84  | 2.06   |
| P 2 | 1.07  | 1.40 | 1.63  | 1.91  | 2.18  | 2.43   |
| P 3 | 1.19  | 1.56 | 1.80  | 2.12  | 2.40  | 2.69   |
| P 6 | 1.43  | 1.85 | 2.14  | 2.50  | 2.83  | 3.16   |
| P24 | 2.16  | 2.81 | 3.25  | 3.81  | 4.32  | 4.82   |

SOIL GROUPS

100. % B, CN= 82, COVER TYPE= DESERT BRUSH , COVER DENSITY= 25 %

IMPERVIOUS COVER= 26. %

RAINFALL/RUNOFF AND PEAK DISCHARGE DATA

|                           | EVENT |       |       |       |       |        |
|---------------------------|-------|-------|-------|-------|-------|--------|
|                           | 2-YR  | 5-YR  | 10-YR | 25-YR | 50-YR | 100-YR |
| RUNOFF SUPPLY RATE (q/i): | .235  | .309  | .366  | .435  | .491  | .539   |
| Tc ( FUNCTION OF i ) :    | 37.98 | 34.04 | 31.80 | 29.67 | 28.27 | 27.24  |
| SOLUTION OF Tc (MINUTES): | 35    | 26    | 22    | 18    | 16    | 15     |
| RAINFL INT. @ Tc (IN/HR): | 1.260 | 2.000 | 2.575 | 3.382 | 4.076 | 4.693  |
| RUNOFF RATE @ Tc (IN/HR): | .296  | .617  | .942  | 1.471 | 2.001 | 2.528  |
| PEAK DISCHARGE (CFS) :    | 4.74  | 9.90  | 15.12 | 23.61 | 32.11 | 40.57  |

PROJECT NAME AND LOCATION: THE PINES II (Developed Conditions)

DRAINAGE CONCENTRATION POINT: D2 (WS D2)

WATERSHED AREA (A): .44 acres

LENGTH OF WATERCOURSE (Lc): 136. ft

LENGTH TO CENTER OF GRAVITY (Lca): 69. ft

INCREMENTAL CHANGE IN LENGTH (Li) - ft      INCREMENTAL CHANGE IN ELEV (Hi) - ft  
136.      .7

MEAN SLOPE (Sc): .0050 ft      BASIN FACTOR (Nb): .0350

WATERSHED TYPE(S): VALLEY

RAINFALL VALUES

|     | EVENT |      |       |       |       |        |
|-----|-------|------|-------|-------|-------|--------|
|     | 2-YR  | 5-YR | 10-YR | 25-YR | 50-YR | 100-YR |
| P 1 | .88   | 1.17 | 1.36  | 1.61  | 1.84  | 2.06   |
| P 2 | 1.07  | 1.40 | 1.63  | 1.91  | 2.18  | 2.43   |
| P 3 | 1.19  | 1.56 | 1.80  | 2.12  | 2.40  | 2.69   |
| P 6 | 1.43  | 1.85 | 2.14  | 2.50  | 2.83  | 3.16   |
| P24 | 2.16  | 2.81 | 3.25  | 3.81  | 4.32  | 4.82   |

SOIL GROUPS

100. % B, CN= 82, COVER TYPE= DESERT BRUSH , COVER DENSITY= 25 %

IMPERVIOUS COVER= 0. %

RAINFALL/RUNOFF AND PEAK DISCHARGE DATA

|                           | EVENT |       |       |       |       |        |
|---------------------------|-------|-------|-------|-------|-------|--------|
|                           | 2-YR  | 5-YR  | 10-YR | 25-YR | 50-YR | 100-YR |
| RUNOFF SUPPLY RATE (q/i): | .010  | .100  | .172  | .262  | .334  | .397   |
| Tc ( FUNCTION OF i ) :    | 34.54 | 13.68 | 10.98 | 9.29  | 8.43  | 7.87   |
| SOLUTION OF Tc (MINUTES): | 31    | 8     | 6     | 5     | 5     | 5      |
| RAINFL INT. @ Tc (IN/HR): | 1.356 | 3.497 | 4.524 | 5.604 | 6.389 | 7.162  |
| RUNOFF RATE @ Tc (IN/HR): | .013  | .348  | .780  | 1.467 | 2.135 | 2.840  |
| PEAK DISCHARGE (CFS) :    | .01   | .15   | .35   | .65   | .95   | 1.26   |



PROJECT NAME AND LOCATION: THE PINES II (Developed Conditions)

DRAINAGE CONCENTRATION POINT: D2 (WS D1, D2 OS-1)

WATERSHED AREA (A): 16.36 acres

LENGTH OF WATERCOURSE (Lc): 2066. ft

LENGTH TO CENTER OF GRAVITY (Lca): 1033. ft

INCREMENTAL CHANGE IN LENGTH (Li) - ft      INCREMENTAL CHANGE IN ELEV (Hi) - ft

|      |     |
|------|-----|
| 967. | 4.8 |
| 963. | 4.8 |
| 136. | 1.4 |

MEAN SLOPE (Sc): .0052 ft      BASIN FACTOR (Nb): .0290

WATERSHED TYPE(S): Moderate Urban

RAINFALL VALUES

|     | EVENT |      |       |       |       |        |
|-----|-------|------|-------|-------|-------|--------|
|     | 2-YR  | 5-YR | 10-YR | 25-YR | 50-YR | 100-YR |
| P 1 | .88   | 1.17 | 1.36  | 1.61  | 1.84  | 2.06   |
| P 2 | 1.07  | 1.40 | 1.63  | 1.91  | 2.18  | 2.43   |
| P 3 | 1.19  | 1.56 | 1.80  | 2.12  | 2.40  | 2.69   |
| P 6 | 1.43  | 1.85 | 2.14  | 2.50  | 2.83  | 3.16   |
| P24 | 2.16  | 2.81 | 3.25  | 3.81  | 4.32  | 4.82   |

SOIL GROUPS

100. % B, CN= 82, COVER TYPE= DESERT BRUSH , COVER DENSITY= 25 %

IMPERVIOUS COVER= 25. %

RAINFALL/RUNOFF AND PEAK DISCHARGE DATA

|                           | EVENT |       |       |       |       |        |
|---------------------------|-------|-------|-------|-------|-------|--------|
|                           | 2-YR  | 5-YR  | 10-YR | 25-YR | 50-YR | 100-YR |
| RUNOFF SUPPLY RATE (q/i): | .226  | .300  | .358  | .428  | .485  | .533   |
| Tc ( FUNCTION OF i ) :    | 40.94 | 36.53 | 34.05 | 31.70 | 30.17 | 29.04  |
| SOLUTION OF Tc (MINUTES): | 38    | 28    | 24    | 20    | 18    | 16     |
| RAINFL INT. @ Tc (IN/HR): | 1.198 | 1.918 | 2.453 | 3.205 | 3.856 | 4.569  |
| RUNOFF RATE @ Tc (IN/HR): | .271  | .576  | .879  | 1.373 | 1.869 | 2.436  |
| PEAK DISCHARGE (CFS) :    | 4.46  | 9.50  | 14.50 | 22.64 | 30.83 | 40.18  |

PROJECT NAME AND LOCATION: THE PINES II (Developed Conditions)

DRAINAGE CONCENTRATION POINT: D3 (WS D3)

WATERSHED AREA (A): .26 acres

LENGTH OF WATERCOURSE (Lc): 288. ft

LENGTH TO CENTER OF GRAVITY (Lca): 144. ft

INCREMENTAL CHANGE IN LENGTH (Li) - ft      INCREMENTAL CHANGE IN ELEV (Hi) - ft

288.

1.4

MEAN SLOPE (Sc): .0050 ft      BASIN FACTOR (Nb): .0350

WATERSHED TYPE(S): VALLEY

RAINFALL VALUES

|     | EVENT |      |       |       |       |        |
|-----|-------|------|-------|-------|-------|--------|
|     | 2-YR  | 5-YR | 10-YR | 25-YR | 50-YR | 100-YR |
| P 1 | .88   | 1.17 | 1.36  | 1.61  | 1.84  | 2.06   |
| P 2 | 1.07  | 1.40 | 1.63  | 1.91  | 2.18  | 2.43   |
| P 3 | 1.19  | 1.56 | 1.80  | 2.12  | 2.40  | 2.69   |
| P 6 | 1.43  | 1.85 | 2.14  | 2.50  | 2.83  | 3.16   |
| P24 | 2.16  | 2.81 | 3.25  | 3.81  | 4.32  | 4.82   |

SOIL GROUPS

100. % B, CN= 82, COVER TYPE= DESERT BRUSH , COVER DENSITY= 25 %

IMPERVIOUS COVER= 0. %

RAINFALL/RUNOFF AND PEAK DISCHARGE DATA

|                           | EVENT |       |       |       |       |        |
|---------------------------|-------|-------|-------|-------|-------|--------|
|                           | 2-YR  | 5-YR  | 10-YR | 25-YR | 50-YR | 100-YR |
| RUNOFF SUPPLY RATE (q/i): | .010  | .100  | .172  | .262  | .334  | .397   |
| Tc ( FUNCTION OF i ) :    | 53.95 | 21.37 | 17.15 | 14.52 | 13.16 | 12.29  |
| SOLUTION OF Tc (MINUTES): | 56    | 14    | 10    | 8     | 7     | 6      |
| RAINFL INT. @ Tc (IN/HR): | .925  | 2.772 | 3.679 | 4.815 | 5.783 | 6.833  |
| RUNOFF RATE @ Tc (IN/HR): | .009  | .276  | .635  | 1.260 | 1.932 | 2.709  |
| PEAK DISCHARGE (CFS) :    | .00   | .07   | .17   | .33   | .51   | .71    |





PROJECT NAME AND LOCATION: THE PINES II (Developed Conditions)

DRAINAGE CONCENTRATION POINT: D5 (WS D5)

WATERSHED AREA (A): .50 acres

LENGTH OF WATERCOURSE (Lc): 435. ft

LENGTH TO CENTER OF GRAVITY (Lca): 218. ft

INCREMENTAL CHANGE IN LENGTH (Li) - ft      INCREMENTAL CHANGE IN ELEV (Hi) - ft  
435.      2.2

MEAN SLOPE (Sc): .0050 ft      BASIN FACTOR (Nb): .0350

WATERSHED TYPE(S): VALLEY

RAINFALL VALUES

|     | EVENT |      |       |       |       |        |
|-----|-------|------|-------|-------|-------|--------|
|     | 2-YR  | 5-YR | 10-YR | 25-YR | 50-YR | 100-YR |
| P 1 | .88   | 1.17 | 1.36  | 1.61  | 1.84  | 2.06   |
| P 2 | 1.07  | 1.40 | 1.63  | 1.91  | 2.18  | 2.43   |
| P 3 | 1.19  | 1.56 | 1.80  | 2.12  | 2.40  | 2.69   |
| P 6 | 1.43  | 1.85 | 2.14  | 2.50  | 2.83  | 3.16   |
| P24 | 2.16  | 2.81 | 3.25  | 3.81  | 4.32  | 4.82   |

SOIL GROUPS

100. % B, CN= 82, COVER TYPE= DESERT BRUSH , COVER DENSITY= 25 %  
IMPERVIOUS COVER= 0. %

RAINFALL/RUNOFF AND PEAK DISCHARGE DATA

|                           | EVENT |       |       |       |       |        |
|---------------------------|-------|-------|-------|-------|-------|--------|
|                           | 2-YR  | 5-YR  | 10-YR | 25-YR | 50-YR | 100-YR |
| RUNOFF SUPPLY RATE (q/i): | .010  | .100  | .172  | .262  | .334  | .397   |
| Tc ( FUNCTION OF i ) :    | 69.08 | 27.37 | 21.96 | 18.59 | 16.86 | 15.74  |
| SOLUTION OF Tc (MINUTES): | 79    | 20    | 14    | 10    | 9     | 8      |
| RAINFL INT. @ Tc (IN/HR): | .714  | 2.327 | 3.230 | 4.348 | 5.214 | 6.154  |
| RUNOFF RATE @ Tc (IN/HR): | .007  | .232  | .557  | 1.138 | 1.742 | 2.440  |
| PEAK DISCHARGE (CFS) :    | .00   | .12   | .28   | .57   | .88   | 1.23   |

PROJECT NAME AND LOCATION: THE PINES II (Developed Conditions)

DRAINAGE CONCENTRATION POINT: D5 (WS D3,D4 OS-6, D5)

WATERSHED AREA (A): 5.03 acres

LENGTH OF WATERCOURSE (Lc): 1278. ft

LENGTH TO CENTER OF GRAVITY (Lca): 639. ft

INCREMENTAL CHANGE IN LENGTH (Li) - ft      INCREMENTAL CHANGE IN ELEV (Hi) - ft

|      |     |
|------|-----|
| 546. | 2.7 |
| 297. | 1.5 |
| 435. | 2.2 |

MEAN SLOPE (Sc): .0050 ft      BASIN FACTOR (Nb): .0300

WATERSHED TYPE(S): Moderate Urban

#### RAINFALL VALUES

|     | EVENT |      |       |       |       |        |
|-----|-------|------|-------|-------|-------|--------|
|     | 2-YR  | 5-YR | 10-YR | 25-YR | 50-YR | 100-YR |
| P 1 | .88   | 1.17 | 1.36  | 1.61  | 1.84  | 2.06   |
| P 2 | 1.07  | 1.40 | 1.63  | 1.91  | 2.18  | 2.43   |
| P 3 | 1.19  | 1.56 | 1.80  | 2.12  | 2.40  | 2.69   |
| P 6 | 1.43  | 1.85 | 2.14  | 2.50  | 2.83  | 3.16   |
| P24 | 2.16  | 2.81 | 3.25  | 3.81  | 4.32  | 4.82   |

#### SOIL GROUPS

100. % B, CN= 82, COVER TYPE= DESERT BRUSH , COVER DENSITY= 25 %

IMPERVIOUS COVER= 48. %

#### RAINFALL/RUNOFF AND PEAK DISCHARGE DATA

|                           | EVENT |       |       |       |       |        |
|---------------------------|-------|-------|-------|-------|-------|--------|
|                           | 2-YR  | 5-YR  | 10-YR | 25-YR | 50-YR | 100-YR |
| RUNOFF SUPPLY RATE (q/i): | .425  | .485  | .529  | .582  | .623  | .659   |
| Tc ( FUNCTION OF i ) :    | 25.08 | 23.78 | 22.96 | 22.12 | 21.51 | 21.04  |
| SOLUTION OF Tc (MINUTES): | 20    | 16    | 15    | 13    | 12    | 11     |
| RAINFL INT. @ Tc (IN/HR): | 1.753 | 2.596 | 3.107 | 3.929 | 4.627 | 5.372  |
| RUNOFF RATE @ Tc (IN/HR): | .745  | 1.260 | 1.645 | 2.286 | 2.885 | 3.540  |
| PEAK DISCHARGE (CFS) :    | 3.78  | 6.39  | 8.34  | 11.59 | 14.63 | 17.95  |

PROJECT NAME AND LOCATION: THE PINES II (Developed Conditions)

DRAINAGE CONCENTRATION POINT: D6 (WS D6)

WATERSHED AREA (A): 5.04 acres

LENGTH OF WATERCOURSE (Lc): 821. ft

LENGTH TO CENTER OF GRAVITY (Lca): 411. ft

INCREMENTAL CHANGE IN LENGTH (Li) - ft      INCREMENTAL CHANGE IN ELEV (Hi) - ft

821.

4.1

MEAN SLOPE (Sc): .0050 ft      BASIN FACTOR (Nb): .0220

WATERSHED TYPE(S): Moderate Urban

RAINFALL VALUES

|     | EVENT |      |       |       |       |        |
|-----|-------|------|-------|-------|-------|--------|
|     | 2-YR  | 5-YR | 10-YR | 25-YR | 50-YR | 100-YR |
| P 1 | .88   | 1.17 | 1.36  | 1.61  | 1.84  | 2.06   |
| P 2 | 1.07  | 1.40 | 1.63  | 1.91  | 2.18  | 2.43   |
| P 3 | 1.19  | 1.56 | 1.80  | 2.12  | 2.40  | 2.69   |
| P 6 | 1.43  | 1.85 | 2.14  | 2.50  | 2.83  | 3.16   |
| P24 | 2.16  | 2.81 | 3.25  | 3.81  | 4.32  | 4.82   |

SOIL GROUPS

100. % B, CN= 82, COVER TYPE= DESERT BRUSH , COVER DENSITY= 25 %

IMPERVIOUS COVER= 60. %

RAINFALL/RUNOFF AND PEAK DISCHARGE DATA

|                           | EVENT |       |       |       |       |        |
|---------------------------|-------|-------|-------|-------|-------|--------|
|                           | 2-YR  | 5-YR  | 10-YR | 25-YR | 50-YR | 100-YR |
| RUNOFF SUPPLY RATE (q/i): | .529  | .582  | .619  | .662  | .696  | .725   |
| Tc ( FUNCTION OF i ) :    | 12.91 | 12.43 | 12.12 | 11.80 | 11.57 | 11.38  |
| SOLUTION OF Tc (MINUTES): | 9     | 8     | 7     | 6     | 6     | 5      |
| RAINFL INT. @ Tc (IN/HR): | 2.501 | 3.497 | 4.292 | 5.347 | 6.096 | 7.162  |
| RUNOFF RATE @ Tc (IN/HR): | 1.322 | 2.035 | 2.656 | 3.538 | 4.241 | 5.190  |
| PEAK DISCHARGE (CFS) :    | 6.72  | 10.34 | 13.49 | 17.98 | 21.55 | 26.37  |

PROJECT NAME AND LOCATION: THE PINES II (Developed Conditions)

DRAINAGE CONCENTRATION POINT: D7 (WS D3-D6 OS-6)

WATERSHED AREA (A): 10.07 acres

LENGTH OF WATERCOURSE (Lc): 1529. ft

LENGTH TO CENTER OF GRAVITY (Lca): 764. ft

INCREMENTAL CHANGE IN LENGTH (Li) - ft      INCREMENTAL CHANGE IN ELEV (Hi) - ft

|      |     |
|------|-----|
| 546. | 2.7 |
| 288. | 1.4 |
| 101. | .5  |
| 455. | 2.5 |
| 159. | .8  |

MEAN SLOPE (Sc): .0051 ft      BASIN FACTOR (Nb): .0330

WATERSHED TYPE(S): Moderate Urban

RAINFALL VALUES

|     | EVENT |      |       |       |       |        |
|-----|-------|------|-------|-------|-------|--------|
|     | 2-YR  | 5-YR | 10-YR | 25-YR | 50-YR | 100-YR |
| P 1 | .88   | 1.17 | 1.36  | 1.61  | 1.84  | 2.06   |
| P 2 | 1.07  | 1.40 | 1.63  | 1.91  | 2.18  | 2.43   |
| P 3 | 1.19  | 1.56 | 1.80  | 2.12  | 2.40  | 2.69   |
| P 6 | 1.43  | 1.85 | 2.14  | 2.50  | 2.83  | 3.16   |
| P24 | 2.16  | 2.81 | 3.25  | 3.81  | 4.32  | 4.82   |

SOIL GROUPS

100. % B, CN= 82, COVER TYPE= DESERT BRUSH , COVER DENSITY= 25 %

IMPERVIOUS COVER= 54. %

RAINFALL/RUNOFF AND PEAK DISCHARGE DATA

|                           | EVENT |       |       |       |       |        |
|---------------------------|-------|-------|-------|-------|-------|--------|
|                           | 2-YR  | 5-YR  | 10-YR | 25-YR | 50-YR | 100-YR |
| RUNOFF SUPPLY RATE (q/i): | .477  | .534  | .574  | .622  | .660  | .692   |
| Tc ( FUNCTION OF i ) :    | 29.04 | 27.76 | 26.96 | 26.11 | 25.50 | 25.02  |
| SOLUTION OF Tc (MINUTES): | 24    | 20    | 18    | 16    | 14    | 13     |
| RAINFL INT. @ Tc (IN/HR): | 1.585 | 2.327 | 2.862 | 3.575 | 4.351 | 5.022  |
| RUNOFF RATE @ Tc (IN/HR): | .756  | 1.242 | 1.643 | 2.223 | 2.870 | 3.474  |
| PEAK DISCHARGE (CFS) :    | 7.67  | 12.61 | 16.68 | 22.56 | 29.13 | 35.27  |





PROJECT NAME AND LOCATION: THE PINES II (Developed Conditions)

DRAINAGE CONCENTRATION POINT: D9 (WS D9)

WATERSHED AREA (A): .51 acres

LENGTH OF WATERCOURSE (Lc): 320. ft

LENGTH TO CENTER OF GRAVITY (Lca): 160. ft

INCREMENTAL CHANGE IN LENGTH (Li) - ft      INCREMENTAL CHANGE IN ELEV (Hi) - ft

320.

1.6

MEAN SLOPE (Sc): .0050 ft      BASIN FACTOR (Nb): .0250

WATERSHED TYPE(S): Moderate Urban

RAINFALL VALUES

|     | EVENT |      |       |       |       |        |
|-----|-------|------|-------|-------|-------|--------|
|     | 2-YR  | 5-YR | 10-YR | 25-YR | 50-YR | 100-YR |
| P 1 | .88   | 1.17 | 1.36  | 1.61  | 1.84  | 2.06   |
| P 2 | 1.07  | 1.40 | 1.63  | 1.91  | 2.18  | 2.43   |
| P 3 | 1.19  | 1.56 | 1.80  | 2.12  | 2.40  | 2.69   |
| P 6 | 1.43  | 1.85 | 2.14  | 2.50  | 2.83  | 3.16   |
| P24 | 2.16  | 2.81 | 3.25  | 3.81  | 4.32  | 4.82   |

SOIL GROUPS

100. % B, CN= 82, COVER TYPE= DESERT BRUSH , COVER DENSITY= 25 %

IMPERVIOUS COVER= 100. %

RAINFALL/RUNOFF AND PEAK DISCHARGE DATA

|                           | EVENT |       |       |       |       |        |
|---------------------------|-------|-------|-------|-------|-------|--------|
|                           | 2-YR  | 5-YR  | 10-YR | 25-YR | 50-YR | 100-YR |
| RUNOFF SUPPLY RATE (q/i): | .874  | .903  | .916  | .928  | .937  | .943   |
| Tc ( FUNCTION OF i ) :    | 6.82  | 6.73  | 6.69  | 6.66  | 6.63  | 6.61   |
| SOLUTION OF Tc (MINUTES): | 5     | 5     | 5     | 5     | 5     | 5      |
| RAINFL INT. @ Tc (IN/HR): | 3.065 | 4.070 | 4.742 | 5.604 | 6.389 | 7.162  |
| RUNOFF RATE @ Tc (IN/HR): | 2.680 | 3.677 | 4.345 | 5.204 | 5.986 | 6.757  |
| PEAK DISCHARGE (CFS) :    | 1.38  | 1.89  | 2.23  | 2.68  | 3.08  | 3.47   |

PROJECT NAME AND LOCATION: THE PINES II (Developed Conditions)

DRAINAGE CONCENTRATION POINT: D10 (WS D10)

WATERSHED AREA (A): 2.44 acres

LENGTH OF WATERCOURSE (Lc): 516. ft

LENGTH TO CENTER OF GRAVITY (Lca): 258. ft

INCREMENTAL CHANGE IN LENGTH (Li) - ft      INCREMENTAL CHANGE IN ELEV (Hi) - ft

516.

2.6

MEAN SLOPE (Sc): .0050 ft      BASIN FACTOR (Nb): .0220

WATERSHED TYPE(S): Moderate Urban

RAINFALL VALUES

|     | EVENT |      |       |       |       |        |
|-----|-------|------|-------|-------|-------|--------|
|     | 2-YR  | 5-YR | 10-YR | 25-YR | 50-YR | 100-YR |
| P 1 | .88   | 1.17 | 1.36  | 1.61  | 1.84  | 2.06   |
| P 2 | 1.07  | 1.40 | 1.63  | 1.91  | 2.18  | 2.43   |
| P 3 | 1.19  | 1.56 | 1.80  | 2.12  | 2.40  | 2.69   |
| P 6 | 1.43  | 1.85 | 2.14  | 2.50  | 2.83  | 3.16   |
| P24 | 2.16  | 2.81 | 3.25  | 3.81  | 4.32  | 4.82   |

SOIL GROUPS

100. % B, CN= 82, COVER TYPE= DESERT BRUSH , COVER DENSITY= 25 %

IMPERVIOUS COVER= 60. %

RAINFALL/RUNOFF AND PEAK DISCHARGE DATA

|                           | EVENT |       |       |       |       |        |
|---------------------------|-------|-------|-------|-------|-------|--------|
|                           | 2-YR  | 5-YR  | 10-YR | 25-YR | 50-YR | 100-YR |
| RUNOFF SUPPLY RATE (q/i): | .529  | .582  | .619  | .662  | .696  | .725   |
| Tc ( FUNCTION OF i ) :    | 9.77  | 9.41  | 9.18  | 8.93  | 8.76  | 8.61   |
| SOLUTION OF Tc (MINUTES): | 6     | 5     | 5     | 5     | 5     | 5      |
| RAINFL INT. @ Tc (IN/HR): | 2.924 | 4.070 | 4.742 | 5.604 | 6.389 | 7.162  |
| RUNOFF RATE @ Tc (IN/HR): | 1.546 | 2.368 | 2.934 | 3.709 | 4.446 | 5.190  |
| PEAK DISCHARGE (CFS) :    | 3.80  | 5.82  | 7.22  | 9.12  | 10.93 | 12.77  |

PROJECT NAME AND LOCATION: THE PINES II (Developed Conditions)

DRAINAGE CONCENTRATION POINT: D11 (WS D11)

WATERSHED AREA (A): .34 acres

LENGTH OF WATERCOURSE (Lc): 230. ft

LENGTH TO CENTER OF GRAVITY (Lca): 115. ft

INCREMENTAL CHANGE IN LENGTH (Li) - ft      INCREMENTAL CHANGE IN ELEV (Hi) - ft

230.

1.1

MEAN SLOPE (Sc): .0050 ft      BASIN FACTOR (Nb): .0350

WATERSHED TYPE(S): VALLEY

RAINFALL VALUES

|     | EVENT |      |       |       |       |        |
|-----|-------|------|-------|-------|-------|--------|
|     | 2-YR  | 5-YR | 10-YR | 25-YR | 50-YR | 100-YR |
| P 1 | .88   | 1.17 | 1.36  | 1.61  | 1.84  | 2.06   |
| P 2 | 1.07  | 1.40 | 1.63  | 1.91  | 2.18  | 2.43   |
| P 3 | 1.19  | 1.56 | 1.80  | 2.12  | 2.40  | 2.69   |
| P 6 | 1.43  | 1.85 | 2.14  | 2.50  | 2.83  | 3.16   |
| P24 | 2.16  | 2.81 | 3.25  | 3.81  | 4.32  | 4.82   |

SOIL GROUPS

100. % B, CN= 82, COVER TYPE= DESERT BRUSH , COVER DENSITY= 25 %

IMPERVIOUS COVER= 0. %

RAINFALL/RUNOFF AND PEAK DISCHARGE DATA

|                           | EVENT |       |       |       |       |        |
|---------------------------|-------|-------|-------|-------|-------|--------|
|                           | 2-YR  | 5-YR  | 10-YR | 25-YR | 50-YR | 100-YR |
| RUNOFF SUPPLY RATE (q/i): | .010  | .100  | .172  | .262  | .334  | .397   |
| Tc ( FUNCTION OF i ) :    | 47.14 | 18.67 | 14.99 | 12.68 | 11.50 | 10.74  |
| SOLUTION OF Tc (MINUTES): | 46    | 12    | 9     | 7     | 6     | 5      |
| RAINFL INT. @ Tc (IN/HR): | 1.057 | 2.947 | 3.870 | 5.073 | 6.096 | 7.162  |
| RUNOFF RATE @ Tc (IN/HR): | .010  | .293  | .667  | 1.328 | 2.037 | 2.840  |
| PEAK DISCHARGE (CFS) :    | .00   | .10   | .23   | .46   | .70   | .97    |





PROJECT NAME AND LOCATION: THE PINES II (Developed Conditions)

DRAINAGE CONCENTRATION POINT: D13 (WS D10-D13)

WATERSHED AREA (A): 5.59 acres

LENGTH OF WATERCOURSE (Lc): 956. ft

LENGTH TO CENTER OF GRAVITY (Lca): 478. ft

INCREMENTAL CHANGE IN LENGTH (Li) - ft      INCREMENTAL CHANGE IN ELEV (Hi) - ft

|      |     |
|------|-----|
| 516. | 2.6 |
| 230. | 1.1 |
| 210. | 1.0 |

MEAN SLOPE (Sc): .0050 ft      BASIN FACTOR (Nb): .0250

WATERSHED TYPE(S): Moderate Urban

RAINFALL VALUES

|     | EVENT |      |       |       |       |        |
|-----|-------|------|-------|-------|-------|--------|
|     | 2-YR  | 5-YR | 10-YR | 25-YR | 50-YR | 100-YR |
| P 1 | .88   | 1.17 | 1.36  | 1.61  | 1.84  | 2.06   |
| P 2 | 1.07  | 1.40 | 1.63  | 1.91  | 2.18  | 2.43   |
| P 3 | 1.19  | 1.56 | 1.80  | 2.12  | 2.40  | 2.69   |
| P 6 | 1.43  | 1.85 | 2.14  | 2.50  | 2.83  | 3.16   |
| P24 | 2.16  | 2.81 | 3.25  | 3.81  | 4.32  | 4.82   |

SOIL GROUPS

100. % B, CN= 82, COVER TYPE= DESERT BRUSH , COVER DENSITY= 25 %

IMPERVIOUS COVER= 56. %

RAINFALL/RUNOFF AND PEAK DISCHARGE DATA

|                           | EVENT |       |       |       |       |        |
|---------------------------|-------|-------|-------|-------|-------|--------|
|                           | 2-YR  | 5-YR  | 10-YR | 25-YR | 50-YR | 100-YR |
| RUNOFF SUPPLY RATE (q/i): | .494  | .550  | .589  | .635  | .672  | .703   |
| Tc ( FUNCTION OF i ) :    | 16.52 | 15.83 | 15.40 | 14.94 | 14.61 | 14.35  |
| SOLUTION OF Tc (MINUTES): | 12    | 10    | 9     | 8     | 7     | 7      |
| RAINFL INT. @ Tc (IN/HR): | 2.220 | 3.158 | 3.870 | 4.815 | 5.783 | 6.483  |
| RUNOFF RATE @ Tc (IN/HR): | 1.097 | 1.736 | 2.279 | 3.058 | 3.885 | 4.556  |
| PEAK DISCHARGE (CFS) :    | 6.18  | 9.78  | 12.84 | 17.23 | 21.89 | 25.67  |

PROJECT NAME AND LOCATION: THE PINES II (Developed Conditions)

DRAINAGE CONCENTRATION POINT: D14 (WS D14)

WATERSHED AREA (A): 3.25 acres

LENGTH OF WATERCOURSE (Lc): 497. ft

LENGTH TO CENTER OF GRAVITY (Lca): 249. ft

INCREMENTAL CHANGE IN LENGTH (Li) - ft      INCREMENTAL CHANGE IN ELEV (Hi) - ft  
497.      2.5

MEAN SLOPE (Sc): .0050 ft      BASIN FACTOR (Nb): .0220

WATERSHED TYPE(S): Moderate Urban

RAINFALL VALUES

|     | EVENT |      |       |       |       |        |
|-----|-------|------|-------|-------|-------|--------|
|     | 2-YR  | 5-YR | 10-YR | 25-YR | 50-YR | 100-YR |
| P 1 | .88   | 1.17 | 1.36  | 1.61  | 1.84  | 2.06   |
| P 2 | 1.07  | 1.40 | 1.63  | 1.91  | 2.18  | 2.43   |
| P 3 | 1.19  | 1.56 | 1.80  | 2.12  | 2.40  | 2.69   |
| P 6 | 1.43  | 1.85 | 2.14  | 2.50  | 2.83  | 3.16   |
| P24 | 2.16  | 2.81 | 3.25  | 3.81  | 4.32  | 4.82   |

SOIL GROUPS

100. % B, CN= 82, COVER TYPE= DESERT BRUSH , COVER DENSITY= 25 %

IMPERVIOUS COVER= 60. %

RAINFALL/RUNOFF AND PEAK DISCHARGE DATA

|                           | EVENT |       |       |       |       |        |
|---------------------------|-------|-------|-------|-------|-------|--------|
|                           | 2-YR  | 5-YR  | 10-YR | 25-YR | 50-YR | 100-YR |
| RUNOFF SUPPLY RATE (q/i): | .529  | .582  | .619  | .662  | .696  | .725   |
| Tc ( FUNCTION OF i ) :    | 9.55  | 9.19  | 8.97  | 8.73  | 8.56  | 8.42   |
| SOLUTION OF Tc (MINUTES): | 6     | 5     | 5     | 5     | 5     | 5      |
| RAINFL INT. @ Tc (IN/HR): | 2.924 | 4.070 | 4.742 | 5.604 | 6.389 | 7.162  |
| RUNOFF RATE @ Tc (IN/HR): | 1.546 | 2.368 | 2.934 | 3.709 | 4.446 | 5.190  |
| PEAK DISCHARGE (CFS) :    | 5.06  | 7.76  | 9.61  | 12.15 | 14.56 | 17.00  |



PROJECT NAME AND LOCATION: THE PINES II (Developed Conditions)

DRAINAGE CONCENTRATION POINT: D15 (WS D15)

WATERSHED AREA (A): 5.26 acres

LENGTH OF WATERCOURSE (Lc): 888. ft

LENGTH TO CENTER OF GRAVITY (Lca): 444. ft

INCREMENTAL CHANGE IN LENGTH (Li) - ft      INCREMENTAL CHANGE IN ELEV (Hi) - ft  
888.      4.4

MEAN SLOPE (Sc): .0050 ft      BASIN FACTOR (Nb): .0220

WATERSHED TYPE(S): Moderate Urban

RAINFALL VALUES

|     | EVENT |      |       |       |       |        |
|-----|-------|------|-------|-------|-------|--------|
|     | 2-YR  | 5-YR | 10-YR | 25-YR | 50-YR | 100-YR |
| P 1 | .88   | 1.17 | 1.36  | 1.61  | 1.84  | 2.06   |
| P 2 | 1.07  | 1.40 | 1.63  | 1.91  | 2.18  | 2.43   |
| P 3 | 1.19  | 1.56 | 1.80  | 2.12  | 2.40  | 2.69   |
| P 6 | 1.43  | 1.85 | 2.14  | 2.50  | 2.83  | 3.16   |
| P24 | 2.16  | 2.81 | 3.25  | 3.81  | 4.32  | 4.82   |

SOIL GROUPS

100. % B, CN= 82, COVER TYPE= DESERT BRUSH , COVER DENSITY= 25 %

IMPERVIOUS COVER= 60. %

RAINFALL/RUNOFF AND PEAK DISCHARGE DATA

|                           | EVENT |       |       |       |       |        |
|---------------------------|-------|-------|-------|-------|-------|--------|
|                           | 2-YR  | 5-YR  | 10-YR | 25-YR | 50-YR | 100-YR |
| RUNOFF SUPPLY RATE (q/i): | .529  | .582  | .619  | .662  | .696  | .725   |
| Tc ( FUNCTION OF i ) :    | 13.54 | 13.03 | 12.71 | 12.37 | 12.13 | 11.93  |
| SOLUTION OF Tc (MINUTES): | 10    | 8     | 7     | 6     | 6     | 6      |
| RAINFL INT. @ Tc (IN/HR): | 2.378 | 3.497 | 4.292 | 5.347 | 6.096 | 6.833  |
| RUNOFF RATE @ Tc (IN/HR): | 1.257 | 2.035 | 2.656 | 3.538 | 4.241 | 4.952  |
| PEAK DISCHARGE (CFS) :    | 6.67  | 10.79 | 14.08 | 18.76 | 22.49 | 26.25  |

PROJECT NAME AND LOCATION: THE PINES II (Developed Conditions)

DRAINAGE CONCENTRATION POINT: D15 (WS D15, OS-2)

WATERSHED AREA (A): 5.72 acres

LENGTH OF WATERCOURSE (Lc): 1033. ft

LENGTH TO CENTER OF GRAVITY (Lca): 517. ft

INCREMENTAL CHANGE IN LENGTH (Li) - ft      INCREMENTAL CHANGE IN ELEV (Hi) - ft

888.      4.4  
145.      .7

MEAN SLOPE (Sc): .0050 ft      BASIN FACTOR (Nb): .0240

WATERSHED TYPE(S): Moderate Urban

#### RAINFALL VALUES

|     | EVENT |      |       |       |       |        |
|-----|-------|------|-------|-------|-------|--------|
|     | 2-YR  | 5-YR | 10-YR | 25-YR | 50-YR | 100-YR |
| P 1 | .88   | 1.17 | 1.36  | 1.61  | 1.84  | 2.06   |
| P 2 | 1.07  | 1.40 | 1.63  | 1.91  | 2.18  | 2.43   |
| P 3 | 1.19  | 1.56 | 1.80  | 2.12  | 2.40  | 2.69   |
| P 6 | 1.43  | 1.85 | 2.14  | 2.50  | 2.83  | 3.16   |
| P24 | 2.16  | 2.81 | 3.25  | 3.81  | 4.32  | 4.82   |

#### SOIL GROUPS

100. % B, CN= 82, COVER TYPE= DESERT BRUSH , COVER DENSITY= 25 %

IMPERVIOUS COVER= 55. %

#### RAINFALL/RUNOFF AND PEAK DISCHARGE DATA

|                           | EVENT |       |       |       |       |        |
|---------------------------|-------|-------|-------|-------|-------|--------|
|                           | 2-YR  | 5-YR  | 10-YR | 25-YR | 50-YR | 100-YR |
| RUNOFF SUPPLY RATE (q/i): | .485  | .542  | .582  | .628  | .666  | .697   |
| Tc ( FUNCTION OF i ) :    | 16.73 | 16.01 | 15.56 | 15.09 | 14.74 | 14.47  |
| SOLUTION OF Tc (MINUTES): | 12    | 10    | 9     | 8     | 7     | 7      |
| RAINFL INT. @ Tc (IN/HR): | 2.220 | 3.158 | 3.870 | 4.815 | 5.783 | 6.483  |
| RUNOFF RATE @ Tc (IN/HR): | 1.077 | 1.710 | 2.251 | 3.026 | 3.850 | 4.521  |
| PEAK DISCHARGE (CFS) :    | 6.21  | 9.86  | 12.98 | 17.45 | 22.20 | 26.07  |

PROJECT NAME AND LOCATION: THE PINES II (Developed Conditions)

DRAINAGE CONCENTRATION POINT: D16 (WS D15, D14 OS-2)

WATERSHED AREA (A): 8.97 acres

LENGTH OF WATERCOURSE (Lc): 1117. ft

LENGTH TO CENTER OF GRAVITY (Lca): 559. ft

INCREMENTAL CHANGE IN LENGTH (Li) - ft      INCREMENTAL CHANGE IN ELEV (Hi) - ft

|      |     |
|------|-----|
| 888. | 4.4 |
| 145. | .7  |
| 84.  | .4  |

MEAN SLOPE (Sc): .0050 ft      BASIN FACTOR (Nb): .0250

WATERSHED TYPE(S): Moderate Urban

#### RAINFALL VALUES

|     | EVENT |      |       |       |       |        |
|-----|-------|------|-------|-------|-------|--------|
|     | 2-YR  | 5-YR | 10-YR | 25-YR | 50-YR | 100-YR |
| P 1 | .88   | 1.17 | 1.36  | 1.61  | 1.84  | 2.06   |
| P 2 | 1.07  | 1.40 | 1.63  | 1.91  | 2.18  | 2.43   |
| P 3 | 1.19  | 1.56 | 1.80  | 2.12  | 2.40  | 2.69   |
| P 6 | 1.43  | 1.85 | 2.14  | 2.50  | 2.83  | 3.16   |
| P24 | 2.16  | 2.81 | 3.25  | 3.81  | 4.32  | 4.82   |

#### SOIL GROUPS

100. % B, CN= 82, COVER TYPE= DESERT BRUSH , COVER DENSITY= 25 %

IMPERVIOUS COVER= 57. %

#### RAINFALL/RUNOFF AND PEAK DISCHARGE DATA

|                           | EVENT |       |       |       |       |        |
|---------------------------|-------|-------|-------|-------|-------|--------|
|                           | 2-YR  | 5-YR  | 10-YR | 25-YR | 50-YR | 100-YR |
| RUNOFF SUPPLY RATE (q/i): | .503  | .558  | .596  | .642  | .678  | .708   |
| Tc ( FUNCTION OF i ) :    | 18.01 | 17.28 | 16.82 | 16.33 | 15.98 | 15.70  |
| SOLUTION OF Tc (MINUTES): | 13    | 11    | 10    | 9     | 8     | 8      |
| RAINFL INT. @ Tc (IN/HR): | 2.149 | 3.053 | 3.679 | 4.574 | 5.490 | 6.154  |
| RUNOFF RATE @ Tc (IN/HR): | 1.080 | 1.702 | 2.194 | 2.935 | 3.720 | 4.358  |
| PEAK DISCHARGE (CFS) :    | 9.77  | 15.39 | 19.84 | 26.54 | 33.64 | 39.41  |

PROJECT NAME AND LOCATION: THE PINES II (Developed Conditions)

DRAINAGE CONCENTRATION POINT: D17 (WS D17)

WATERSHED AREA (A): 3.60 acres

LENGTH OF WATERCOURSE (Lc): 627. ft

LENGTH TO CENTER OF GRAVITY (Lca): 314. ft

INCREMENTAL CHANGE IN LENGTH (Li) - ft      INCREMENTAL CHANGE IN ELEV (Hi) - ft

627.      3.1

MEAN SLOPE (Sc): .0050 ft      BASIN FACTOR (Nb): .0220

WATERSHED TYPE(S): Moderate Urban

RAINFALL VALUES

|     | EVENT |      |       |       |       |        |
|-----|-------|------|-------|-------|-------|--------|
|     | 2-YR  | 5-YR | 10-YR | 25-YR | 50-YR | 100-YR |
| P 1 | .88   | 1.17 | 1.36  | 1.61  | 1.84  | 2.06   |
| P 2 | 1.07  | 1.40 | 1.63  | 1.91  | 2.18  | 2.43   |
| P 3 | 1.19  | 1.56 | 1.80  | 2.12  | 2.40  | 2.69   |
| P 6 | 1.43  | 1.85 | 2.14  | 2.50  | 2.83  | 3.16   |
| P24 | 2.16  | 2.81 | 3.25  | 3.81  | 4.32  | 4.82   |

SOIL GROUPS

100. % B, CN= 82, COVER TYPE= DESERT BRUSH , COVER DENSITY= 25 %

IMPERVIOUS COVER= 60. %

RAINFALL/RUNOFF AND PEAK DISCHARGE DATA

|                           | EVENT |       |       |       |       |        |
|---------------------------|-------|-------|-------|-------|-------|--------|
|                           | 2-YR  | 5-YR  | 10-YR | 25-YR | 50-YR | 100-YR |
| RUNOFF SUPPLY RATE (q/i): | .529  | .582  | .619  | .662  | .696  | .725   |
| Tc ( FUNCTION OF i ) :    | 10.98 | 10.57 | 10.31 | 10.04 | 9.84  | 9.68   |
| SOLUTION OF Tc (MINUTES): | 7     | 6     | 6     | 5     | 5     | 5      |
| RAINFL INT. @ Tc (IN/HR): | 2.775 | 3.883 | 4.524 | 5.604 | 6.389 | 7.162  |
| RUNOFF RATE @ Tc (IN/HR): | 1.467 | 2.259 | 2.799 | 3.709 | 4.446 | 5.190  |
| PEAK DISCHARGE (CFS) :    | 5.32  | 8.20  | 10.16 | 13.46 | 16.13 | 18.83  |

PROJECT NAME AND LOCATION: THE PINES II (Developed Conditions)

DRAINAGE CONCENTRATION POINT: D17 (WS D17, OS-5)

WATERSHED AREA (A): 4.04 acres

LENGTH OF WATERCOURSE (Lc): 924. ft

LENGTH TO CENTER OF GRAVITY (Lca): 463. ft

INCREMENTAL CHANGE IN LENGTH (Li) - ft      INCREMENTAL CHANGE IN ELEV (Hi) - ft

627.      3.1  
297.      1.5

MEAN SLOPE (Sc): .0050 ft      BASIN FACTOR (Nb): .0260

WATERSHED TYPE(S): Moderate Urban

RAINFALL VALUES

|     | EVENT |      |       |       |       |        |
|-----|-------|------|-------|-------|-------|--------|
|     | 2-YR  | 5-YR | 10-YR | 25-YR | 50-YR | 100-YR |
| P 1 | .88   | 1.17 | 1.36  | 1.61  | 1.84  | 2.06   |
| P 2 | 1.07  | 1.40 | 1.63  | 1.91  | 2.18  | 2.43   |
| P 3 | 1.19  | 1.56 | 1.80  | 2.12  | 2.40  | 2.69   |
| P 6 | 1.43  | 1.85 | 2.14  | 2.50  | 2.83  | 3.16   |
| P24 | 2.16  | 2.81 | 3.25  | 3.81  | 4.32  | 4.82   |

SOIL GROUPS

100. % B, CN= 82, COVER TYPE= DESERT BRUSH , COVER DENSITY= 25 %

IMPERVIOUS COVER= 53. %

RAINFALL/RUNOFF AND PEAK DISCHARGE DATA

|                           | EVENT |       |       |       |       |        |
|---------------------------|-------|-------|-------|-------|-------|--------|
|                           | 2-YR  | 5-YR  | 10-YR | 25-YR | 50-YR | 100-YR |
| RUNOFF SUPPLY RATE (q/i): | .468  | .526  | .567  | .615  | .654  | .686   |
| Tc ( FUNCTION OF i ) :    | 17.20 | 16.42 | 15.93 | 15.42 | 15.05 | 14.76  |
| SOLUTION OF Tc (MINUTES): | 13    | 11    | 9     | 8     | 8     | 7      |
| RAINFL INT. @ Tc (IN/HR): | 2.149 | 3.053 | 3.870 | 4.815 | 5.490 | 6.483  |
| RUNOFF RATE @ Tc (IN/HR): | 1.006 | 1.604 | 2.193 | 2.962 | 3.588 | 4.450  |
| PEAK DISCHARGE (CFS) :    | 4.10  | 6.53  | 8.93  | 12.06 | 14.61 | 18.12  |

PROJECT NAME AND LOCATION: THE PINES II (Developed Conditions)

DRAINAGE CONCENTRATION POINT: D18 (WS D18)

WATERSHED AREA (A): 3.91 acres

LENGTH OF WATERCOURSE (Lc): 1156. ft

LENGTH TO CENTER OF GRAVITY (Lca): 578. ft

INCREMENTAL CHANGE IN LENGTH (Li) - ft      INCREMENTAL CHANGE IN ELEV (Hi) - ft

1156.      5.8

MEAN SLOPE (Sc): .0050 ft      BASIN FACTOR (Nb): .0350

WATERSHED TYPE(S): VALLEY

RAINFALL VALUES

|     | EVENT |      |       |       |       |        |
|-----|-------|------|-------|-------|-------|--------|
|     | 2-YR  | 5-YR | 10-YR | 25-YR | 50-YR | 100-YR |
| P 1 | .88   | 1.17 | 1.36  | 1.61  | 1.84  | 2.06   |
| P 2 | 1.07  | 1.40 | 1.63  | 1.91  | 2.18  | 2.43   |
| P 3 | 1.19  | 1.56 | 1.80  | 2.12  | 2.40  | 2.69   |
| P 6 | 1.43  | 1.85 | 2.14  | 2.50  | 2.83  | 3.16   |
| P24 | 2.16  | 2.81 | 3.25  | 3.81  | 4.32  | 4.82   |

SOIL GROUPS

100. % B, CN= 82, COVER TYPE= DESERT BRUSH , COVER DENSITY= 25 %

IMPERVIOUS COVER= 0. %

RAINFALL/RUNOFF AND PEAK DISCHARGE DATA

|                           | EVENT  |       |       |       |       |        |
|---------------------------|--------|-------|-------|-------|-------|--------|
|                           | 2-YR   | 5-YR  | 10-YR | 25-YR | 50-YR | 100-YR |
| RUNOFF SUPPLY RATE (q/i): | .010   | .100  | .172  | .262  | .334  | .397   |
| Tc ( FUNCTION OF i ) :    | 124.20 | 49.20 | 39.49 | 33.42 | 30.31 | 28.30  |
| SOLUTION OF Tc (MINUTES): | 180    | 42    | 29    | 21    | 18    | 15     |
| RAINFL INT. @ Tc (IN/HR): | .398   | 1.485 | 2.194 | 3.108 | 3.856 | 4.693  |
| RUNOFF RATE @ Tc (IN/HR): | .004   | .148  | .378  | .813  | 1.288 | 1.861  |
| PEAK DISCHARGE (CFS) :    | .02    | .58   | 1.49  | 3.21  | 5.08  | 7.33   |

PROJECT NAME AND LOCATION: THE PINES II (Developed Conditions)

DRAINAGE CONCENTRATION POINT: D19 (WS D19)

WATERSHED AREA (A): 3.43 acres

LENGTH OF WATERCOURSE (Lc): 902. ft

LENGTH TO CENTER OF GRAVITY (Lca): 451. ft

INCREMENTAL CHANGE IN LENGTH (Li) - ft      INCREMENTAL CHANGE IN ELEV (Hi) - ft  
902.      4.5

MEAN SLOPE (Sc): .0050 ft      BASIN FACTOR (Nb): .0220

WATERSHED TYPE(S): Moderate Urban

RAINFALL VALUES

|     | EVENT |      |       |       |       |        |
|-----|-------|------|-------|-------|-------|--------|
|     | 2-YR  | 5-YR | 10-YR | 25-YR | 50-YR | 100-YR |
| P 1 | .88   | 1.17 | 1.36  | 1.61  | 1.84  | 2.06   |
| P 2 | 1.07  | 1.40 | 1.63  | 1.91  | 2.18  | 2.43   |
| P 3 | 1.19  | 1.56 | 1.80  | 2.12  | 2.40  | 2.69   |
| P 6 | 1.43  | 1.85 | 2.14  | 2.50  | 2.83  | 3.16   |
| P24 | 2.16  | 2.81 | 3.25  | 3.81  | 4.32  | 4.82   |

SOIL GROUPS

100. % B, CN= 82, COVER TYPE= DESERT BRUSH , COVER DENSITY= 25 %  
IMPERVIOUS COVER= 60. %

RAINFALL/RUNOFF AND PEAK DISCHARGE DATA

|                           | EVENT |       |       |       |       |        |
|---------------------------|-------|-------|-------|-------|-------|--------|
|                           | 2-YR  | 5-YR  | 10-YR | 25-YR | 50-YR | 100-YR |
| RUNOFF SUPPLY RATE (q/i): | .529  | .582  | .619  | .662  | .696  | .725   |
| Tc ( FUNCTION OF i ) :    | 13.66 | 13.15 | 12.83 | 12.49 | 12.24 | 12.04  |
| SOLUTION OF Tc (MINUTES): | 10    | 8     | 7     | 7     | 6     | 6      |
| RAINFL INT. @ Tc (IN/HR): | 2.378 | 3.497 | 4.292 | 5.073 | 6.096 | 6.833  |
| RUNOFF RATE @ Tc (IN/HR): | 1.257 | 2.035 | 2.656 | 3.357 | 4.241 | 4.952  |
| PEAK DISCHARGE (CFS) :    | 4.35  | 7.03  | 9.18  | 11.61 | 14.66 | 17.12  |

PROJECT NAME AND LOCATION: THE PINES II (Developed Conditions)

DRAINAGE CONCENTRATION POINT: D20 (WS D20)

WATERSHED AREA (A): 5.40 acres

LENGTH OF WATERCOURSE (Lc): 587. ft

LENGTH TO CENTER OF GRAVITY (Lca): 294. ft

INCREMENTAL CHANGE IN LENGTH (Li) - ft      INCREMENTAL CHANGE IN ELEV (Hi) - ft

587.

2.9

MEAN SLOPE (Sc): .0050 ft      BASIN FACTOR (Nb): .0220

WATERSHED TYPE(S): Moderate Urban

RAINFALL VALUES

|     | EVENT |      |       |       |       |        |
|-----|-------|------|-------|-------|-------|--------|
|     | 2-YR  | 5-YR | 10-YR | 25-YR | 50-YR | 100-YR |
| P 1 | .88   | 1.17 | 1.36  | 1.61  | 1.84  | 2.06   |
| P 2 | 1.07  | 1.40 | 1.63  | 1.91  | 2.18  | 2.43   |
| P 3 | 1.19  | 1.56 | 1.80  | 2.12  | 2.40  | 2.69   |
| P 6 | 1.43  | 1.85 | 2.14  | 2.50  | 2.83  | 3.16   |
| P24 | 2.16  | 2.81 | 3.25  | 3.81  | 4.32  | 4.82   |

SOIL GROUPS

100. % B, CN= 82, COVER TYPE= DESERT BRUSH , COVER DENSITY= 25 %

IMPERVIOUS COVER= 60. %

RAINFALL/RUNOFF AND PEAK DISCHARGE DATA

|                           | EVENT |       |       |       |       |        |
|---------------------------|-------|-------|-------|-------|-------|--------|
|                           | 2-YR  | 5-YR  | 10-YR | 25-YR | 50-YR | 100-YR |
| RUNOFF SUPPLY RATE (q/i): | .529  | .582  | .619  | .662  | .696  | .725   |
| Tc ( FUNCTION OF i ) :    | 10.56 | 10.16 | 9.91  | 9.65  | 9.46  | 9.31   |
| SOLUTION OF Tc (MINUTES): | 7     | 6     | 5     | 5     | 5     | 5      |
| RAINFL INT. @ Tc (IN/HR): | 2.775 | 3.883 | 4.742 | 5.604 | 6.389 | 7.162  |
| RUNOFF RATE @ Tc (IN/HR): | 1.467 | 2.259 | 2.934 | 3.709 | 4.446 | 5.190  |
| PEAK DISCHARGE (CFS) :    | 7.98  | 12.30 | 15.97 | 20.19 | 24.20 | 28.25  |





PROJECT NAME AND LOCATION: THE PINES II (Developed Conditions)

DRAINAGE CONCENTRATION POINT: D21 (WS D21)

WATERSHED AREA (A): .32 acres

LENGTH OF WATERCOURSE (Lc): 132. ft

LENGTH TO CENTER OF GRAVITY (Lca): 66. ft

INCREMENTAL CHANGE IN LENGTH (Li) - ft      INCREMENTAL CHANGE IN ELEV (Hi) - ft

132.      .7

MEAN SLOPE (Sc): .0050 ft      BASIN FACTOR (Nb): .0350

WATERSHED TYPE(S): VALLEY

RAINFALL VALUES

|     | EVENT |      |       |       |       |        |
|-----|-------|------|-------|-------|-------|--------|
|     | 2-YR  | 5-YR | 10-YR | 25-YR | 50-YR | 100-YR |
| P 1 | .88   | 1.17 | 1.36  | 1.61  | 1.84  | 2.06   |
| P 2 | 1.07  | 1.40 | 1.63  | 1.91  | 2.18  | 2.43   |
| P 3 | 1.19  | 1.56 | 1.80  | 2.12  | 2.40  | 2.69   |
| P 6 | 1.43  | 1.85 | 2.14  | 2.50  | 2.83  | 3.16   |
| P24 | 2.16  | 2.81 | 3.25  | 3.81  | 4.32  | 4.82   |

SOIL GROUPS

100. % B, CN= 82, COVER TYPE= DESERT BRUSH , COVER DENSITY= 25 %

IMPERVIOUS COVER= 0. %

RAINFALL/RUNOFF AND PEAK DISCHARGE DATA

|                           | EVENT |       |       |       |       |        |
|---------------------------|-------|-------|-------|-------|-------|--------|
|                           | 2-YR  | 5-YR  | 10-YR | 25-YR | 50-YR | 100-YR |
| RUNOFF SUPPLY RATE (q/i): | .010  | .100  | .172  | .262  | .334  | .397   |
| Tc ( FUNCTION OF i ) :    | 33.78 | 13.38 | 10.74 | 9.09  | 8.24  | 7.70   |
| SOLUTION OF Tc (MINUTES): | 30    | 8     | 6     | 5     | 5     | 5      |
| RAINFL INT. @ Tc (IN/HR): | 1.392 | 3.497 | 4.524 | 5.604 | 6.389 | 7.162  |
| RUNOFF RATE @ Tc (IN/HR): | .014  | .348  | .780  | 1.467 | 2.135 | 2.840  |
| PEAK DISCHARGE (CFS) :    | .00   | .11   | .25   | .47   | .69   | .92    |

PROJECT NAME AND LOCATION: THE PINES II (Developed Conditions)

DRAINAGE CONCENTRATION POINT: D22 (WS D22)

WATERSHED AREA (A): .79 acres

LENGTH OF WATERCOURSE (Lc): 244. ft

LENGTH TO CENTER OF GRAVITY (Lca): 122. ft

INCREMENTAL CHANGE IN LENGTH (Li) - ft      INCREMENTAL CHANGE IN ELEV (Hi) - ft

244.

1.2

MEAN SLOPE (Sc): .0050 ft      BASIN FACTOR (Nb): .0350

WATERSHED TYPE(S): VALLEY

RAINFALL VALUES

|     | EVENT |      |       |       |       |        |
|-----|-------|------|-------|-------|-------|--------|
|     | 2-YR  | 5-YR | 10-YR | 25-YR | 50-YR | 100-YR |
| P 1 | .88   | 1.17 | 1.36  | 1.61  | 1.84  | 2.06   |
| P 2 | 1.07  | 1.40 | 1.63  | 1.91  | 2.18  | 2.43   |
| P 3 | 1.19  | 1.56 | 1.80  | 2.12  | 2.40  | 2.69   |
| P 6 | 1.43  | 1.85 | 2.14  | 2.50  | 2.83  | 3.16   |
| P24 | 2.16  | 2.81 | 3.25  | 3.81  | 4.32  | 4.82   |

SOIL GROUPS

100. % B, CN= 82, COVER TYPE= DESERT BRUSH , COVER DENSITY= 25 %

IMPERVIOUS COVER= 0. %

RAINFALL/RUNOFF AND PEAK DISCHARGE DATA

|                           | EVENT |       |       |       |       |        |
|---------------------------|-------|-------|-------|-------|-------|--------|
|                           | 2-YR  | 5-YR  | 10-YR | 25-YR | 50-YR | 100-YR |
| RUNOFF SUPPLY RATE (q/i): | .010  | .100  | .172  | .262  | .334  | .397   |
| Tc ( FUNCTION OF i ) :    | 48.84 | 19.35 | 15.53 | 13.14 | 11.92 | 11.13  |
| SOLUTION OF Tc (MINUTES): | 49    | 13    | 9     | 7     | 6     | 5      |
| RAINFL INT. @ Tc (IN/HR): | 1.013 | 2.854 | 3.870 | 5.073 | 6.096 | 7.162  |
| RUNOFF RATE @ Tc (IN/HR): | .010  | .284  | .667  | 1.328 | 2.037 | 2.840  |
| PEAK DISCHARGE (CFS) :    | .01   | .23   | .53   | 1.06  | 1.62  | 2.26   |

PROJECT NAME AND LOCATION: THE PINES II (Developed Conditions)

DRAINAGE CONCENTRATION POINT: OS-1 (WS OS-1)

WATERSHED AREA (A): 9.05 acres

LENGTH OF WATERCOURSE (Lc): 963. ft

LENGTH TO CENTER OF GRAVITY (Lca): 482. ft

INCREMENTAL CHANGE IN LENGTH (Li) - ft      INCREMENTAL CHANGE IN ELEV (Hi) - ft  
963.      4.8

MEAN SLOPE (Sc): .0050 ft      BASIN FACTOR (Nb): .0350

WATERSHED TYPE(S): VALLEY

RAINFALL VALUES

|     | EVENT |      |       |       |       |        |
|-----|-------|------|-------|-------|-------|--------|
|     | 2-YR  | 5-YR | 10-YR | 25-YR | 50-YR | 100-YR |
| P 1 | .88   | 1.17 | 1.36  | 1.61  | 1.84  | 2.06   |
| P 2 | 1.07  | 1.40 | 1.63  | 1.91  | 2.18  | 2.43   |
| P 3 | 1.19  | 1.56 | 1.80  | 2.12  | 2.40  | 2.69   |
| P 6 | 1.43  | 1.85 | 2.14  | 2.50  | 2.83  | 3.16   |
| P24 | 2.16  | 2.81 | 3.25  | 3.81  | 4.32  | 4.82   |

SOIL GROUPS

100. % B, CN= 82, COVER TYPE= DESERT BRUSH , COVER DENSITY= 25 %

IMPERVIOUS COVER= 0. %

RAINFALL/RUNOFF AND PEAK DISCHARGE DATA

|                           | EVENT  |       |       |       |       |        |
|---------------------------|--------|-------|-------|-------|-------|--------|
|                           | 2-YR   | 5-YR  | 10-YR | 25-YR | 50-YR | 100-YR |
| RUNOFF SUPPLY RATE (q/i): | .010   | .100  | .172  | .262  | .334  | .397   |
| Tc ( FUNCTION OF i ) :    | 111.29 | 44.09 | 35.38 | 29.95 | 27.16 | 25.36  |
| SOLUTION OF Tc (MINUTES): | 154    | 36    | 25    | 19    | 15    | 13     |
| RAINFL INT. @ Tc (IN/HR): | .444   | 1.649 | 2.385 | 3.285 | 4.186 | 5.022  |
| RUNOFF RATE @ Tc (IN/HR): | .004   | .164  | .411  | .860  | 1.399 | 1.991  |
| PEAK DISCHARGE (CFS) :    | .04    | 1.50  | 3.75  | 7.84  | 12.76 | 18.16  |

PROJECT NAME AND LOCATION: THE PINES II (Developed Conditions)

DRAINAGE CONCENTRATION POINT: OS-2 (WS OS-2)

WATERSHED AREA (A): .46 acres

LENGTH OF WATERCOURSE (Lc): 145. ft

LENGTH TO CENTER OF GRAVITY (Lca): 73. ft

INCREMENTAL CHANGE IN LENGTH (Li) - ft      INCREMENTAL CHANGE IN ELEV (Hi) - ft

145.      .7

MEAN SLOPE (Sc): .0050 ft      BASIN FACTOR (Nb): .0350

WATERSHED TYPE(S): VALLEY

RAINFALL VALUES

|     | EVENT |      |       |       |       |        |
|-----|-------|------|-------|-------|-------|--------|
|     | 2-YR  | 5-YR | 10-YR | 25-YR | 50-YR | 100-YR |
| P 1 | .88   | 1.17 | 1.36  | 1.61  | 1.84  | 2.06   |
| P 2 | 1.07  | 1.40 | 1.63  | 1.91  | 2.18  | 2.43   |
| P 3 | 1.19  | 1.56 | 1.80  | 2.12  | 2.40  | 2.69   |
| P 6 | 1.43  | 1.85 | 2.14  | 2.50  | 2.83  | 3.16   |
| P24 | 2.16  | 2.81 | 3.25  | 3.81  | 4.32  | 4.82   |

SOIL GROUPS

100. % B, CN= 82, COVER TYPE= DESERT BRUSH , COVER DENSITY= 25 %

IMPERVIOUS COVER= 0. %

RAINFALL/RUNOFF AND PEAK DISCHARGE DATA

|                           | EVENT |       |       |       |       |        |
|---------------------------|-------|-------|-------|-------|-------|--------|
|                           | 2-YR  | 5-YR  | 10-YR | 25-YR | 50-YR | 100-YR |
| RUNOFF SUPPLY RATE (q/i): | .010  | .100  | .172  | .262  | .334  | .397   |
| Tc ( FUNCTION OF i ) :    | 35.72 | 14.15 | 11.36 | 9.61  | 8.72  | 8.14   |
| SOLUTION OF Tc (MINUTES): | 32    | 9     | 6     | 5     | 5     | 5      |
| RAINFL INT. @ Tc (IN/HR): | 1.330 | 3.322 | 4.524 | 5.604 | 6.389 | 7.162  |
| RUNOFF RATE @ Tc (IN/HR): | .013  | .331  | .780  | 1.467 | 2.135 | 2.840  |
| PEAK DISCHARGE (CFS) :    | .01   | .15   | .36   | .68   | .99   | 1.32   |

PROJECT NAME AND LOCATION: THE PINES II (Developed Conditions)

DRAINAGE CONCENTRATION POINT: OS-3 (WS OS-3)

WATERSHED AREA (A): 6.62 acres

LENGTH OF WATERCOURSE (Lc): 903. ft

LENGTH TO CENTER OF GRAVITY (Lca): 452. ft

INCREMENTAL CHANGE IN LENGTH (Li) - ft      INCREMENTAL CHANGE IN ELEV (Hi) - ft

903.

4.5

MEAN SLOPE (Sc): .0050 ft      BASIN FACTOR (Nb): .0350

WATERSHED TYPE(S): VALLEY

RAINFALL VALUES

|     | EVENT |      |       |       |       |        |
|-----|-------|------|-------|-------|-------|--------|
|     | 2-YR  | 5-YR | 10-YR | 25-YR | 50-YR | 100-YR |
| P 1 | .88   | 1.17 | 1.36  | 1.61  | 1.84  | 2.06   |
| P 2 | 1.07  | 1.40 | 1.63  | 1.91  | 2.18  | 2.43   |
| P 3 | 1.19  | 1.56 | 1.80  | 2.12  | 2.40  | 2.69   |
| P 6 | 1.43  | 1.85 | 2.14  | 2.50  | 2.83  | 3.16   |
| P24 | 2.16  | 2.81 | 3.25  | 3.81  | 4.32  | 4.82   |

SOIL GROUPS

100. % B, CN= 82, COVER TYPE= DESERT BRUSH , COVER DENSITY= 25 %

IMPERVIOUS COVER= 0. %

RAINFALL/RUNOFF AND PEAK DISCHARGE DATA

|                           | EVENT  |       |       |       |       |        |
|---------------------------|--------|-------|-------|-------|-------|--------|
|                           | 2-YR   | 5-YR  | 10-YR | 25-YR | 50-YR | 100-YR |
| RUNOFF SUPPLY RATE (q/i): | .010   | .100  | .172  | .262  | .334  | .397   |
| Tc ( FUNCTION OF i ) :    | 107.08 | 42.42 | 34.04 | 28.81 | 26.13 | 24.40  |
| SOLUTION OF Tc (MINUTES): | 146    | 35    | 24    | 18    | 15    | 13     |
| RAINFL INT. @ Tc (IN/HR): | .461   | 1.673 | 2.453 | 3.382 | 4.186 | 5.022  |
| RUNOFF RATE @ Tc (IN/HR): | .005   | .166  | .423  | .885  | 1.399 | 1.991  |
| PEAK DISCHARGE (CFS) :    | .03    | 1.11  | 2.82  | 5.91  | 9.33  | 13.29  |

PROJECT NAME AND LOCATION: THE PINES II (Developed Conditions)

DRAINAGE CONCENTRATION POINT: OS-4 (WS OS-4)

WATERSHED AREA (A): 1.65 acres

LENGTH OF WATERCOURSE (Lc): 870. ft

LENGTH TO CENTER OF GRAVITY (Lca): 435. ft

INCREMENTAL CHANGE IN LENGTH (Li) - ft      INCREMENTAL CHANGE IN ELEV (Hi) - ft

870.

4.3

MEAN SLOPE (Sc): .0050 ft      BASIN FACTOR (Nb): .0350

WATERSHED TYPE(S): VALLEY

RAINFALL VALUES

|     | EVENT |      |       |       |       |        |
|-----|-------|------|-------|-------|-------|--------|
|     | 2-YR  | 5-YR | 10-YR | 25-YR | 50-YR | 100-YR |
| P 1 | .88   | 1.17 | 1.36  | 1.61  | 1.84  | 2.06   |
| P 2 | 1.07  | 1.40 | 1.63  | 1.91  | 2.18  | 2.43   |
| P 3 | 1.19  | 1.56 | 1.80  | 2.12  | 2.40  | 2.69   |
| P 6 | 1.43  | 1.85 | 2.14  | 2.50  | 2.83  | 3.16   |
| P24 | 2.16  | 2.81 | 3.25  | 3.81  | 4.32  | 4.82   |

SOIL GROUPS

100. % B, CN= 82, COVER TYPE= DESERT BRUSH , COVER DENSITY= 25 %

IMPERVIOUS COVER= 0. %

RAINFALL/RUNOFF AND PEAK DISCHARGE DATA

|                           | EVENT  |       |       |       |       |        |
|---------------------------|--------|-------|-------|-------|-------|--------|
|                           | 2-YR   | 5-YR  | 10-YR | 25-YR | 50-YR | 100-YR |
| RUNOFF SUPPLY RATE (q/i): | .010   | .100  | .172  | .262  | .334  | .397   |
| Tc ( FUNCTION OF i ) :    | 104.73 | 41.49 | 33.30 | 28.18 | 25.56 | 23.87  |
| SOLUTION OF Tc (MINUTES): | 142    | 33    | 23    | 17    | 14    | 13     |
| RAINFL INT. @ Tc (IN/HR): | .471   | 1.731 | 2.507 | 3.479 | 4.351 | 5.022  |
| RUNOFF RATE @ Tc (IN/HR): | .005   | .172  | .432  | .910  | 1.454 | 1.991  |
| PEAK DISCHARGE (CFS) :    | .01    | .29   | .72   | 1.51  | 2.42  | 3.31   |

PROJECT NAME AND LOCATION: THE PINES II (Developed Conditions)

DRAINAGE CONCENTRATION POINT: OS-5 (WS OS-5)

WATERSHED AREA (A): .44 acres

LENGTH OF WATERCOURSE (Lc): 297. ft

LENGTH TO CENTER OF GRAVITY (Lca): 149. ft

INCREMENTAL CHANGE IN LENGTH (Li) - ft      INCREMENTAL CHANGE IN ELEV (Hi) - ft  
297.      1.5

MEAN SLOPE (Sc): .0050 ft      BASIN FACTOR (Nb): .0350

WATERSHED TYPE(S): VALLEY

RAINFALL VALUES

|     | EVENT |      |       |       |       |        |
|-----|-------|------|-------|-------|-------|--------|
|     | 2-YR  | 5-YR | 10-YR | 25-YR | 50-YR | 100-YR |
| P 1 | .88   | 1.17 | 1.36  | 1.61  | 1.84  | 2.06   |
| P 2 | 1.07  | 1.40 | 1.63  | 1.91  | 2.18  | 2.43   |
| P 3 | 1.19  | 1.56 | 1.80  | 2.12  | 2.40  | 2.69   |
| P 6 | 1.43  | 1.85 | 2.14  | 2.50  | 2.83  | 3.16   |
| P24 | 2.16  | 2.81 | 3.25  | 3.81  | 4.32  | 4.82   |

SOIL GROUPS

100. % B, CN= 82, COVER TYPE= DESERT BRUSH , COVER DENSITY= 25 %  
IMPERVIOUS COVER= 0. %

RAINFALL/RUNOFF AND PEAK DISCHARGE DATA

|                           | EVENT |       |       |       |       |        |
|---------------------------|-------|-------|-------|-------|-------|--------|
|                           | 2-YR  | 5-YR  | 10-YR | 25-YR | 50-YR | 100-YR |
| RUNOFF SUPPLY RATE (q/i): | .010  | .100  | .172  | .262  | .334  | .397   |
| Tc ( FUNCTION OF i ) :    | 54.93 | 21.76 | 17.47 | 14.78 | 13.41 | 12.52  |
| SOLUTION OF Tc (MINUTES): | 57    | 15    | 11    | 8     | 7     | 6      |
| RAINFL INT. @ Tc (IN/HR): | .916  | 2.667 | 3.557 | 4.815 | 5.783 | 6.833  |
| RUNOFF RATE @ Tc (IN/HR): | .009  | .265  | .613  | 1.260 | 1.932 | 2.709  |
| PEAK DISCHARGE (CFS) :    | .00   | .12   | .27   | .56   | .86   | 1.20   |



PROJECT NAME AND LOCATION: THE PINES II (Developed Conditions)

DRAINAGE CONCENTRATION POINT: OS-6 (WS OS-6)

WATERSHED AREA (A): .23 acres

LENGTH OF WATERCOURSE (Lc): 297. ft

LENGTH TO CENTER OF GRAVITY (Lca): 149. ft

INCREMENTAL CHANGE IN LENGTH (Li) - ft      INCREMENTAL CHANGE IN ELEV (Hi) - ft

297.

1.5

MEAN SLOPE (Sc): .0050 ft      BASIN FACTOR (Nb): .0350

WATERSHED TYPE(S): VALLEY

RAINFALL VALUES

|     | EVENT |      |       |       |       |        |
|-----|-------|------|-------|-------|-------|--------|
|     | 2-YR  | 5-YR | 10-YR | 25-YR | 50-YR | 100-YR |
| P 1 | .88   | 1.17 | 1.36  | 1.61  | 1.84  | 2.06   |
| P 2 | 1.07  | 1.40 | 1.63  | 1.91  | 2.18  | 2.43   |
| P 3 | 1.19  | 1.56 | 1.80  | 2.12  | 2.40  | 2.69   |
| P 6 | 1.43  | 1.85 | 2.14  | 2.50  | 2.83  | 3.16   |
| P24 | 2.16  | 2.81 | 3.25  | 3.81  | 4.32  | 4.82   |

SOIL GROUPS

100. % B, CN= 82, COVER TYPE= DESERT BRUSH , COVER DENSITY= 25 %

IMPERVIOUS COVER= 0. %

RAINFALL/RUNOFF AND PEAK DISCHARGE DATA

|                           | EVENT |       |       |       |       |        |
|---------------------------|-------|-------|-------|-------|-------|--------|
|                           | 2-YR  | 5-YR  | 10-YR | 25-YR | 50-YR | 100-YR |
| RUNOFF SUPPLY RATE (q/i): | .010  | .100  | .172  | .262  | .334  | .397   |
| Tc ( FUNCTION OF i ) :    | 54.93 | 21.76 | 17.47 | 14.78 | 13.41 | 12.52  |
| SOLUTION OF Tc (MINUTES): | 57    | 15    | 11    | 8     | 7     | 6      |
| RAINFL INT. @ Tc (IN/HR): | .916  | 2.667 | 3.557 | 4.815 | 5.783 | 6.833  |
| RUNOFF RATE @ Tc (IN/HR): | .009  | .265  | .613  | 1.260 | 1.932 | 2.709  |
| PEAK DISCHARGE (CFS) :    | .00   | .06   | .14   | .29   | .45   | .63    |

**ROADWAY RATING  
CALCULATIONS**

# Roadway Rating Table

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## Project Description

|              |   |
|--------------|---|
| Worksheet    | 2-16' Lanes w/5in Rolled Curb and Sidewalk 1% Super |
| Flow Element | Irregular Channel                                   |
| Method       | Manning's Formula                                   |
| Solve For    | Discharge   |

---

## Input Data

|                         |                |
|-------------------------|----------------|
| Channel Slope           | 0.005000 ft/ft |
| Water Surface Elevation | 100.09 ft      |

---

## Results

|                      |                      |
|----------------------|----------------------|
| Mannings Coefficient | 0.015                |
| Elevation Range      | 99.56 to 100.42      |
| Discharge            | 40.00 cfs            |
| Flow Area            | 12.5 ft <sup>2</sup> |
| Wetted Perimeter     | 40.01 ft             |
| Top Width            | 39.90 ft             |
| Actual Depth         | 0.54 ft              |
| Critical Elevation   | 100.10 ft            |
| Critical Slope       | 0.004877 ft/ft       |
| Velocity             | 3.21 ft/s            |
| Velocity Head        | 0.16 ft              |
| Specific Energy      | 100.25 ft            |
| Froude Number        | 1.01                 |
| Flow Type            | Supercritical        |

---

## Natural Channel Points

| Station (ft) | Elevation (ft) |
|--------------|----------------|
| 0+95.00      | 100.10         |
| 1+00.00      | 100.00         |
| 1+00.25      | 99.97          |
| 1+00.50      | 99.90          |
| 1+00.75      | 99.80          |
| 1+01.00      | 99.69          |
| 1+01.25      | 99.61          |
| 1+01.50      | 99.57          |
| 1+01.75      | 99.56          |
| 1+02.00      | 99.58          |
| 1+18.00      | 99.74          |
| 1+34.00      | 99.90          |
| 1+34.25      | 99.88          |
| 1+34.50      | 99.89          |
| 1+34.75      | 99.93          |
| 1+35.00      | 100.01         |
| 1+35.25      | 100.12         |
| 1+35.50      | 100.22         |
| 1+35.75      | 100.29         |
| 1+36.00      | 100.32         |
| 1+41.00      | 100.42         |

# Roadway Rating Table

---

**Project Description**


---

Worksheet      2-16' Lanes w/5in Rolled Curb and Sidewalk 1% Super  
 Flow Element    Irregular Channel  
 Method          Manning's Formula  
 Solve For        Discharge

---

**Input Data**


---

Water Surface      100.09 ft  
 Elevation

---

| Attribute             | Minimum  | Maximum  | Increment |
|-----------------------|----------|----------|-----------|
| Channel Slope (ft/ft) | 0.005000 | 0.030000 | 0.002000  |

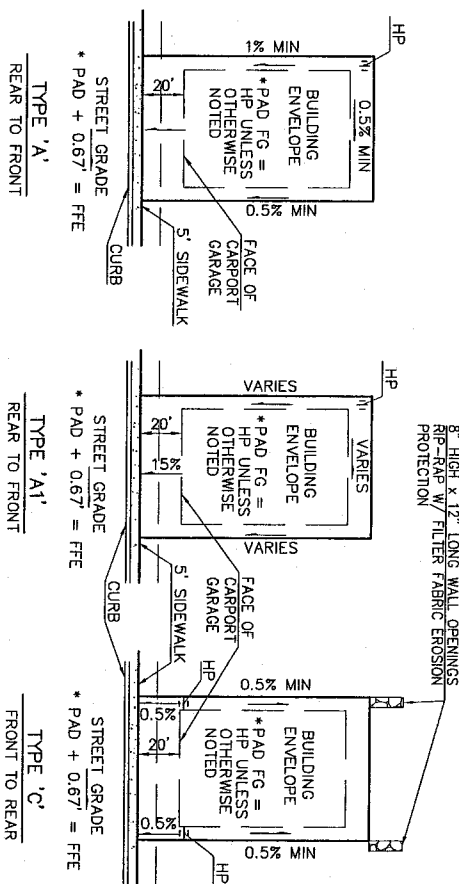
---

| Channel Slope (ft/ft) | Discharge (cfs) | Velocity (ft/s) | Flow Area (ft <sup>2</sup> ) | Wetted Perimeter (ft) | Top Width (ft) |
|-----------------------|-----------------|-----------------|------------------------------|-----------------------|----------------|
| 0.005000              | 40.00           | 3.21            | 12.5                         | 40.01                 | 39.90          |
| 0.007000              | 47.33           | 3.79            | 12.5                         | 40.01                 | 39.90          |
| 0.009000              | 53.67           | 4.30            | 12.5                         | 40.01                 | 39.90          |
| 0.011000              | 59.33           | 4.76            | 12.5                         | 40.01                 | 39.90          |
| 0.013000              | 64.50           | 5.17            | 12.5                         | 40.01                 | 39.90          |
| 0.015000              | 69.28           | 5.55            | 12.5                         | 40.01                 | 39.90          |
| 0.017000              | 73.76           | 5.91            | 12.5                         | 40.01                 | 39.90          |
| 0.019000              | 77.98           | 6.25            | 12.5                         | 40.01                 | 39.90          |
| 0.021000              | 81.98           | 6.57            | 12.5                         | 40.01                 | 39.90          |
| 0.023000              | 85.79           | 6.88            | 12.5                         | 40.01                 | 39.90          |
| 0.025000              | 89.44           | 7.17            | 12.5                         | 40.01                 | 39.90          |
| 0.027000              | 92.95           | 7.45            | 12.5                         | 40.01                 | 39.90          |
| 0.029000              | 96.33           | 7.72            | 12.5                         | 40.01                 | 39.90          |

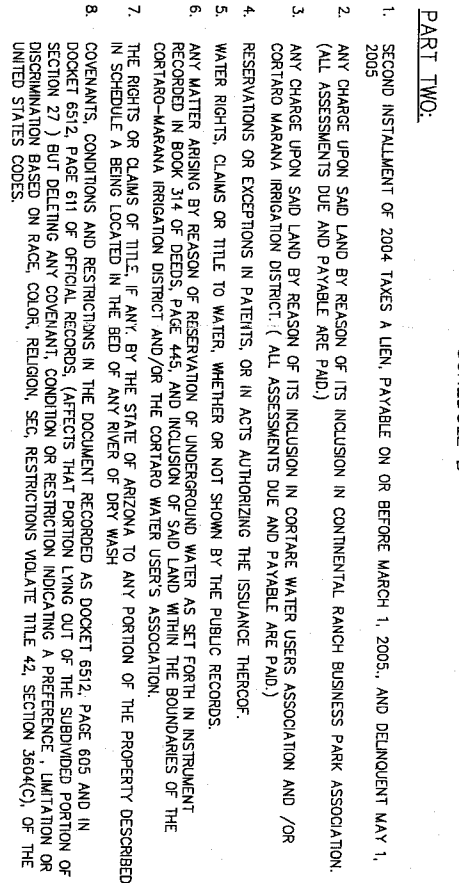
SCHEDULE B

PART TWO:

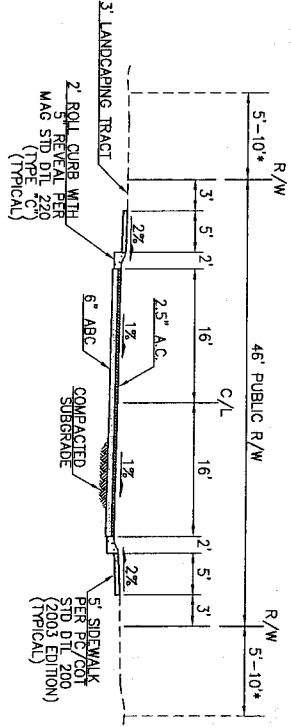
1. SECOND INSTALLMENT OF 2004 TAXES A LIEN, PAYABLE ON OR BEFORE MARCH 1, 2005, AND DELINQUENT MAY 1, 2005.
2. ANY CHARGE UPON SAID LAND BY REASON OF ITS INCLUSION IN CONTINENTAL RANCH BUSINESS PARK ASSOCIATION. (ALL ASSESSMENTS DUE AND PAYABLE ARE PAID.)
3. ANY CHARGE UPON SAID LAND BY REASON OF ITS INCLUSION IN CORTIARO WATER USERS ASSOCIATION AND /OR CORTIARO MARANA IRRIGATION DISTRICT. ( ALL ASSESSMENTS DUE AND PAYABLE ARE PAID.)
4. RESERVATIONS OR EXCEPTIONS IN PATENTS, OR IN ACTS AUTHORIZING THE ISSUANCE THEREOF.
5. WATER RIGHTS, CLAIMS OR TITLE TO WATER, WHETHER OR NOT SHOWN BY THE PUBLIC RECORDS.
6. ANY MATTER ARISING BY REASON OF RESERVATION OF UNDERGROUND WATER AS SET FORTH IN INSTRUMENT RECORDED IN BOOK 314 OF DEEDS, PAGE 445, AND INCLUSION OF SAID LAND WITHIN THE BOUNDARIES OF THE CORTIARO-MARANA IRRIGATION DISTRICT AND/OR THE CORTIARO WATER USER'S ASSOCIATION.
7. THE RIGHTS OR CLAIMS OF TITLE, IF ANY, BY THE STATE OF ARIZONA TO ANY PORTION OF THE PROPERTY DESCRIBED IN SCHEDULE A BEING LOCATED IN THE BED OF ANY RIVER OR DRY WASH.
8. COVENANTS, CONDITIONS AND RESTRICTIONS IN THE DOCUMENT RECORDED AS DOCKET 6512, PAGE 605 AND IN DOCKET 6512, PAGE 611 OF OFFICIAL RECORDS (AFFECTS THAT PORTION LYING OUT OF THE SUBDIVIDED PORTION OF SECTION 27 ) BUT DELETING ANY COVENANT, CONDITION OR RESTRICTION INDICATING A PREFERENCE, LIMITATION OR DISCRIMINATION BASED ON RACE, COLOR, RELIGION, SEC. HANDICAP, FAMILIAL STATUS OR NATIONAL ORIGIN, TO THE EXTENT SUCH COVENANTS, CONDITIONS OR RESTRICTIONS VIOLATE TITLE 42, SECTION 3604(C), OF THE UNITED STATES CODES.
9. COVENANTS, CONDITIONS AND RESTRICTIONS IN THE DOCUMENT RECORDED AS DOCKET 6528, PAGE 790 OF OFFICIAL RECORDS (AFFECTS THAT PORTION LYING OUT OF THE SUBDIVIDED PORTION OF SECTION 27) BUT DELETING ANY COVENANT, CONDITION OR RESTRICTION INDICATING A PREFERENCE, LIMITATION OR DISCRIMINATION BASED ON RACE, COLOR, RELIGION, SEC. HANDICAP, FAMILIAL STATUS OR NATIONAL ORIGIN, TO THE EXTENT SUCH COVENANTS, CONDITIONS OR RESTRICTIONS VIOLATE TITLE 42, SECTION 3604(C), OF THE UNITED STATES CODES.
10. COVENANTS, CONDITIONS AND RESTRICTIONS IN THE DOCUMENT RECORDED AS DOCKET 7724, PAGE 1059, DOCKET 8796, PAGE 1591, DOCKET 9727, PAGE 1958 AND DOCKET 10231, PAGE 113, ASSIGNMENT IN DOCKET 7543, PAGE 101, DOCKET 9301, PAGE 1761, DOCKET 9655, PAGE 1507 AND DOCKET 12041, PAGE 574 OF OFFICIAL RECORDS, BUT DELETING ANY COVENANT, CONDITION OR RESTRICTION INDICATING A PREFERENCE, LIMITATION OR DISCRIMINATION BASED ON RACE, COLOR, RELIGION, SEC. HANDICAP, FAMILIAL STATUS, OR NATIONAL ORIGIN, TO THE EXTENT SUCH COVENANTS, CONDITIONS OR RESTRICTIONS VIOLATE TITLE 42, SECTION 3604(C), OF THE UNITED STATES CODES.
11. COVENANTS, CONDITIONS AND RESTRICTIONS IN THE DOCUMENT RECORDED AS DOCKET 10895, PAGE 282 OF OFFICIAL RECORDS, BUT DELETING ANY COVENANT, CONDITION OR RESTRICTION INDICATING A PREFERENCE, LIMITATION OR DISCRIMINATION BASED ON RACE, COLOR, RELIGION, SEC. HANDICAP, FAMILIAL STATUS, OR NATIONAL ORIGIN, TO THE EXTENT SUCH COVENANTS, CONDITIONS OR RESTRICTIONS VIOLATE TITLE 42, SECTION 3604(C), OF THE UNITED STATES CODES.
12. EASEMENTS, RESTRICTIONS, RESERVATIONS, CONDITIONS AND SET-BACK LINES AS SET FORTH ON THE PLAT RECORDED IN BOOK 1 OF MAPS, PAGE 1 BUT DELETING ANY COVENANT, CONDITION OR RESTRICTION INDICATING A PREFERENCE, LIMITATION OR DISCRIMINATION BASED ON RACE, COLOR, RELIGION, SEC. HANDICAP, FAMILIAL STATUS OR NATIONAL ORIGIN TO THE EXTENT SUCH COVENANTS, CONDITIONS OR RESTRICTIONS VIOLATE 42 USC 3604(C).
13. RELEASE BY SOUTHWEST GAS CORPORATION OF EASEMENTS SET FORTH IN SAID INSTRUMENT RECORDED IN DOCKET 10915, PAGE 531 RELEASE BY TUCSON ELECTRIC POWER COMPANY, AN ARIZONA CORPORATION OF EASEMENTS SET FORTH IN SAID INSTRUMENT RECORDED IN DOCKET 10918, PAGE 2784, RESOLUTION NO. 2000-02 ABANDONING EASEMENTS LOCATED IN PEPPERREE RANCH BUSINESS PARK PLAT, RECORDED IN DOCKET 11209, PAGE 1479, RE-RECORDED IN DOCKET 11580, PAGE 3055, PARTIAL RELEASE OF SEWER EASEMENTS RECORDED IN DOCKET 11555, PAGE 1145.
14. RELEASE BY SOUTHWEST GAS CORPORATION OF EASEMENTS SET FORTH IN SAID INSTRUMENT RECORDED IN DOCKET 10915, PAGE 531 RELEASE BY TUCSON ELECTRIC POWER COMPANY, AN ARIZONA CORPORATION OF EASEMENTS SET FORTH IN SAID INSTRUMENT RECORDED IN DOCKET 10918, PAGE 2784, RESOLUTION NO. 2000-02 ABANDONING EASEMENTS LOCATED IN PEPPERREE RANCH BUSINESS PARK PLAT, RECORDED IN DOCKET 11209, PAGE 1479, RE-RECORDED IN DOCKET 11580, PAGE 3055.
15. LACK OF ACCESS TO INTERSTATE 10 AND GRANT OF ACCESS TO A TWO-WAY FRONTAGE ROAD CONNECTION WITH INTERSTATE HIGHWAY 10 AND CORTIARO INTERCHANGE AS CONTAINED IN ORDER OF CONDEMNATION RECORDED DECEMBER 27, 1956 IN DOCKET 2647, PAGE 20. (BLOCK 2)
16. AGREEMENT BETWEEN PIMA COUNTY, ARIZONA, A BODY POLITIC, AND STEWART TITLE & TRUST OF TUCSON, AS TRUSTEE UNDER TRUST NO. 1746, RECORDED SEPTEMBER 19, 1979, IN DOCKET 6116, PAGE 719.
17. AGREEMENT BY AND BETWEEN PIMA COUNTY, ARIZONA, AND STEWART TITLE & TRUST OF TUCSON, UNDER TRUST NO. 1746, RECORDED NOVEMBER 30, 1979 IN DOCKET 6165, PAGE 1435.
18. AN EASEMENT FOR WATER LINES AND FACILITIES AND INCIDENTAL PURPOSES, RECORDED AS DOCKET 6829, PAGE 980 OF OFFICIAL RECORDS. (BLOCK 2)
19. AGREEMENT BETWEEN UNION ROCK AND MATERIALS CORPORATION AND CORTIARO WATER USER'S ASSOCIATION AND CORTIARO-MARANA IRRIGATION DISTRICT RECORDED OCTOBER 9, 1984 IN DOCKET 7384, PAGE 1103. (AFFECTS THAT PORTION LYING OUT OF THE SUBDIVIDED PORTION OF SECTION 27)
20. ALL MATTERS CONTAINED IN THE GOLF COURSE WATER AGREEMENT BETWEEN CORTIARO WATER USER'S ASSOCIATION, AN ARIZONA NON-FRONT CORPORATION ACTING AS AGENT FOR CORTIARO MARANA IRRIGATION DISTRICT, AND SVP LINKS, L.L.C. AND ARIZONA LIMITED LIABILITY COMPANY, RECORDED IN DOCKET 1066, PAGE 368.
21. ALL MATTERS BY REASON OF THE AGREEMENT FOR WATER SERVICES WITH THE CITY OF TUCSON, AS SET FORTH IN THE INSTRUMENT RECORDED DECEMBER 17, 1998 IN DOCKET 10945, PAGE 1021. (ALL PARCELS)
22. ALL MATTERS BY REASON OF ORDINANCE NO. 9931 BY THE MAYOR AND COUNCIL OF THE TOWN OF MARANA, ARIZONA RECORDED IN DOCKET 11919, PAGE 1175. (BLOCK LAND PORTION BLOCK 2)
23. RESERVATIONS OF EXISTING SEWER, GAS, WATER OR SIMILAR PIPELINES AND APPURTENANCES, CANALS LATERALS OR DITCHES AND APPURTENANCES, ELECTRIC, TELEPHONE AND SIMILAR LINES AND APPURTENANCES IN THE RESOLUTION NO. 2000-02 ABANDONING EASEMENTS LOCATED IN PEPPERREE RANCH BUSINESS PARK PLAT, RECORDED IN DOCKET 11209, PAGE 1479, RE-RECORDED IN DOCKET 11580, PAGE 3055.
24. ALL MATTERS AS SET FORTH IN THE EASEMENT AND COVENANT AND RIGHTS INCIDENT THERETO, IN INSTRUMENT RECORDED IN DOCKET 11577, PAGE 380H.
25. RESOLUTION NO. 2002.01 AMENDING THE CONTINENTAL RANCH SPECIFIC PLAN BY THE MAYOR AND COUNCIL OF THE TOWN OF MARANA, ARIZONA RECORDED IN DOCKET 11742, PAGE 2744.
26. AN EASEMENT FOR ELECTRIC AND COMMUNICATION LINES AND FACILITIES AND INCIDENTAL PURPOSES RECORDED AS DOCKET 11855, PAGE 1278 OF OFFICIAL RECORDS.
27. AN EASEMENT FOR ELECTRIC AND COMMUNICATION LINES AND FACILITIES AND INCIDENTAL PURPOSES, RECORDED AS DOCKET 11995, PAGE 6299 OF OFFICIAL RECORDS.
28. AN EASEMENT FOR ELECTRIC AND COMMUNICATION LINES AND FACILITIES AND INCIDENTAL PURPOSES, RECORDED AS DOCKET 12198, PAGE 754 OF OFFICIAL RECORDS.



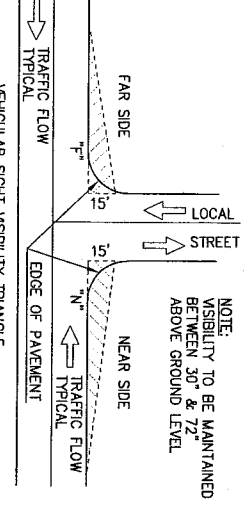
**A** TYPICAL LOT DRAINAGE  
NTS



**D** TYPICAL LOT SETBACKS  
SEE 08:06 OF LAND DEVELOPMENT CODE  
NTS



**B** TYPICAL SUPER ELEVATED STREET SECTION  
NTS



**C** SIGHT VISIBILITY TRIANGLE DETAIL  
NTS

LOCAL STREETS:  $T_s = 190'$   $N_s = 240'$  NTS  
 COCHISE CANYON TRAIL:  $T_s = 470'$   $N_s = 600'$  NTS  
 ADONIS ROAD:  $T_s = 470'$   $N_s = 600'$  NTS

**M M L A**  
 PSOMAS  
 601 E. Wilshire Blvd., Suite 110, Tempe, AZ 85281  
 Tel: (520) 297-2300 (800) 441-5815  
 Fax: (520) 297-1289  
 www.mmla.com  
 MAIL: J08 05082-01-1025

PRELIMINARY PLAT  
 FOR  
**THE PINES PHASE II**  
 S01-024

RES-99-159  
 CG-84-65  
 DATE 11-15-05 SCALE 1"=40' SHEET 9 OF 9

LOTS 1-284 & COMMON AREAS 'A' & 'B'  
 COMMON AREAS USES: 'A' RECREATION AND OPEN SPACE  
 'B' DRAINAGE AND OPEN SPACE  
 BEING A RESUBDIVISION OF A PORTION OF BLOCK 1 AND BLOCK 3  
 OF FINAL BLOCK PLAT, MARANA GOLF, CONTINENTAL RANCH, BK. 58  
 M&P, PG. 15 IN A PORTION OF THE S 1/2 OF SECTION 22, THE NW 1/4  
 OF SECTION 26 AND THE N 1/2 OF SECTION 27, T 12 S, R 12 E,  
 G&SR384M, TOWN OF MARANA, PIMA COUNTY, ARIZONA.



# **SCUPPER DESIGN**



**MMLA**

McGovern MacVittie Lodge & Associates, Inc.

Project Name: Pines II  
 Project Number #: 05082-01 Made by CBR Date 12/1/2005  
 Reference: PC DEV SERV Checked By \_\_\_\_\_ Date \_\_\_\_\_

**PIMA COUNTY SCUPPER DESIGN**

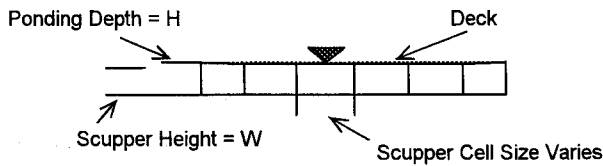
**General Equations**

**Orifice**

$$Q = C_s A H^{1/2}$$

where

- A = Effective Area
- C<sub>s</sub> = Orifice Coefficient 5.35
- C<sub>f</sub> = Clogging Factor 1.00
- H = Depth of ponding in feet
- Q = 100-year Peak Discharge (cfs)



For Sidewalk Scupper

**Solution D1**

**Orifice**

- Q<sub>100</sub> = 34
- C<sub>s</sub> = 5.35
- C<sub>f</sub> = 1.00
- H = 0.75
- A = 7.3

$$A = WL$$

where

- W = Opening Height = 0.500 feet
- L = Effective Length of Opening in feet
- L = 15 feet

| Concentration Point | Q <sub>100</sub> (cfs) | Ponding Depth (ft) | Area (ft <sup>2</sup> ) | Opening Height (ft) | Effective Length (ft) |
|---------------------|------------------------|--------------------|-------------------------|---------------------|-----------------------|
| D1                  | 34                     | 0.75               | 7.3                     | 0.5                 | 15                    |
| D4                  | 20                     | 0.75               | 4.3                     | 0.5                 | 9                     |
| D6                  | 26                     | 0.75               | 5.6                     | 0.5                 | 12                    |
| D10                 | 13                     | 0.75               | 2.8                     | 0.5                 | 6                     |
| D12                 | 15                     | 0.75               | 3.2                     | 0.5                 | 7                     |
| D15                 | 26                     | 0.75               | 5.6                     | 0.5                 | 12                    |
| D17                 | 18                     | 0.75               | 3.9                     | 0.5                 | 8                     |
| D19                 | 17                     | 0.75               | 3.7                     | 0.5                 | 8                     |
| D20                 | 28                     | 0.75               | 6.0                     | 0.5                 | 13                    |

**DEPRESSED CURB DESIGN**





**MMLA**

McGovern MacVittie Lodge & Associates, Inc.

Project Name: Pines II Sheet1  
 Project Number #: 05082-02 Made by CBR Date 12/1/05  
 Reference: COT SMDDFM Checked By \_\_\_\_\_ Date \_\_\_\_\_

**Depressed Curb Calculations**

**General Equation**

$$L = C_f \frac{Q}{C_s Y^{3/2}}$$

where

- L = Length of Opening (ft)
- C<sub>D</sub> = Weir Coefficient = 3 for L>12 2.3 for L<12
- Y = Height of Opening (ft)
- Q = 100-year Peak Discharge (cfs)

**Solution**

For 5-inch Depressed Curb (D3)

- Q = 1 cfs
- C<sub>D</sub> = 2.3
- Y = 0.5 ft
- L = 1 ft

| Concentration Point | Q <sub>100</sub> (cfs) | Opening Height (ft) | Effect. Length (ft) |
|---------------------|------------------------|---------------------|---------------------|
| D3                  | 1                      | 0.5                 | 1                   |
| D9                  | 3                      | 0.5                 | 4                   |
| OS-2                | 1                      | 0.5                 | 1                   |
| OS-4                | 3                      | 0.5                 | 4                   |
| OS-5                | 1                      | 0.5                 | 1                   |
| OS-6                | 1                      | 0.5                 | 1                   |

# **CATCH BASIN DESIGN**



**MMLA**

McGovern MacVittie Lodge & Associates, Inc.

Project Name: Pines II

Project Number #: 05082-01 Made by CBR Date 11/27/2005

Reference: PC DEV SERV Checked By \_\_\_\_\_ Date \_\_\_\_\_

**CATCH BASIN DESIGN**

**General Equations**

**Orifice**

$$Q = C_s A H^{1/2} (C_f^{-1})$$

where

- A = Effective Area
- C<sub>s</sub> = Orifice Coefficient 5.35
- C<sub>f</sub> = Clogging Factor 1.50
- H = Depth of ponding in feet
- Q = 100-year Peak Discharge (cfs)

**Solution CP 1**

Orifice

- Q<sub>100</sub> = 17
- C<sub>s</sub> = 5.35
- C<sub>f</sub> = 1.50
- H = 0.75
- A = 5.5

A=WL

where

- W = Opening Height = 0.417 feet
- L = Effective Length of Opening in feet = 14 feet

| Concentration Point | Q <sub>100</sub> (cfs) | Ponding Depth (ft) | Area (ft <sup>2</sup> ) | Opening Height (ft) | Effective Length (ft) |
|---------------------|------------------------|--------------------|-------------------------|---------------------|-----------------------|
| D14                 | 17                     | 0.75               | 5.5                     | 0.4167              | 14                    |

**CHANNEL DESIGN  
CALCULATIONS**

# Channel Calculations

## CHANNEL 1 – CP OS-1

---

### Project Description

---

|              |                     |
|--------------|---------------------|
| Worksheet    | CP OS-1             |
| Flow Element | Trapezoidal Channel |
| Method       | Manning's Formula   |
| Solve For    | Channel Depth       |

---

### Input Data

---

|                      |                |
|----------------------|----------------|
| Mannings Coefficient | 0.035          |
| Channel Slope        | 0.005000 ft/ft |
| Left Side Slope      | 3.00 H : V     |
| Right Side Slope     | 3.00 H : V     |
| Bottom Width         | 3.00 ft        |
| Discharge            | 44.00 cfs      |

---

### Results

---

|                  |                      |
|------------------|----------------------|
| Depth            | 1.75 ft              |
| Flow Area        | 14.4 ft <sup>2</sup> |
| Wetted Perimeter | 14.06 ft             |
| Top Width        | 13.49 ft             |
| Critical Depth   | 1.27 ft              |
| Critical Slope   | 0.020121 ft/ft       |
| Velocity         | 3.05 ft/s            |
| Velocity Head    | 0.14 ft              |
| Specific Energy  | 1.89 ft              |
| Froude Number    | 0.52                 |
| Flow Type        | Subcritical          |

# Channel Calculations

## CHANNEL 2 - CP D3

---

### Project Description

---

|              |                    |
|--------------|--------------------|
| Worksheet    | D3                 |
| Flow Element | Triangular Channel |
| Method       | Manning's Formula  |
| Solve For    | Channel Depth      |

---

### Input Data

---

|                      |                |
|----------------------|----------------|
| Mannings Coefficient | 0.030          |
| Channel Slope        | 0.005000 ft/ft |
| Left Side Slope      | 12.00 H : V    |
| Right Side Slope     | 12.00 H : V    |
| Discharge            | 1.00 cfs       |

---

### Results

---

|                  |                     |
|------------------|---------------------|
| Depth            | 0.29 ft             |
| Flow Area        | 1.0 ft <sup>2</sup> |
| Wetted Perimeter | 7.06 ft             |
| Top Width        | 7.03 ft             |
| Critical Depth   | 0.21 ft             |
| Critical Slope   | 0.027806 ft/ft      |
| Velocity         | 0.97 ft/s           |
| Velocity Head    | 0.01 ft             |
| Specific Energy  | 0.31 ft             |
| Froude Number    | 0.45                |
| Flow Type        | Subcritical         |

# Channel Calculations

## CHANNEL 3 – CP D2

---

### Project Description

---

|              |                    |
|--------------|--------------------|
| Worksheet    | CP D2              |
| Flow Element | Triangular Channel |
| Method       | Manning's Formula  |
| Solve For    | Channel Depth      |

---

### Input Data

---

|                      |                |
|----------------------|----------------|
| Mannings Coefficient | 0.030          |
| Channel Slope        | 0.010000 ft/ft |
| Left Side Slope      | 6.00 H : V     |
| Right Side Slope     | 6.00 H : V     |
| Discharge            | 66.00 cfs      |

---

### Results

---

|                  |                      |
|------------------|----------------------|
| Depth            | 1.61 ft              |
| Flow Area        | 15.5 ft <sup>2</sup> |
| Wetted Perimeter | 19.58 ft             |
| Top Width        | 19.31 ft             |
| Critical Depth   | 1.50 ft              |
| Critical Slope   | 0.014711 ft/ft       |
| Velocity         | 4.25 ft/s            |
| Velocity Head    | 0.28 ft              |
| Specific Energy  | 1.89 ft              |
| Froude Number    | 0.83                 |
| Flow Type        | Subcritical          |

# Channel Calculations

## CHANNEL 4 - CP D5

---

### Project Description

---

|              |                    |
|--------------|--------------------|
| Worksheet    | D5                 |
| Flow Element | Triangular Channel |
| Method       | Manning's Formula  |
| Solve For    | Channel Depth      |

---

### Input Data

---

|                      |                |
|----------------------|----------------|
| Mannings Coefficient | 0.030          |
| Channel Slope        | 0.010000 ft/ft |
| Left Side Slope      | 12.00 H : V    |
| Right Side Slope     | 12.00 H : V    |
| Discharge            | 18.00 cfs      |

---

### Results

---

|                  |                     |
|------------------|---------------------|
| Depth            | 0.76 ft             |
| Flow Area        | 6.9 ft <sup>2</sup> |
| Wetted Perimeter | 18.31 ft            |
| Top Width        | 18.25 ft            |
| Critical Depth   | 0.67 ft             |
| Critical Slope   | 0.018927 ft/ft      |
| Velocity         | 2.59 ft/s           |
| Velocity Head    | 0.10 ft             |
| Specific Energy  | 0.86 ft             |
| Froude Number    | 0.74                |
| Flow Type        | Subcritical         |



# Channel Calculations

## CHANNEL 5 - CP D7

---

### Project Description

---

|              |                     |
|--------------|---------------------|
| Worksheet    | CP D7               |
| Flow Element | Trapezoidal Channel |
| Method       | Manning's Formula   |
| Solve For    | Channel Depth       |

---

### Input Data

---

|                      |                |
|----------------------|----------------|
| Mannings Coefficient | 0.035          |
| Channel Slope        | 0.010000 ft/ft |
| Left Side Slope      | 3.00 H : V     |
| Right Side Slope     | 3.00 H : V     |
| Bottom Width         | 3.00 ft        |
| Discharge            | 35.00 cfs      |

---

### Results

---

|                  |                     |
|------------------|---------------------|
| Depth            | 1.34 ft             |
| Flow Area        | 9.4 ft <sup>2</sup> |
| Wetted Perimeter | 11.48 ft            |
| Top Width        | 11.04 ft            |
| Critical Depth   | 1.13 ft             |
| Critical Slope   | 0.020760 ft/ft      |
| Velocity         | 3.72 ft/s           |
| Velocity Head    | 0.21 ft             |
| Specific Energy  | 1.56 ft             |
| Froude Number    | 0.71                |
| Flow Type        | Subcritical         |

# Channel Calculations

## CHANNEL 6 - CP D11

---

### Project Description

---

|              |                    |
|--------------|--------------------|
| Worksheet    | D11                |
| Flow Element | Triangular Channel |
| Method       | Manning's Formula  |
| Solve For    | Channel Depth      |

---

### Input Data

---

|                      |                |
|----------------------|----------------|
| Mannings Coefficient | 0.030          |
| Channel Slope        | 0.010000 ft/ft |
| Left Side Slope      | 12.00 H : V    |
| Right Side Slope     | 12.00 H : V    |
| Discharge            | 13.00 cfs      |

---

### Results

---

|                  |                     |
|------------------|---------------------|
| Depth            | 0.67 ft             |
| Flow Area        | 5.4 ft <sup>2</sup> |
| Wetted Perimeter | 16.22 ft            |
| Top Width        | 16.16 ft            |
| Critical Depth   | 0.59 ft             |
| Critical Slope   | 0.019767 ft/ft      |
| Velocity         | 2.39 ft/s           |
| Velocity Head    | 0.09 ft             |
| Specific Energy  | 0.76 ft             |
| Froude Number    | 0.73                |
| Flow Type        | Subcritical         |

# Channel Calculations

## CHANNEL 7 - CP OS-5

---

### Project Description

---

|              |                    |
|--------------|--------------------|
| Worksheet    | CP OS-5            |
| Flow Element | Triangular Channel |
| Method       | Manning's Formula  |
| Solve For    | Channel Depth      |

---

### Input Data

---

|                      |                |
|----------------------|----------------|
| Mannings Coefficient | 0.030          |
| Channel Slope        | 0.005000 ft/ft |
| Left Side Slope      | 12.00 H : V    |
| Right Side Slope     | 12.00 H : V    |
| Discharge            | 1.00 cfs       |

---

### Results

---

|                  |                     |
|------------------|---------------------|
| Depth            | 0.29 ft             |
| Flow Area        | 1.0 ft <sup>2</sup> |
| Wetted Perimeter | 7.06 ft             |
| Top Width        | 7.03 ft             |
| Critical Depth   | 0.21 ft             |
| Critical Slope   | 0.027806 ft/ft      |
| Velocity         | 0.97 ft/s           |
| Velocity Head    | 0.01 ft             |
| Specific Energy  | 0.31 ft             |
| Froude Number    | 0.45                |
| Flow Type        | Subcritical         |

# Channel Calculations

## CHANNEL 8 - CP D13

---

### Project Description

---

|              |                     |
|--------------|---------------------|
| Worksheet    | CP D13              |
| Flow Element | Trapezoidal Channel |
| Method       | Manning's Formula   |
| Solve For    | Channel Depth       |

---

### Input Data

---

|                      |                |
|----------------------|----------------|
| Mannings Coefficient | 0.035          |
| Channel Slope        | 0.010000 ft/ft |
| Left Side Slope      | 3.00 H : V     |
| Right Side Slope     | 3.00 H : V     |
| Bottom Width         | 3.00 ft        |
| Discharge            | 26.00 cfs      |

---

### Results

---

|                  |                     |
|------------------|---------------------|
| Depth            | 1.16 ft             |
| Flow Area        | 7.6 ft <sup>2</sup> |
| Wetted Perimeter | 10.36 ft            |
| Top Width        | 9.98 ft             |
| Critical Depth   | 0.97 ft             |
| Critical Slope   | 0.021619 ft/ft      |
| Velocity         | 3.44 ft/s           |
| Velocity Head    | 0.18 ft             |
| Specific Energy  | 1.35 ft             |
| Froude Number    | 0.70                |
| Flow Type        | Subcritical         |

# Channel Calculations

## CHANNEL 9 - CP D16

---

### Project Description

---

|              |                     |
|--------------|---------------------|
| Worksheet    | CP D16              |
| Flow Element | Trapezoidal Channel |
| Method       | Manning's Formula   |
| Solve For    | Channel Depth       |

---

### Input Data

---

|                      |                |
|----------------------|----------------|
| Mannings Coefficient | 0.035          |
| Channel Slope        | 0.010000 ft/ft |
| Left Side Slope      | 3.00 H : V     |
| Right Side Slope     | 3.00 H : V     |
| Bottom Width         | 3.00 ft        |
| Discharge            | 39.00 cfs      |

---

### Results

---

|                  |                      |
|------------------|----------------------|
| Depth            | 1.41 ft              |
| Flow Area        | 10.2 ft <sup>2</sup> |
| Wetted Perimeter | 11.92 ft             |
| Top Width        | 11.46 ft             |
| Critical Depth   | 1.19 ft              |
| Critical Slope   | 0.020458 ft/ft       |
| Velocity         | 3.83 ft/s            |
| Velocity Head    | 0.23 ft              |
| Specific Energy  | 1.64 ft              |
| Froude Number    | 0.72                 |
| Flow Type        | Subcritical          |

# Channel Calculations

## CHANNEL 10 - CP D17

---

### Project Description

---

|              |                     |
|--------------|---------------------|
| Worksheet    | CP D17              |
| Flow Element | Trapezoidal Channel |
| Method       | Manning's Formula   |
| Solve For    | Channel Depth       |

---

### Input Data

---

|                      |                |
|----------------------|----------------|
| Mannings Coefficient | 0.035          |
| Channel Slope        | 0.010000 ft/ft |
| Left Side Slope      | 3.00 H : V     |
| Right Side Slope     | 3.00 H : V     |
| Bottom Width         | 3.00 ft        |
| Discharge            | 18.00 cfs      |

---

### Results

---

|                  |                     |
|------------------|---------------------|
| Depth            | 0.97 ft             |
| Flow Area        | 5.8 ft <sup>2</sup> |
| Wetted Perimeter | 9.16 ft             |
| Top Width        | 8.84 ft             |
| Critical Depth   | 0.79 ft             |
| Critical Slope   | 0.022746 ft/ft      |
| Velocity         | 3.12 ft/s           |
| Velocity Head    | 0.15 ft             |
| Specific Energy  | 1.13 ft             |
| Froude Number    | 0.68                |
| Flow Type        | Subcritical         |

# Channel Calculations

## CHANNEL 11 - CP D21

---

### Project Description

---

|              |                    |
|--------------|--------------------|
| Worksheet    | D21                |
| Flow Element | Triangular Channel |
| Method       | Manning's Formula  |
| Solve For    | Channel Depth      |

---

### Input Data

---

|                      |                |
|----------------------|----------------|
| Mannings Coefficient | 0.030          |
| Channel Slope        | 0.010000 ft/ft |
| Left Side Slope      | 12.00 H : V    |
| Right Side Slope     | 12.00 H : V    |
| Discharge            | 29.00 cfs      |

---

### Results

---

|                  |                     |
|------------------|---------------------|
| Depth            | 0.91 ft             |
| Flow Area        | 9.9 ft <sup>2</sup> |
| Wetted Perimeter | 21.90 ft            |
| Top Width        | 21.83 ft            |
| Critical Depth   | 0.82 ft             |
| Critical Slope   | 0.017760 ft/ft      |
| Velocity         | 2.92 ft/s           |
| Velocity Head    | 0.13 ft             |
| Specific Energy  | 1.04 ft             |
| Froude Number    | 0.76                |
| Flow Type        | Subcritical         |

# Channel Calculations

## CHANNEL 12 - CP D8

---

### Project Description

---

|              |                     |
|--------------|---------------------|
| Worksheet    | CP D8               |
| Flow Element | Trapezoidal Channel |
| Method       | Manning's Formula   |
| Solve For    | Channel Depth       |

---

### Input Data

---

|                      |                |
|----------------------|----------------|
| Mannings Coefficient | 0.030          |
| Channel Slope        | 0.003900 ft/ft |
| Left Side Slope      | 8.00 H : V     |
| Right Side Slope     | 8.00 H : V     |
| Bottom Width         | 80.00 ft       |
| Discharge            | 1,101.00 cfs   |

---

### Results

---

|                  |                       |
|------------------|-----------------------|
| Depth            | 2.32 ft               |
| Flow Area        | 228.4 ft <sup>2</sup> |
| Wetted Perimeter | 117.37 ft             |
| Top Width        | 117.08 ft             |
| Critical Depth   | 1.70 ft               |
| Critical Slope   | 0.011519 ft/ft        |
| Velocity         | 4.82 ft/s             |
| Velocity Head    | 0.36 ft               |
| Specific Energy  | 2.68 ft               |
| Froude Number    | 0.61                  |
| Flow Type        | Subcritical           |



# Channel Calculations

## CHANNEL 12 - CP D18

---

### Project Description

---

|              |                     |
|--------------|---------------------|
| Worksheet    | CP D18              |
| Flow Element | Trapezoidal Channel |
| Method       | Manning's Formula   |
| Solve For    | Channel Depth       |

---

### Input Data

---

|                      |                |
|----------------------|----------------|
| Mannings Coefficient | 0.030          |
| Channel Slope        | 0.003900 ft/ft |
| Left Side Slope      | 8.00 H : V     |
| Right Side Slope     | 8.00 H : V     |
| Bottom Width         | 80.00 ft       |
| Discharge            | 1,101.00 cfs   |

---

### Results

---

|                  |                       |
|------------------|-----------------------|
| Depth            | 2.32 ft               |
| Flow Area        | 228.4 ft <sup>2</sup> |
| Wetted Perimeter | 117.37 ft             |
| Top Width        | 117.08 ft             |
| Critical Depth   | 1.70 ft               |
| Critical Slope   | 0.011519 ft/ft        |
| Velocity         | 4.82 ft/s             |
| Velocity Head    | 0.36 ft               |
| Specific Energy  | 2.68 ft               |
| Froude Number    | 0.61                  |
| Flow Type        | Subcritical           |

# Channel Calculations

## CHANNEL 12 - CP D22

---

### Project Description

---

|              |                     |
|--------------|---------------------|
| Worksheet    | CP D22              |
| Flow Element | Trapezoidal Channel |
| Method       | Manning's Formula   |
| Solve For    | Channel Depth       |

---

### Input Data

---

|                      |                |
|----------------------|----------------|
| Mannings Coefficient | 0.030          |
| Channel Slope        | 0.003900 ft/ft |
| Left Side Slope      | 8.00 H : V     |
| Right Side Slope     | 8.00 H : V     |
| Bottom Width         | 80.00 ft       |
| Discharge            | 1,101.00 cfs   |

---

### Results

---

|                  |                       |
|------------------|-----------------------|
| Depth            | 2.32 ft               |
| Flow Area        | 228.4 ft <sup>2</sup> |
| Wetted Perimeter | 117.37 ft             |
| Top Width        | 117.08 ft             |
| Critical Depth   | 1.70 ft               |
| Critical Slope   | 0.011519 ft/ft        |
| Velocity         | 4.82 ft/s             |
| Velocity Head    | 0.36 ft               |
| Specific Energy  | 2.68 ft               |
| Froude Number    | 0.61                  |
| Flow Type        | Subcritical           |



**MMLA**

McGovern MacVittie Lodge & Associates, Inc.

Project Name: Pines II Sheet1  
 Project Number #: 05082-78 Made by CBR Date 11/30/05  
 Reference: SMDDFPM Checked By \_\_\_\_\_ Date \_\_\_\_\_

**Calculation of Channel Parameters**

**General Equations:**

**1) Minimum Channel Freeboard**

$$FB = 1/6 \left[ Y + \frac{V^2}{2g} \right] \quad \text{Eq 8.4}$$

Where

- FB = Freeboard (ft)
- Y = Depth of Flow (ft)
- V = average velocity of flow, (fps)
- g = Acceleration due to gravity = 32.2 ft/sec<sup>2</sup>

**2) Minimum Channel Radius**

$$R_c = 3T \quad \text{Froude Number } < 0.86$$

Where

- R<sub>c</sub> = Minimum Radius of Curvature Centerline (ft)
- T = Channel Topwidth at Watersurface (ft)

$$R_c = \frac{4V^2T}{gY} \quad \text{Froude Number } > 0.86 \quad \text{Eq 8.12}$$

Where

- R<sub>c</sub> = Minimum Radius of Curvature Centerline (ft)
- T = Channel Topwidth at Watersurface (ft)
- V = average velocity of flow, (fps)
- Y = Hydraulic Depth of Flow (ft)

| Channel | C.P          | Y<br>(ft) | V<br>(fps) | FB<br>(ft)  | Froude<br>Number | T<br>(ft) | Rc<br>(ft)   |
|---------|--------------|-----------|------------|-------------|------------------|-----------|--------------|
| 1       | OS-1         | 1.75      | 3.05       | <b>0.32</b> | 0.52             | 13.49     | <b>40.47</b> |
| 2       | 3            | 0.29      | 0.97       | <b>0.05</b> | 0.45             | 7.03      | <b>21.09</b> |
| 3       | 2            | 1.61      | 4.25       | <b>0.32</b> | 0.83             | 19.31     | <b>57.93</b> |
| 4       | 5            | 0.76      | 2.59       | <b>0.14</b> | 0.74             | 18.25     | <b>54.75</b> |
| 5       | 7            | 1.34      | 3.72       | <b>0.26</b> | 0.71             | 11.04     | <b>33.12</b> |
| 6       | 11           | 0.67      | 2.39       | <b>0.13</b> | 0.73             | 16.16     | <b>48.48</b> |
| 7       | OS-5         | 0.29      | 0.97       | <b>0.05</b> | 0.45             | 7.03      | <b>21.1</b>  |
| 8       | 13           | 1.16      | 3.44       | <b>0.22</b> | 0.70             | 9.98      | <b>29.9</b>  |
| 9       | 16           | 1.41      | 3.83       | <b>0.27</b> | 0.72             | 11.46     | <b>34.4</b>  |
| 10      | 17           | 0.97      | 3.12       | <b>0.19</b> | 0.68             | 8.84      | <b>26.5</b>  |
| 11      | 21           | 0.91      | 2.92       | <b>0.17</b> | 0.76             | 21.83     | <b>65.5</b>  |
| 12      | D8, D18, D22 | 2.32      | 4.82       | <b>0.45</b> | 0.61             | 117.08    | <b>351.2</b> |

# CULVERT DESIGN

Calculations for Culvert at CP D5

PIPE CULVERT ANALYSIS  
COMPUTATION OF CULVERT PERFORMANCE CURVE

November 27, 2005

=====

PROGRAM INPUT DATA

| DESCRIPTION   | VALUE  |
|---|--------|
| Culvert Diameter (ft).....                              | 2.0    |
| FHWA Chart Number.....                                  | 1      |
| FHWA Scale Number (Type of Culvert Entrance).....       | 1      |
| Manning's Roughness Coefficient (n-value).....          | 0.013  |
| Entrance Loss Coefficient of Culvert Opening.....       | 0.1    |
| Culvert Length (ft).....                                | 65.0   |
| Invert Elevation at Downstream end of Culvert (ft)..... | 100.0  |
| Invert Elevation at Upstream end of Culvert (ft).....   | 100.65 |
| Culvert Slope (ft/ft).....                              | 0.01   |
| Starting Flow Rate (cfs).....                           | 18.0   |
| Incremental Flow Rate (cfs).....                        | 1.0    |
| Ending Flow Rate (cfs).....                             | 18.0   |
| Starting Tailwater Depth (ft).....                      | 1.53   |
| Incremental Tailwater Depth (ft).....                   | 1.0    |
| Ending Tailwater Depth (ft).....                        | 1.53   |

=====

COMPUTATION RESULTS

| Flow Rate (cfs) | Tailwater Depth (ft) | Headwater (ft) Inlet Control | Headwater (ft) Outlet Control | Normal Depth (ft) | Critical Depth (ft) | Depth at Outlet (ft) | Outlet Velocity (fps) |
|-----------------|----------------------|------------------------------|-------------------------------|-------------------|---------------------|----------------------|-----------------------|
| 18.0            | 1.53                 | 2.64                         | 0.0                           | 1.35              | 1.53                | 1.35                 | 7.99                  |

=====

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Phone: (281)440-3787, Fax: (281)440-4742, Email: software@dodson-hydro.com  
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Calculations for Culvert at CP D8

BOX CULVERT ANALYSIS

COMPUTATION OF CULVERT PERFORMANCE CURVE

November 27, 2005

=====

PROGRAM INPUT DATA

| DESCRIPTION   | VALUE  |
|---|--------|
| Culvert Span (ft).....                                  | 10.0   |
| Culvert Rise (ft).....                                  | 4.0    |
| FHWA Chart Number.....                                  | 9      |
| FHWA Scale Number (Type of Culvert Entrance).....       | 1      |
| Manning's Roughness Coefficient (n value).....          | 0.013  |
| Entrance Loss Coefficient of Culvert Opening.....       | 0.2    |
| Culvert Length (ft).....                                | 55.0   |
| Invert Elevation at Downstream end of Culvert (ft)..... | 100.0  |
| Invert Elevation at Upstream end of Culvert (ft).....   | 100.39 |
| Culvert Slope (ft/ft).....                              | 0.0071 |
| Starting Flow Rate (cfs).....                           | 202.0  |
| Incremental Flow Rate (cfs).....                        | 1.0    |
| Ending Flow Rate (cfs).....                             | 202.0  |
| Starting Tailwater Depth (ft).....                      | 2.33   |
| Incremental Tailwater Depth (ft).....                   | 1.0    |
| Ending Tailwater Depth (ft).....                        | 2.33   |

=====

COMPUTATION RESULTS

| Flow Rate<br>(cfs) | Tailwater<br>Depth<br>(ft) | Headwater (ft)<br>Inlet<br>Control | Headwater (ft)<br>Outlet<br>Control | Normal<br>Depth<br>(ft) | Critical<br>Depth<br>(ft) | Depth at<br>Outlet<br>(ft) | Outlet<br>Velocity<br>(fps) |
|--------------------|----------------------------|------------------------------------|-------------------------------------|-------------------------|---------------------------|----------------------------|-----------------------------|
| 202.0              | 2.33                       | 3.78                               | 0.0                                 | 1.76                    | 2.33                      | 1.76                       | 11.48                       |

=====

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Calculations for Culvert at CP D19  
 BOX CULVERT ANALYSIS  
 COMPUTATION OF CULVERT PERFORMANCE CURVE

November 27, 2005

=====

PROGRAM INPUT DATA

| DESCRIPTION   | VALUE  |
|---|--------|
| -----   |        |
| Culvert Span (ft).....                                  | 10.0   |
| Culvert Rise (ft).....                                  | 4.0    |
| FHWA Chart Number.....                                  | 9      |
| FHWA Scale Number (Type of Culvert Entrance).....       | 1      |
| Manning's Roughness Coefficient (n-value).....          | 0.013  |
| Entrance Loss Coefficient of Culvert Opening.....       | 0.2    |
| Culvert Length (ft).....                                | 55.0   |
| Invert Elevation at Downstream end of Culvert (ft)..... | 100.0  |
| Invert Elevation at Upstream end of Culvert (ft).....   | 100.39 |
| Culvert Slope (ft/ft).....                              | 0.0071 |
|   |        |
| Starting Flow Rate (cfs).....                           | 202.0  |
| Incremental Flow Rate (cfs).....                        | 1.0    |
| Ending Flow Rate (cfs).....                             | 202.0  |
|   |        |
| Starting Tailwater Depth (ft).....                      | 2.33   |
| Incremental Tailwater Depth (ft).....                   | 1.0    |
| Ending Tailwater Depth (ft).....                        | 2.33   |

=====

COMPUTATION RESULTS

| Flow Rate<br>(cfs) | Tailwater<br>Depth<br>(ft) | Headwater<br>Inlet<br>Control<br>(ft) | Headwater<br>Outlet<br>Control<br>(ft) | Normal<br>Depth<br>(ft) | Critical<br>Depth<br>(ft) | Depth at<br>Outlet<br>(ft) | Outlet<br>Velocity<br>(fps) |
|--------------------|----------------------------|---------------------------------------|--|-------------------------|---------------------------|----------------------------|-----------------------------|
| 202.0              | 2.33                       | 3.78                                  | 0.0                                    | 1.76                    | 2.33                      | 1.76                       | 11.48                       |

=====

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**SPLASH PAD CALCULATIONS**



Splash Pad Design for CP D1 36" RCP

|           |              |                 |          |
|-----------|--------------|-----------------|----------|
| DISCHARGE | CULVERT DIAM | TAILWATER DEPTH | DURATION |
| 44.00CFS  | 3.00FT       | 1.50FT          | 5.00MIN  |

|               |                 |                 |              |
|---------------|-----------------|-----------------|--------------|
| MAX SCOUR LGT | MAX SCOUR DEPTH | MAX SCOUR WIDTH | SCOUR VOLUME |
| 31.4FT        | 3.8FT           | 14.2FT          | 243.9FT3     |

MAX DEPTH OCCURS 12.6 FT DOWNSTREAM OF THE CULVERT OUTLET

| SCOUR PROFILE |       | SCOUR X-SECT AT LOC MAX DEPTH |       |
|---------------|-------|-------------------------------|-------|
| LENGTH        | DEPTH | DIST FROM CL                  | DEPTH |
| 0.0           | 0.00  | 0.0                           | 3.85  |
| 3.1           | 1.23  | 0.7                           | 3.73  |
| 6.3           | 2.89  | 1.4                           | 3.50  |
| 9.4           | 3.62  | 2.1                           | 3.00  |
| 12.6          | 3.85  | 2.8                           | 1.96  |
| 15.7          | 3.69  | 3.6                           | 0.89  |
| 18.9          | 3.31  | 4.3                           | 0.35  |
| 22.0          | 2.69  | 5.0                           | 0.15  |
| 25.1          | 1.92  | 5.7                           | 0.08  |
| 28.3          | 1.00  | 6.4                           | 0.04  |
| 31.4          | 0.00  | 7.1                           | 0.00  |

STONE DIAM(D50) REQUIRED TO PREVENT SCOUR UNDER ALL TAILWATER CONDITION

==> 5.72 INCHES ON A HORIZONTAL BLANKET 2D50 THICK.

LENGTH OF HORIZONTAL STONE PROTECTION BLANKET REQUIRED TO PREVENT SCOUR

UNDER ALL TAILWATER CONDITIONS = 25.4FT

THE RIPRAP BLANKET SHOULD BE 3 CULVERT DIAMETERS WID E AT THE CULVERT AND

SHOULD BE FLARED 1(NORMAL TO THE CULVE RT CL) ON 2(PARALLEL TO THE CULVERT

CENTERLINE AND HAVE A THICKNESS EQUAL TO 2D50.

IF THE COMPUTED STONE SIZE (D50) IS NOT REALISTIC, IT CAN BE REDUCED BY 38 AND 59 PERCENT IF PREFORMED SCOUR HOLES 0.5 OR 1.0 CULVERT DIAMETER

DEEP, RESPECTIVELY, ARE USED. THE BOTTOM OF THE SCOUR HOLE SHOULD BE 3 CULVERT DIAMETER LONG AND 2 CULVERT DIAMETERS WIDE AND SHOULD BEGIN 1.5 AND 3.0 CULVERT DIAMETERS DOWNSTREAM FROM THE CULVERT EXIT PORTAL FOR SCOUR HOLE DEPTH OF 0.5 AND 1.0 CULVERT DIAMETERS, RESPECTIVELY.

IT SHOULD HAVE 1V TO 3H SIDE SLOPES IN ALL DIRECTIONS AND HAVE A RIP RAP THICKNESS EQUAL TO 2D50.

Splash Pad Design for CP D1 15' Scupper

|               |                 |                 |                 |          |
|---------------|-----------------|-----------------|-----------------|----------|
| DISCHARGE     | CULVERT WIDTH   | HEIGHT          | TAILWATER DEPTH | DURATION |
| 34.00CFS      | 15.00FT         | 0.50FT          | 0.25FT          | 5.00MIN  |
| MAX SCOUR LGT | MAX SCOUR DEPTH | MAX SCOUR WIDTH | SCOUR VOLUME    |          |
| 9.4FT         | 0.9FT           | 5.0FT           | 5.8FT3          |          |

MAX DEPTH OCCURS 3.8 FT DOWNSTREAM OF THE CULVERT OUTLET

| SCOUR PROFILE |       | SCOUR X-SECT AT LOC MAX DEPTH |       |
|---------------|-------|-------------------------------|-------|
| LENGTH        | DEPTH | DIST FROM CL                  | DEPTH |
| 0.0           | 0.00  | 0.0                           | 0.87  |
| 0.9           | 0.28  | 0.3                           | 0.85  |
| 1.9           | 0.65  | 0.5                           | 0.79  |
| 2.8           | 0.82  | 0.8                           | 0.68  |
| 3.8           | 0.87  | 1.0                           | 0.44  |
| 4.7           | 0.84  | 1.3                           | 0.20  |
| 5.6           | 0.75  | 1.5                           | 0.08  |
| 6.6           | 0.61  | 1.8                           | 0.03  |
| 7.5           | 0.44  | 2.0                           | 0.02  |
| 8.4           | 0.23  | 2.3                           | 0.01  |
| 9.4           | 0.00  | 2.5                           | 0.00  |

STONE DIAM(D50) REQUIRED TO PREVENT SCOUR UNDER ALL TAILWATER CONDITION

==> 2.84 INCHES ON A HORIZONTAL BLANKET 2D50 THICK.

LENGTH OF HORIZONTAL STONE PROTECTION BLANKET REQUIRED TO PREVENT SCOUR

UNDER ALL TAILWATER CONDITIONS = 9.6FT

THE RIPRAP BLANKET SHOULD BE 3 CULVERT DIAMETERS WID E AT THE CULVERT AND

SHOULD BE FLARED 1(NORMAL TO THE CULVE RT CL) ON 2(PARALLEL TO THE CULVERT

CENTERLINE AND HAVE A THICKNESS EQUAL TO 2D50.

IF THE COMPUTED STONE SIZE (D50) IS NOT REALISTIC, IT CAN BE REDUCED BY 38 AND 59 PERCENT IF PREFORMED SCOUR HOLES 0.5 OR 1.0 CULVERT DIAMETER

DEEP, RESPECTIVELY, ARE USED. THE BOTTOM OF THE SCOUR HOLE SHOULD BE 3 CULVERT DIAMETER LONG AND 2 CULVERT DIAMETERS WIDE AND SHOULD BEGIN 1.5 AND 3.0 CULVERT DIAMETERS DOWNSTREAM FROM THE CULVERT EXIT PORTAL FOR SCOUR HOLE DEPTH OF 0.5 AND 1.0 CULVERT DIAMETERS, RESPECTIVELY.

IT SHOULD HAVE 1V TO 3H SIDE SLOPES IN ALL DIRECTIONS AND HAVE A RIP RAP THICKNESS EQUAL TO 2D50.

CUL.OUT

Splash Pad Design for CP D2 21' Channel

|               |                 |                 |                     |          |
|---------------|-----------------|-----------------|---------------------|----------|
| DISCHARGE     | CULVERT WIDTH   | HEIGHT          | TAILWATER DEPTH     | DURATION |
| 66.00CFS      | 21.00FT         | 1.75FT          | 1.75FT              | 5.00MIN  |
| MAX SCOUR LGT | MAX SCOUR DEPTH | MAX SCOUR WIDTH | SCOUR VOLUME        |          |
| 10.9FT        | 1.7FT           | 4.2FT           | 11.2FT <sup>3</sup> |          |

MAX DEPTH OCCURS 4.4 FT DOWNSTREAM OF THE CULVERT OUTLET

| SCOUR PROFILE |       | SCOUR X-SECT AT LOC MAX DEPTH |       |
|---------------|-------|-------------------------------|-------|
| LENGTH        | DEPTH | DIST FROM CL                  | DEPTH |
| 0.0           | 0.00  | 0.0                           | 1.71  |
| 1.1           | 0.55  | 0.2                           | 1.65  |
| 2.2           | 1.28  | 0.4                           | 1.55  |
| 3.3           | 1.60  | 0.6                           | 1.33  |
| 4.4           | 1.71  | 0.8                           | 0.87  |
| 5.5           | 1.64  | 1.1                           | 0.39  |
| 6.5           | 1.47  | 1.3                           | 0.15  |
| 7.6           | 1.19  | 1.5                           | 0.07  |
| 8.7           | 0.85  | 1.7                           | 0.03  |
| 9.8           | 0.44  | 1.9                           | 0.02  |
| 10.9          | 0.00  | 2.1                           | 0.00  |

STONE DIAM(D50) REQUIRED TO PREVENT SCOUR UNDER ALL TAILWATER CONDITION  
 ==> 0.63 INCHES ON A HORIZONTAL BLANKET 2D50 THICK.

LENGTH OF HORIZONTAL STONE PROTECTION BLANKET REQUIRED TO PREVENT SCOUR  
 UNDER ALL TAILWATER CONDITIONS = 7.1FT

THE RIPRAP BLANKET SHOULD BE 3 CULVERT DIAMETERS WID E AT THE CULVERT AND  
 SHOULD BE FLARED 1(NORMAL TO THE CULVE RT CL) ON 2(PARALLEL TO THE CULVERT  
 CENTERLINE AND HAVE A THICKNESS EQUAL TO 2D50.

IF THE COMPUTED STONE SIZE (D50) IS NOT REALISTIC, IT CAN BE REDUCED  
 BY 38 AND 59 PERCENT IF PREFORMED SCOUR HOLES 0.5 OR 1.0 CULVERT DIAMETER  
 DEEP, RESPECTIVELY, ARE USED. THE BOTTOM OF THE SCOUR HOLE SHOULD BE  
 3 CULVERT DIAMETER LONG AND 2 CULVERT DIAMETERS WIDE AND SHOULD  
 BEGIN 1.5 AND 3.0 CULVERT DIAMETERS DOWNSTREAM FROM THE CULVERT EXIT  
 PORTAL FOR SCOUR HOLE DEPTH OF 0.5 AND 1.0 CULVERT DIAMETERS, RESPECTIVELY.  
 IT SHOULD HAVE 1V TO 3H SIDE SLOPES IN ALL DIRECTIONS AND HAVE A RIP  
 RAP THICKNESS EQUAL TO 2D50.

Splash Pad Design for CP D4 9' Scupper

|               |                 |                 |                    |          |
|---------------|-----------------|-----------------|--------------------|----------|
| DISCHARGE     | CULVERT WIDTH   | HEIGHT          | TAILWATER DEPTH    | DURATION |
| 20.00CFS      | 9.00FT          | 0.50FT          | 0.25FT             | 5.00MIN  |
| MAX SCOUR LGT | MAX SCOUR DEPTH | MAX SCOUR WIDTH | SCOUR VOLUME       |          |
| 9.2FT         | 0.9FT           | 4.9FT           | 5.6FT <sup>3</sup> |          |

MAX DEPTH OCCURS 3.7 FT DOWNSTREAM OF THE CULVERT OUTLET

| SCOUR PROFILE |       | SCOUR X-SECT AT LOC MAX DEPTH |       |
|---------------|-------|-------------------------------|-------|
| LENGTH        | DEPTH | DIST FROM CL                  | DEPTH |
| 0.0           | 0.00  | 0.0                           | 0.87  |
| 0.9           | 0.28  | 0.2                           | 0.84  |
| 1.8           | 0.65  | 0.5                           | 0.79  |
| 2.8           | 0.81  | 0.7                           | 0.68  |
| 3.7           | 0.87  | 1.0                           | 0.44  |
| 4.6           | 0.83  | 1.2                           | 0.20  |
| 5.5           | 0.74  | 1.5                           | 0.08  |
| 6.5           | 0.61  | 1.7                           | 0.03  |
| 7.4           | 0.43  | 2.0                           | 0.02  |
| 8.3           | 0.23  | 2.2                           | 0.01  |
| 9.2           | 0.00  | 2.5                           | 0.00  |

STONE DIAM(D50) REQUIRED TO PREVENT SCOUR UNDER ALL TAILWATER CONDITION

==> 2.77 INCHES ON A HORIZONTAL BLANKET 2D50 THICK.

LENGTH OF HORIZONTAL STONE PROTECTION BLANKET REQUIRED TO PREVENT SCOUR

UNDER ALL TAILWATER CONDITIONS = 9.4FT

THE RIPRAP BLANKET SHOULD BE 3 CULVERT DIAMETERS WIDE AT THE CULVERT AND

SHOULD BE FLARED 1(NORMAL TO THE CULVERT CL) ON 2(PARALLEL TO THE CULVERT

CENTERLINE AND HAVE A THICKNESS EQUAL TO 2D50.

IF THE COMPUTED STONE SIZE (D50) IS NOT REALISTIC, IT CAN BE REDUCED BY 38 AND 59 PERCENT IF PREFORMED SCOUR HOLES 0.5 OR 1.0 CULVERT DIAMETER

DEEP, RESPECTIVELY, ARE USED. THE BOTTOM OF THE SCOUR HOLE SHOULD BE 3 CULVERT DIAMETER LONG AND 2 CULVERT DIAMETERS WIDE AND SHOULD BEGIN 1.5 AND 3.0 CULVERT DIAMETERS DOWNSTREAM FROM THE CULVERT EXIT PORTAL FOR SCOUR HOLE DEPTH OF 0.5 AND 1.0 CULVERT DIAMETERS, RESPECTIVELY.

IT SHOULD HAVE 1V TO 3H SIDE SLOPES IN ALL DIRECTIONS AND HAVE A RIP RAP THICKNESS EQUAL TO 2D50.

Splash Pad Design for CP D7 11' Channel

|               |                 |                 |                     |          |
|---------------|-----------------|-----------------|---------------------|----------|
| DISCHARGE     | CULVERT WIDTH   | HEIGHT          | TAILWATER DEPTH     | DURATION |
| 35.00CFS      | 11.00FT         | 1.34FT          | 1.34FT              | 5.00MIN  |
| MAX SCOUR LGT | MAX SCOUR DEPTH | MAX SCOUR WIDTH | SCOUR VOLUME        |          |
| 11.2FT        | 1.5FT           | 4.7FT           | 11.5FT <sup>3</sup> |          |

MAX DEPTH OCCURS 4.5 FT DOWNSTREAM OF THE CULVERT OUTLET

| SCOUR PROFILE |       | SCOUR X-SECT AT LOC MAX DEPTH |       |
|---------------|-------|-------------------------------|-------|
| LENGTH        | DEPTH | DIST FROM CL                  | DEPTH |
| 0.0           | 0.00  | 0.0                           | 1.52  |
| 1.1           | 0.49  | 0.2                           | 1.48  |
| 2.2           | 1.14  | 0.5                           | 1.39  |
| 3.4           | 1.43  | 0.7                           | 1.19  |
| 4.5           | 1.52  | 0.9                           | 0.78  |
| 5.6           | 1.46  | 1.2                           | 0.35  |
| 6.7           | 1.31  | 1.4                           | 0.14  |
| 7.8           | 1.07  | 1.7                           | 0.06  |
| 9.0           | 0.76  | 1.9                           | 0.03  |
| 10.1          | 0.40  | 2.1                           | 0.02  |
| 11.2          | 0.00  | 2.4                           | 0.00  |

STONE DIAM(D50) REQUIRED TO PREVENT SCOUR UNDER ALL TAILWATER CONDITION  
 ==> 0.84 INCHES ON A HORIZONTAL BLANKET 2D50 THICK.

LENGTH OF HORIZONTAL STONE PROTECTION BLANKET REQUIRED TO PREVENT SCOUR  
 UNDER ALL TAILWATER CONDITIONS = 8.2FT

THE RIPRAP BLANKET SHOULD BE 3 CULVERT DIAMETERS WID E AT THE CULVERT AND  
 SHOULD BE FLARED 1(NORMAL TO THE CULVE RT CL) ON 2(PARALLEL TO THE CULVERT  
 CENTERLINE AND HAVE A THICKNESS EQUAL TO 2D50.

IF THE COMPUTED STONE SIZE (D50) IS NOT REALISTIC, IT CAN BE REDUCED  
 BY 38 AND 59 PERCENT IF PREFORMED SCOUR HOLES 0.5 OR 1.0 CULVERT DIAMETER  
 DEEP, RESPECTIVELY, ARE USED. THE BOTTOM OF THE SCOUR HOLE SHOULD BE  
 3 CULVERT DIAMETER LONG AND 2 CULVERT DIAMETERS WIDE AND SHOULD  
 BEGIN 1.5 AND 3.0 CULVERT DIAMETERS DOWNSTREAM FROM THE CULVERT EXIT  
 PORTAL FOR SCOUR HOLE DEPTH OF 0.5 AND 1.0 CULVERT DIAMETERS, RESPECTIVELY.  
 IT SHOULD HAVE 1V TO 3H SIDE SLOPES IN ALL DIRECTIONS AND HAVE A RIP  
 RAP THICKNESS EQUAL TO 2D50.

Splash Pad Design for CP D8 5-4x10 RCBC

|               |                 |                 |                 |          |
|---------------|-----------------|-----------------|-----------------|----------|
| DISCHARGE     | CULVERT WIDTH   | HEIGHT          | TAILWATER DEPTH | DURATION |
| 220.00CFS     | 10.00FT         | 4.00FT          | 2.00FT          | 5.00MIN  |
| MAX SCOUR LGT | MAX SCOUR DEPTH | MAX SCOUR WIDTH | SCOUR VOLUME    |          |
| 41.1FT        | 5.1FT           | 18.5FT          | 548.7FT3        |          |

MAX DEPTH OCCURS 16.5 FT DOWNSTREAM OF THE CULVERT OUTLET

| SCOUR PROFILE |       | SCOUR X-SECT AT LOC MAX DEPTH |       |
|---------------|-------|-------------------------------|-------|
| LENGTH        | DEPTH | DIST FROM CL                  | DEPTH |
| 0.0           | 0.00  | 0.0                           | 5.08  |
| 4.1           | 1.63  | 0.9                           | 4.93  |
| 8.2           | 3.81  | 1.9                           | 4.62  |
| 12.3          | 4.78  | 2.8                           | 3.96  |
| 16.5          | 5.08  | 3.7                           | 2.59  |
| 20.6          | 4.88  | 4.6                           | 1.17  |
| 24.7          | 4.37  | 5.6                           | 0.46  |
| 28.8          | 3.56  | 6.5                           | 0.20  |
| 32.9          | 2.54  | 7.4                           | 0.10  |
| 37.0          | 1.32  | 8.3                           | 0.05  |
| 41.1          | 0.00  | 9.3                           | 0.00  |

STONE DIAM(D50) REQUIRED TO PREVENT SCOUR UNDER ALL TAILWATER CONDITION

==> 7.37 INCHES ON A HORIZONTAL BLANKET 2D50 THICK.

LENGTH OF HORIZONTAL STONE PROTECTION BLANKET REQUIRED TO PREVENT SCOUR

UNDER ALL TAILWATER CONDITIONS = 33.0FT

THE RIPRAP BLANKET SHOULD BE 3 CULVERT DIAMETERS WID E AT THE CULVERT AND

SHOULD BE FLARED 1(NORMAL TO THE CULVE RT CL) ON 2(PARALLEL TO THE CULVERT

CENTERLINE AND HAVE A THICKNESS EQUAL TO 2D50.

IF THE COMPUTED STONE SIZE (D50) IS NOT REALISTIC, IT CAN BE REDUCED BY 38 AND 59 PERCENT IF PREFORMED SCOUR HOLES 0.5 OR 1.0 CULVERT DIAMETER

DEEP, RESPECTIVELY, ARE USED. THE BOTTOM OF THE SCOUR HOLE SHOULD BE 3 CULVERT DIAMETER LONG AND 2 CULVERT DIAMETERS WIDE AND SHOULD BEGIN 1.5 AND 3.0 CULVERT DIAMETERS DOWNSTREAM FROM THE CULVERT EXIT PORTAL FOR SCOUR HOLE DEPTH OF 0.5 AND 1.0 CULVERT DIAMETERS, RESPECTIVELY.

IT SHOULD HAVE 1V TO 3H SIDE SLOPES IN ALL DIRECTIONS AND HAVE A RIP RAP THICKNESS EQUAL TO 2D50.

\*\* Note: Discharge of 220 cfs x 5 Cells = 1100 cfs total discharge.

Splash Pad Design for CP D10 13' Scupper

|               |                 |                 |                 |          |
|---------------|-----------------|-----------------|-----------------|----------|
| DISCHARGE     | CULVERT WIDTH   | HEIGHT          | TAILWATER DEPTH | DURATION |
| 13.00CFS      | 13.00FT         | 0.50FT          | 0.25FT          | 5.00MIN  |
| MAX SCOUR LGT | MAX SCOUR DEPTH | MAX SCOUR WIDTH | SCOUR VOLUME    |          |
| 5.2FT         | 0.6FT           | 2.4FT           | 1.1FT3          |          |

MAX DEPTH OCCURS 2.1 FT DOWNSTREAM OF THE CULVERT OUTLET

| SCOUR PROFILE |       | SCOUR X-SECT AT LOC MAX DEPTH |       |
|---------------|-------|-------------------------------|-------|
| LENGTH        | DEPTH | DIST FROM CL                  | DEPTH |
| 0.0           | 0.00  | 0.0                           | 0.64  |
| 0.5           | 0.21  | 0.1                           | 0.62  |
| 1.0           | 0.48  | 0.2                           | 0.58  |
| 1.6           | 0.60  | 0.4                           | 0.50  |
| 2.1           | 0.64  | 0.5                           | 0.33  |
| 2.6           | 0.62  | 0.6                           | 0.15  |
| 3.1           | 0.55  | 0.7                           | 0.06  |
| 3.7           | 0.45  | 0.8                           | 0.03  |
| 4.2           | 0.32  | 0.9                           | 0.01  |
| 4.7           | 0.17  | 1.1                           | 0.01  |
| 5.2           | 0.00  | 1.2                           | 0.00  |

STONE DIAM(D50) REQUIRED TO PREVENT SCOUR UNDER ALL TAILWATER CONDITION

==> 0.96 INCHES ON A HORIZONTAL BLANKET 2D50 THICK.

LENGTH OF HORIZONTAL STONE PROTECTION BLANKET REQUIRED TO PREVENT SCOUR

UNDER ALL TAILWATER CONDITIONS = 4.2FT

THE RIPRAP BLANKET SHOULD BE 3 CULVERT DIAMETERS WIDE AT THE CULVERT AND

SHOULD BE FLARED 1(NORMAL TO THE CULVERT CL) ON 2(PARALLEL TO THE CULVERT

CENTERLINE AND HAVE A THICKNESS EQUAL TO 2D50.

IF THE COMPUTED STONE SIZE (D50) IS NOT REALISTIC, IT CAN BE REDUCED BY 38 AND 59 PERCENT IF PREFORMED SCOUR HOLES 0.5 OR 1.0 CULVERT DIAMETER

DEEP, RESPECTIVELY, ARE USED. THE BOTTOM OF THE SCOUR HOLE SHOULD BE 3 CULVERT DIAMETER LONG AND 2 CULVERT DIAMETERS WIDE AND SHOULD BEGIN 1.5 AND 3.0 CULVERT DIAMETERS DOWNSTREAM FROM THE CULVERT EXIT PORTAL FOR SCOUR HOLE DEPTH OF 0.5 AND 1.0 CULVERT DIAMETERS, RESPECTIVELY.

IT SHOULD HAVE 1V TO 3H SIDE SLOPES IN ALL DIRECTIONS AND HAVE A RIPRAP THICKNESS EQUAL TO 2D50.

CUL.OUT

Splash Pad Design for CP D13 12' Channel

|               |                 |                 |                    |          |
|---------------|-----------------|-----------------|--------------------|----------|
| DISCHARGE     | CULVERT WIDTH   | HEIGHT          | TAILWATER DEPTH    | DURATION |
| 26.00CFS      | 12.00FT         | 1.50FT          | 1.50FT             | 5.00MIN  |
| MAX SCOUR LGT | MAX SCOUR DEPTH | MAX SCOUR WIDTH | SCOUR VOLUME       |          |
| 8.5FT         | 1.4FT           | 3.2FT           | 5.3FT <sup>3</sup> |          |

MAX DEPTH OCCURS 3.4 FT DOWNSTREAM OF THE CULVERT OUTLET

| SCOUR PROFILE |       | SCOUR X-SECT AT LOC MAX DEPTH |       |
|---------------|-------|-------------------------------|-------|
| LENGTH        | DEPTH | DIST FROM CL                  | DEPTH |
| 0.0           | 0.00  | 0.0                           | 1.39  |
| 0.8           | 0.44  | 0.2                           | 1.35  |
| 1.7           | 1.04  | 0.3                           | 1.26  |
| 2.5           | 1.30  | 0.5                           | 1.08  |
| 3.4           | 1.39  | 0.6                           | 0.71  |
| 4.2           | 1.33  | 0.8                           | 0.32  |
| 5.1           | 1.19  | 1.0                           | 0.12  |
| 5.9           | 0.97  | 1.1                           | 0.06  |
| 6.8           | 0.69  | 1.3                           | 0.03  |
| 7.6           | 0.36  | 1.4                           | 0.01  |
| 8.5           | 0.00  | 1.6                           | 0.00  |

STONE DIAM(D50) REQUIRED TO PREVENT SCOUR UNDER ALL TAILWATER CONDITION  
 ==> 0.45 INCHES ON A HORIZONTAL BLANKET 2D50 THICK.

LENGTH OF HORIZONTAL STONE PROTECTION BLANKET REQUIRED TO PREVENT SCOUR  
 UNDER ALL TAILWATER CONDITIONS = 5.3FT

THE RIPRAP BLANKET SHOULD BE 3 CULVERT DIAMETERS WID E AT THE CULVERT AND  
 SHOULD BE FLARED 1(NORMAL TO THE CULVE RT CL) ON 2(PARALLEL TO THE CULVERT  
 CENTERLINE AND HAVE A THICKNESS EQUAL TO 2D50.

IF THE COMPUTED STONE SIZE (D50) IS NOT REALISTIC, IT CAN BE REDUCED  
 BY 38 AND 59 PERCENT IF PREFORMED SCOUR HOLES 0.5 OR 1.0 CULVERT DIAMETER  
 DEEP, RESPECTIVELY, ARE USED. THE BOTTOM OF THE SCOUR HOLE SHOULD BE  
 3 CULVERT DIAMETER LONG AND 2 CULVERT DIAMETERS WIDE AND SHOULD  
 BEGIN 1.5 AND 3.0 CULVERT DIAMETERS DOWNSTREAM FROM THE CULVERT EXIT  
 PORTAL FOR SCOUR HOLE DEPTH OF 0.5 AND 1.0 CULVERT DIAMETERS, RESPECTIVELY.  
 IT SHOULD HAVE 1V TO 3H SIDE SLOPES IN ALL DIRECTIONS AND HAVE A RIP  
 RAP THICKNESS EQUAL TO 2D50.



CUL.OUT

Splash Pad Design for CP D16 13.5' Channel

|               |                 |                 |                    |          |
|---------------|-----------------|-----------------|--------------------|----------|
| DISCHARGE     | CULVERT WIDTH   | HEIGHT          | TAILWATER DEPTH    | DURATION |
| 39.00CFS      | 13.50FT         | 1.75FT          | 1.75FT             | 5.00MIN  |
| MAX SCOUR LGT | MAX SCOUR DEPTH | MAX SCOUR WIDTH | SCOUR VOLUME       |          |
| 10.3FT        | 1.7FT           | 3.9FT           | 9.5FT <sup>3</sup> |          |

MAX DEPTH OCCURS 4.1 FT DOWNSTREAM OF THE CULVERT OUTLET

| SCOUR PROFILE |       | SCOUR X-SECT AT LOC MAX DEPTH |       |
|---------------|-------|-------------------------------|-------|
| LENGTH        | DEPTH | DIST FROM CL                  | DEPTH |
| 0.0           | 0.00  | 0.0                           | 1.65  |
| 1.0           | 0.53  | 0.2                           | 1.60  |
| 2.1           | 1.24  | 0.4                           | 1.50  |
| 3.1           | 1.55  | 0.6                           | 1.29  |
| 4.1           | 1.65  | 0.8                           | 0.84  |
| 5.1           | 1.59  | 1.0                           | 0.38  |
| 6.2           | 1.42  | 1.2                           | 0.15  |
| 7.2           | 1.16  | 1.4                           | 0.07  |
| 8.2           | 0.83  | 1.6                           | 0.03  |
| 9.2           | 0.43  | 1.8                           | 0.02  |
| 10.3          | 0.00  | 2.0                           | 0.00  |

STONE DIAM(D50) REQUIRED TO PREVENT SCOUR UNDER ALL TAILWATER CONDITION  
 ==> 0.56 INCHES ON A HORIZONTAL BLANKET 2D50 THICK.

LENGTH OF HORIZONTAL STONE PROTECTION BLANKET REQUIRED TO PREVENT SCOUR  
 UNDER ALL TAILWATER CONDITIONS = 6.6FT

THE RIPRAP BLANKET SHOULD BE 3 CULVERT DIAMETERS WID E AT THE CULVERT AND  
 SHOULD BE FLARED 1(NORMAL TO THE CULVE RT CL) ON 2(PARALLEL TO THE CULVERT  
 CENTERLINE AND HAVE A THICKNESS EQUAL TO 2D50.

IF THE COMPUTED STONE SIZE (D50) IS NOT REALISTIC, IT CAN BE REDUCED  
 BY 38 AND 59 PERCENT IF PREFORMED SCOUR HOLES 0.5 OR 1.0 CULVERT DIAMETER  
 DEEP, RESPECTIVELY, ARE USED. THE BOTTOM OF THE SCOUR HOLE SHOULD BE  
 3 CULVERT DIAMETER LONG AND 2 CULVERT DIAMETERS WIDE AND SHOULD  
 BEGIN 1.5 AND 3.0 CULVERT DIAMETERS DOWNSTREAM FROM THE CULVERT EXIT  
 PORTAL FOR SCOUR HOLE DEPTH OF 0.5 AND 1.0 CULVERT DIAMETERS, RESPECTIVELY.  
 IT SHOULD HAVE 1V TO 3H SIDE SLOPES IN ALL DIRECTIONS AND HAVE A RIP  
 RAP THICKNESS EQUAL TO 2D50.

Splash Pad Design for CP D17 18' Scupper

|               |                 |                 |                 |          |
|---------------|-----------------|-----------------|-----------------|----------|
| DISCHARGE     | CULVERT WIDTH   | HEIGHT          | TAILWATER DEPTH | DURATION |
| 18.00CFS      | 18.00FT         | 0.50FT          | 0.25FT          | 5.00MIN  |
| MAX SCOUR LGT | MAX SCOUR DEPTH | MAX SCOUR WIDTH | SCOUR VOLUME    |          |
| 5.2FT         | 0.6FT           | 2.4FT           | 1.1FT3          |          |

MAX DEPTH OCCURS 2.1 FT DOWNSTREAM OF THE CULVERT OUTLET

| SCOUR PROFILE |       | SCOUR X-SECT AT LOC MAX DEPTH |       |
|---------------|-------|-------------------------------|-------|
| LENGTH        | DEPTH | DIST FROM CL                  | DEPTH |
| 0.0           | 0.00  | 0.0                           | 0.64  |
| 0.5           | 0.21  | 0.1                           | 0.62  |
| 1.0           | 0.48  | 0.2                           | 0.58  |
| 1.6           | 0.60  | 0.4                           | 0.50  |
| 2.1           | 0.64  | 0.5                           | 0.33  |
| 2.6           | 0.62  | 0.6                           | 0.15  |
| 3.1           | 0.55  | 0.7                           | 0.06  |
| 3.7           | 0.45  | 0.8                           | 0.03  |
| 4.2           | 0.32  | 0.9                           | 0.01  |
| 4.7           | 0.17  | 1.1                           | 0.01  |
| 5.2           | 0.00  | 1.2                           | 0.00  |

STONE DIAM(D50) REQUIRED TO PREVENT SCOUR UNDER ALL TAILWATER CONDITION

==> 0.96 INCHES ON A HORIZONTAL BLANKET 2D50 THICK.

LENGTH OF HORIZONTAL STONE PROTECTION BLANKET REQUIRED TO PREVENT SCOUR

UNDER ALL TAILWATER CONDITIONS = 4.2FT

THE RIPRAP BLANKET SHOULD BE 3 CULVERT DIAMETERS WIDE AT THE CULVERT AND

SHOULD BE FLARED 1(NORMAL TO THE CULVERT CL) ON 2(PARALLEL TO THE CULVERT

CENTERLINE AND HAVE A THICKNESS EQUAL TO 2D50.

IF THE COMPUTED STONE SIZE (D50) IS NOT REALISTIC, IT CAN BE REDUCED BY 38 AND 59 PERCENT IF PREFORMED SCOUR HOLES 0.5 OR 1.0 CULVERT DIAMETER

DEEP, RESPECTIVELY, ARE USED. THE BOTTOM OF THE SCOUR HOLE SHOULD BE 3 CULVERT DIAMETER LONG AND 2 CULVERT DIAMETERS WIDE AND SHOULD BEGIN 1.5 AND 3.0 CULVERT DIAMETERS DOWNSTREAM FROM THE CULVERT EXIT PORTAL FOR SCOUR HOLE DEPTH OF 0.5 AND 1.0 CULVERT DIAMETERS, RESPECTIVELY.

IT SHOULD HAVE 1V TO 3H SIDE SLOPES IN ALL DIRECTIONS AND HAVE A RIP RAP THICKNESS EQUAL TO 2D50.

Splash Pad Design for CP D18 5-4x10 RCBC

|               |                 |                 |                      |          |
|---------------|-----------------|-----------------|----------------------|----------|
| DISCHARGE     | CULVERT WIDTH   | HEIGHT          | TAILWATER DEPTH      | DURATION |
| 220.00CFS     | 10.00FT         | 4.00FT          | 2.00FT               | 5.00MIN  |
| MAX SCOUR LGT | MAX SCOUR DEPTH | MAX SCOUR WIDTH | SCOUR VOLUME         |          |
| 41.1FT        | 5.1FT           | 18.5FT          | 548.7FT <sup>3</sup> |          |

MAX DEPTH OCCURS 16.5 FT DOWNSTREAM OF THE CULVERT OUTLET

| SCOUR PROFILE |       | SCOUR X-SECT AT LOC MAX DEPTH |       |
|---------------|-------|-------------------------------|-------|
| LENGTH        | DEPTH | DIST FROM CL                  | DEPTH |
| 0.0           | 0.00  | 0.0                           | 5.08  |
| 4.1           | 1.63  | 0.9                           | 4.93  |
| 8.2           | 3.81  | 1.9                           | 4.62  |
| 12.3          | 4.78  | 2.8                           | 3.96  |
| 16.5          | 5.08  | 3.7                           | 2.59  |
| 20.6          | 4.88  | 4.6                           | 1.17  |
| 24.7          | 4.37  | 5.6                           | 0.46  |
| 28.8          | 3.56  | 6.5                           | 0.20  |
| 32.9          | 2.54  | 7.4                           | 0.10  |
| 37.0          | 1.32  | 8.3                           | 0.05  |
| 41.1          | 0.00  | 9.3                           | 0.00  |

STONE DIAM(D50) REQUIRED TO PREVENT SCOUR UNDER ALL TAILWATER CONDITION

==> 7.37 INCHES ON A HORIZONTAL BLANKET 2D50 THICK.

LENGTH OF HORIZONTAL STONE PROTECTION BLANKET REQUIRED TO PREVENT SCOUR

UNDER ALL TAILWATER CONDITIONS = 33.0FT

THE RIPRAP BLANKET SHOULD BE 3 CULVERT DIAMETERS WIDE AT THE CULVERT AND

SHOULD BE FLARED 1(NORMAL TO THE CULVERT CL) ON 2(PARALLEL TO THE CULVERT

CENTERLINE AND HAVE A THICKNESS EQUAL TO 2D50.

IF THE COMPUTED STONE SIZE (D50) IS NOT REALISTIC, IT CAN BE REDUCED BY 38 AND 59 PERCENT IF PREFORMED SCOUR HOLES 0.5 OR 1.0 CULVERT DIAMETER

DEEP, RESPECTIVELY, ARE USED. THE BOTTOM OF THE SCOUR HOLE SHOULD BE 3 CULVERT DIAMETER LONG AND 2 CULVERT DIAMETERS WIDE AND SHOULD BEGIN 1.5 AND 3.0 CULVERT DIAMETERS DOWNSTREAM FROM THE CULVERT EXIT PORTAL FOR SCOUR HOLE DEPTH OF 0.5 AND 1.0 CULVERT DIAMETERS, RESPECTIVELY.

IT SHOULD HAVE 1V TO 3H SIDE SLOPES IN ALL DIRECTIONS AND HAVE A RIPRAP THICKNESS EQUAL TO 2D50.

\*\* Note: Discharge of 220 cfs x 5 Cells = 1100 cfs total discharge.

Splash Pad Design for CP D19 17' Scupper

|               |                 |                 |                 |          |
|---------------|-----------------|-----------------|-----------------|----------|
| DISCHARGE     | CULVERT WIDTH   | HEIGHT          | TAILWATER DEPTH | DURATION |
| 17.00CFS      | 17.00FT         | 0.50FT          | 0.25FT          | 5.00MIN  |
| MAX SCOUR LGT | MAX SCOUR DEPTH | MAX SCOUR WIDTH | SCOUR VOLUME    |          |
| 5.2FT         | 0.6FT           | 2.4FT           | 1.1FT3          |          |

MAX DEPTH OCCURS 2.1 FT DOWNSTREAM OF THE CULVERT OUTLET

| SCOUR PROFILE |       | SCOUR X-SECT AT LOC MAX DEPTH |       |
|---------------|-------|-------------------------------|-------|
| LENGTH        | DEPTH | DIST FROM CL                  | DEPTH |
| 0.0           | 0.00  | 0.0                           | 0.64  |
| 0.5           | 0.21  | 0.1                           | 0.62  |
| 1.0           | 0.48  | 0.2                           | 0.58  |
| 1.6           | 0.60  | 0.4                           | 0.50  |
| 2.1           | 0.64  | 0.5                           | 0.33  |
| 2.6           | 0.62  | 0.6                           | 0.15  |
| 3.1           | 0.55  | 0.7                           | 0.06  |
| 3.7           | 0.45  | 0.8                           | 0.03  |
| 4.2           | 0.32  | 0.9                           | 0.01  |
| 4.7           | 0.17  | 1.1                           | 0.01  |
| 5.2           | 0.00  | 1.2                           | 0.00  |

STONE DIAM(D50) REQUIRED TO PREVENT SCOUR UNDER ALL TAILWATER CONDITION

==> 0.96 INCHES ON A HORIZONTAL BLANKET 2D50 THICK.

LENGTH OF HORIZONTAL STONE PROTECTION BLANKET REQUIRED TO PREVENT SCOUR

UNDER ALL TAILWATER CONDITIONS = 4.2FT

THE RIPRAP BLANKET SHOULD BE 3 CULVERT DIAMETERS WIDE AT THE CULVERT AND

SHOULD BE FLARED 1(NORMAL TO THE CULVERT CL) ON 2(PARALLEL TO THE CULVERT

CENTERLINE AND HAVE A THICKNESS EQUAL TO 2D50.

IF THE COMPUTED STONE SIZE (D50) IS NOT REALISTIC, IT CAN BE REDUCED BY 38 AND 59 PERCENT IF PREFORMED SCOUR HOLES 0.5 OR 1.0 CULVERT DIAMETER

DEEP, RESPECTIVELY, ARE USED. THE BOTTOM OF THE SCOUR HOLE SHOULD BE 3 CULVERT DIAMETER LONG AND 2 CULVERT DIAMETERS WIDE AND SHOULD BEGIN 1.5 AND 3.0 CULVERT DIAMETERS DOWNSTREAM FROM THE CULVERT EXIT PORTAL FOR SCOUR HOLE DEPTH OF 0.5 AND 1.0 CULVERT DIAMETERS, RESPECTIVELY.

IT SHOULD HAVE 1V TO 3H SIDE SLOPES IN ALL DIRECTIONS AND HAVE A RIP RAP THICKNESS EQUAL TO 2D50.

Splash Pad Design for CP D20 28' Scupper

|               |                 |                 |                    |          |
|---------------|-----------------|-----------------|--------------------|----------|
| DISCHARGE     | CULVERT WIDTH   | HEIGHT          | TAILWATER DEPTH    | DURATION |
| 28.00CFS      | 28.00FT         | 0.50FT          | 0.25FT             | 5.00MIN  |
| MAX SCOUR LGT | MAX SCOUR DEPTH | MAX SCOUR WIDTH | SCOUR VOLUME       |          |
| 5.2FT         | 0.6FT           | 2.4FT           | 1.1FT <sup>3</sup> |          |

MAX DEPTH OCCURS 2.1 FT DOWNSTREAM OF THE CULVERT OUTLET

| SCOUR PROFILE |       | SCOUR X-SECT AT LOC MAX DEPTH |       |
|---------------|-------|-------------------------------|-------|
| LENGTH        | DEPTH | DIST FROM CL                  | DEPTH |
| 0.0           | 0.00  | 0.0                           | 0.64  |
| 0.5           | 0.21  | 0.1                           | 0.62  |
| 1.0           | 0.48  | 0.2                           | 0.58  |
| 1.6           | 0.60  | 0.4                           | 0.50  |
| 2.1           | 0.64  | 0.5                           | 0.33  |
| 2.6           | 0.62  | 0.6                           | 0.15  |
| 3.1           | 0.55  | 0.7                           | 0.06  |
| 3.7           | 0.45  | 0.8                           | 0.03  |
| 4.2           | 0.32  | 0.9                           | 0.01  |
| 4.7           | 0.17  | 1.1                           | 0.01  |
| 5.2           | 0.00  | 1.2                           | 0.00  |

STONE DIAM(D50) REQUIRED TO PREVENT SCOUR UNDER ALL TAILWATER CONDITION

==> 0.96 INCHES ON A HORIZONTAL BLANKET 2D50 THICK.

LENGTH OF HORIZONTAL STONE PROTECTION BLANKET REQUIRED TO PREVENT SCOUR

UNDER ALL TAILWATER CONDITIONS = 4.2FT

THE RIPRAP BLANKET SHOULD BE 3 CULVERT DIAMETERS WIDE AT THE CULVERT AND

SHOULD BE FLARED 1(NORMAL TO THE CULVERT CL) ON 2(PARALLEL TO THE CULVERT

CENTERLINE AND HAVE A THICKNESS EQUAL TO 2D50.

IF THE COMPUTED STONE SIZE (D50) IS NOT REALISTIC, IT CAN BE REDUCED BY 38 AND 59 PERCENT IF PREFORMED SCOUR HOLES 0.5 OR 1.0 CULVERT DIAMETER

DEEP, RESPECTIVELY, ARE USED. THE BOTTOM OF THE SCOUR HOLE SHOULD BE 3 CULVERT DIAMETER LONG AND 2 CULVERT DIAMETERS WIDE AND SHOULD BEGIN 1.5 AND 3.0 CULVERT DIAMETERS DOWNSTREAM FROM THE CULVERT EXIT PORTAL FOR SCOUR HOLE DEPTH OF 0.5 AND 1.0 CULVERT DIAMETERS, RESPECTIVELY.

IT SHOULD HAVE 1V TO 3H SIDE SLOPES IN ALL DIRECTIONS AND HAVE A RIPRAP THICKNESS EQUAL TO 2D50.

Splash Pad Design for CP D22 125' Channel

|               |                 |                 |                 |          |
|---------------|-----------------|-----------------|-----------------|----------|
| DISCHARGE     | CULVERT WIDTH   | HEIGHT          | TAILWATER DEPTH | DURATION |
| 1101.00CFS    | 125.00FT        | 2.32FT          | 1.16FT          | 5.00MIN  |
| MAX SCOUR LGT | MAX SCOUR DEPTH | MAX SCOUR WIDTH | SCOUR VOLUME    |          |
| 22.2FT        | 2.8FT           | 9.8FT           | 88.0FT3         |          |

MAX DEPTH OCCURS 8.9 FT DOWNSTREAM OF THE CULVERT OUTLET

| SCOUR PROFILE |       | SCOUR X-SECT AT LOC MAX DEPTH |       |
|---------------|-------|-------------------------------|-------|
| LENGTH        | DEPTH | DIST FROM CL                  | DEPTH |
| 0.0           | 0.00  | 0.0                           | 2.84  |
| 2.2           | 0.91  | 0.5                           | 2.76  |
| 4.4           | 2.13  | 1.0                           | 2.58  |
| 6.7           | 2.67  | 1.5                           | 2.22  |
| 8.9           | 2.84  | 2.0                           | 1.45  |
| 11.1          | 2.73  | 2.5                           | 0.65  |
| 13.3          | 2.44  | 2.9                           | 0.26  |
| 15.6          | 1.99  | 3.4                           | 0.11  |
| 17.8          | 1.42  | 3.9                           | 0.06  |
| 20.0          | 0.74  | 4.4                           | 0.03  |
| 22.2          | 0.00  | 4.9                           | 0.00  |

STONE DIAM(D50) REQUIRED TO PREVENT SCOUR UNDER ALL TAILWATER CONDITION

==> 3.75 INCHES ON A HORIZONTAL BLANKET 2D50 THICK.

LENGTH OF HORIZONTAL STONE PROTECTION BLANKET REQUIRED TO PREVENT SCOUR

UNDER ALL TAILWATER CONDITIONS = 17.3FT

THE RIPRAP BLANKET SHOULD BE 3 CULVERT DIAMETERS WID E AT THE CULVERT AND

SHOULD BE FLARED 1(NORMAL TO THE CULVE RT CL) ON 2(PARALLEL TO THE CULVERT

CENTERLINE AND HAVE A THICKNESS EQUAL TO 2D50.

IF THE COMPUTED STONE SIZE (D50) IS NOT REALISTIC, IT CAN BE REDUCED BY 38 AND 59 PERCENT IF PREFORMED SCOUR HOLES 0.5 OR 1.0 CULVERT DIAMETER

DEEP, RESPECTIVELY, ARE USED. THE BOTTOM OF THE SCOUR HOLE SHOULD BE 3 CULVERT DIAMETER LONG AND 2 CULVERT DIAMETERS WIDE AND SHOULD BEGIN 1.5 AND 3.0 CULVERT DIAMETERS DOWNSTREAM FROM THE CULVERT EXIT PORTAL FOR SCOUR HOLE DEPTH OF 0.5 AND 1.0 CULVERT DIAMETERS, RESPECTIVELY.

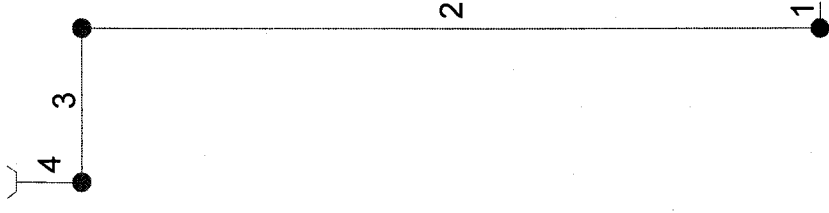
IT SHOULD HAVE 1V TO 3H SIDE SLOPES IN ALL DIRECTIONS AND HAVE A RIP RAP THICKNESS EQUAL TO 2D50.

**PRELIMINARY  
STORM DRAIN CALCULATIONS**

**SYSTEM 1**



# Hydraflow Plan View



# Hydraflow Summary Report

| Line No. | Line ID    | Flow rate (cfs) | Line size (in) | Line length (ft) | Invert EL Dn (ft) | Invert EL Up (ft) | Line slope (%) | HGL down (ft) | HGL up (ft) | Minor loss (ft) | Dns line No. |
|----------|------------|-----------------|----------------|------------------|-------------------|-------------------|----------------|---------------|-------------|-----------------|--------------|
| 1        | CP D1      | 44.00           | 36 c           | 15.0             | 100.00            | 100.08            | 0.533          | 103.00        | 103.06      | 0.51            | End          |
| 2        | MH 1- MH 2 | 44.00           | 36 c           | 305.0            | 100.38            | 101.91            | 0.502          | 103.58        | 104.81      | 0.52            | 1            |
| 3        | MH2 - MH 3 | 44.00           | 36 c           | 89.0             | 102.21            | 102.65            | 0.494          | 105.33*       | 105.72*     | 0.51            | 2            |
| 4        | MH4-OS-1   | 44.00           | 36 c           | 27.0             | 102.95            | 103.09            | 0.519          | 106.23*       | 106.35*     | 0.51            | 3            |

Project File: System 1 - D1 OS-1.stm I-D-F File: New.IDF.IDF

Total No. Lines: 4

Run Date: 11-28-2005

NOTES: c = circular; e = elliptical; b = box; Return period = 100 Yrs.; \* Indicates surcharge condition.

# Hydraflow Hydraulic Grade Line Computations

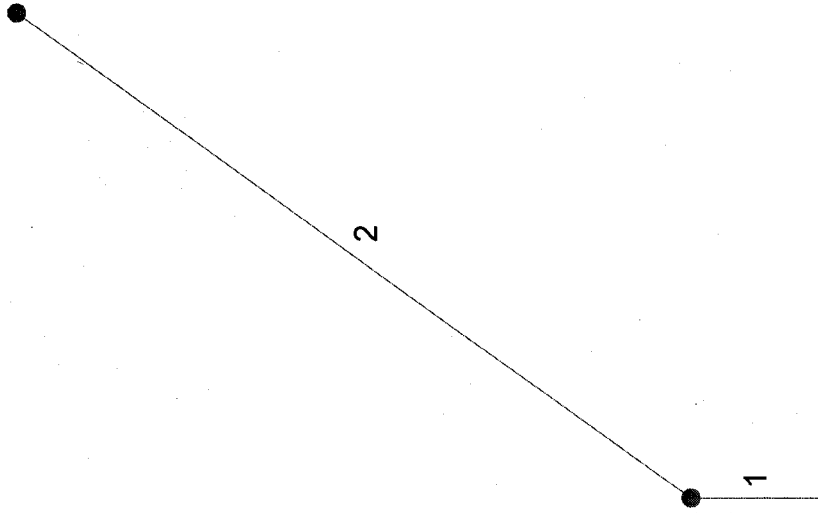
| Line | Size (in) | Q (cfs) | Downstream       |               |            |             |            |               | Len (ft) | Upstream      |        |                  |               |            |             | Check      |               | JL coeff (K) | Minor loss (ft) |               |        |            |                 |
|------|-----------|---------|------------------|---------------|------------|-------------|------------|---------------|----------|---------------|--------|------------------|---------------|------------|-------------|------------|---------------|--------------|-----------------|---------------|--------|------------|-----------------|
|      |           |         | Invert elev (ft) | HGL elev (ft) | Depth (ft) | Area (sqft) | Vel (ft/s) | Vel head (ft) |          | EGL elev (ft) | Sf (%) | Invert elev (ft) | HGL elev (ft) | Depth (ft) | Area (sqft) | Vel (ft/s) | Vel head (ft) |              |                 | EGL elev (ft) | Sf (%) | Ave Sf (%) | Enrgy loss (ft) |
| 1    | 36        | 44.00   | 100.00           | 103.00        | 3.00       | 7.07        | 6.23       | 0.60          | 103.60   | 0.435         | 15.0   | 100.08           | 103.06        | 2.98       | 7.06        | 6.23       | 0.60          | 103.67       | 0.408           | 0.422         | 0.063  | 0.85       | 0.51            |
| 2    | 36        | 44.00   | 100.38           | 103.58        | 3.00       | 7.07        | 6.23       | 0.60          | 104.18   | 0.435         | 305    | 101.91           | 104.81        | 2.90       | 7.00        | 6.29       | 0.62          | 105.42       | 0.381           | 0.408         | 1.246  | 0.85       | 0.52            |
| 3    | 36        | 44.00   | 102.21           | 105.33        | 3.00       | 7.07        | 6.23       | 0.60          | 105.93   | 0.435         | 89.0   | 102.65           | 105.72        | 3.00       | 7.07        | 6.22       | 0.60          | 106.32       | 0.435           | 0.435         | 0.387  | 0.85       | 0.51            |
| 4    | 36        | 44.00   | 102.95           | 106.23        | 3.00       | 7.07        | 6.23       | 0.60          | 106.83   | 0.435         | 27.0   | 103.09           | 106.35        | 3.00       | 7.07        | 6.22       | 0.60          | 106.95       | 0.435           | 0.435         | 0.118  | 0.85       | 0.51            |

Project File: System 1 - D1 OS-1.stm  
 I-D-F File: New.IDF.IDF  
 Total number of lines: 4  
 Run Date: 11-28-2005

NOTES: Initial tailwater elevation = 103 (ft), \* Crown depth assumed., \*\* Critical depth assumed.

**SYSTEM 2**

# Hydraflow Plan View



Project file: New.stm

IDF file: New.IDF.IDF

No. Lines: 2

11-28-2005

# Hydraflow Hydraulic Grade Line Computations

| Line | Size<br>(in) | Q<br>(cfs) | Downstream             |                     |               |                |               |                     |                     |           | Len<br>(ft) | Upstream               |                     |               |                |               |                     |                     |           | Check            |                        | JL<br>coeff<br>(K) | Minor<br>loss<br>(ft) |
|------|--------------|------------|------------------------|---------------------|---------------|----------------|---------------|---------------------|---------------------|-----------|-------------|------------------------|---------------------|---------------|----------------|---------------|---------------------|---------------------|-----------|------------------|------------------------|--------------------|-----------------------|
|      |              |            | Invert<br>elev<br>(ft) | HGL<br>elev<br>(ft) | Depth<br>(ft) | Area<br>(sqft) | Vel<br>(ft/s) | Vel<br>head<br>(ft) | EGL<br>elev<br>(ft) | Sf<br>(%) |             | Invert<br>elev<br>(ft) | HGL<br>elev<br>(ft) | Depth<br>(ft) | Area<br>(sqft) | Vel<br>(ft/s) | Vel<br>head<br>(ft) | EGL<br>elev<br>(ft) | Sf<br>(%) | Ave<br>Sf<br>(%) | Energy<br>loss<br>(ft) |                    |                       |
| 1    | 24           | 13.00      | 100.00                 | 102.00              | 2.00          | 3.14           | 4.14          | 0.27                | 102.27              | 0.331     | 15.0        | 100.08                 | 102.05              | 1.97          | 3.13           | 4.15          | 0.27                | 102.31              | 0.298     | 0.314            | 0.047                  | 0.85               | 0.23                  |
| 2    | 24           | 13.00      | 100.28                 | 102.28              | 2.00*         | 3.14           | 4.14          | 0.27                | 102.55              | 0.331     | 110         | 100.83                 | 102.59              | 1.76          | 2.92           | 4.45          | 0.31                | 102.89              | 0.298     | 0.314            | 0.346                  | 1.00               | 0.31                  |

Project File: New.stm

I-D-F File: New.IDF.IDF

Total number of lines: 2

Run Date: 11-28-2005

NOTES: Initial tailwater elevation = 102 (ft), \* Crown depth assumed., \*\* Critical depth assumed.

# Hydraflow Summary Report

| Line No. | Line ID   | Flow rate (cfs) | Line size (in) | Line length (ft) | Invert EL Dn (ft) | Invert EL Up (ft) | Line slope (%) | HGL down (ft) | HGL up (ft) | Minor loss (ft) | Dns line No. |
|----------|-----------|-----------------|----------------|------------------|-------------------|-------------------|----------------|---------------|-------------|-----------------|--------------|
| 1        | D13 - MH4 | 13.00           | 24 c           | 15.0             | 100.00            | 100.08            | 0.533          | 102.00        | 102.05      | 0.23            | End          |
| 2        | MH4 - D11 | 13.00           | 24 c           | 110.0            | 100.28            | 100.83            | 0.500          | 102.28        | 102.59      | 0.31            | 1            |

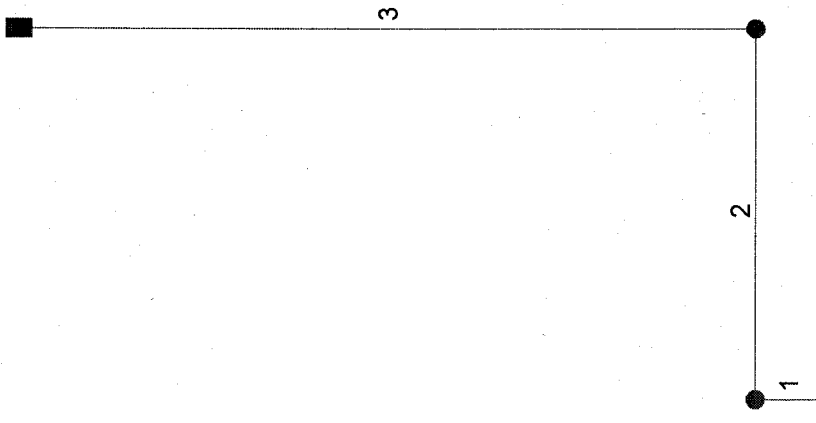
|                       |                         |                    |                      |
|-----------------------|-------------------------|--------------------|----------------------|
| Project File: New.stm | I-D-F File: New.IDF.IDF | Total No. Lines: 2 | Run Date: 11-28-2005 |
|-----------------------|-------------------------|--------------------|----------------------|

NOTES: c = circular; e = elliptical; b = box; Return period = 100 Yrs.; \* Indicates surcharge condition.

**SYSTEM 3**



# Hydraflow Plan View



# Hydraflow Summary Report

| Line No. | Line ID  | Flow rate (cfs) | Line size (in) | Line length (ft) | Invert EL Dn (ft) | Invert EL Up (ft) | Line slope (%) | HGL down (ft) | HGL up (ft) | Minor loss (ft) | Dns line No. |
|----------|----------|-----------------|----------------|------------------|-------------------|-------------------|----------------|---------------|-------------|-----------------|--------------|
| 1        | D16- D14 | 17.00           | 24 c           | 34.0             | 100.00            | 100.17            | 0.500          | 102.00        | 102.17      | 0.39            | End          |
| 2        | MH4- MH5 | 17.00           | 24 c           | 261.0            | 100.47            | 101.78            | 0.502          | 102.56*       | 104.03*     | 0.46            | 1            |
| 3        | MH5-D14  | 17.00           | 24 c           | 372.0            | 102.08            | 103.94            | 0.500          | 104.49*       | 106.59*     | 0.39            | 2            |

Project File: New.stm

I-D-F File: New.IDF.IDF

Total No. Lines: 3

Run Date: 11-28-2005

NOTES: c = circular; e = elliptical; b = box; Return period = 100 Yrs.; \* Indicates surcharge condition.

# Hydraflow Hydraulic Grade Line Computations

| Line | Size<br>(in) | Q<br>(cfs) | Downstream             |                     |               |                |               |                     |                     |           | Len<br>(ft) | Upstream               |                     |               |                |               |                     |                     |           | Check            |                       | JL<br>coeff<br>(K) | Minor<br>loss<br>(ft) |
|------|--------------|------------|------------------------|---------------------|---------------|----------------|---------------|---------------------|---------------------|-----------|-------------|------------------------|---------------------|---------------|----------------|---------------|---------------------|---------------------|-----------|------------------|-----------------------|--------------------|-----------------------|
|      |              |            | Invert<br>elev<br>(ft) | HGL<br>elev<br>(ft) | Depth<br>(ft) | Area<br>(sqft) | Vel<br>(ft/s) | Vel<br>head<br>(ft) | EGL<br>elev<br>(ft) | Sf<br>(%) |             | Invert<br>elev<br>(ft) | HGL<br>elev<br>(ft) | Depth<br>(ft) | Area<br>(sqft) | Vel<br>(ft/s) | Vel<br>head<br>(ft) | EGL<br>elev<br>(ft) | Sf<br>(%) | Ave<br>Sf<br>(%) | Enrgy<br>loss<br>(ft) |                    |                       |
| 1    | 24           | 17.00      | 100.00                 | 102.00              | 2.00          | 3.14           | 5.41          | 0.46                | 102.46              | 0.565     | 34.0        | 100.17                 | 102.17              | 2.00          | 3.14           | 5.41          | 0.46                | 102.62              | 0.555     | 0.560            | 0.190                 | 0.85               | 0.39                  |
| 2    | 24           | 17.00      | 100.47                 | 102.56              | 2.00          | 3.14           | 5.41          | 0.46                | 103.01              | 0.565     | 261         | 101.78                 | 104.03              | 2.00          | 3.14           | 5.41          | 0.46                | 104.49              | 0.565     | 0.565            | 1.475                 | 1.00               | 0.46                  |
| 3    | 24           | 17.00      | 102.08                 | 104.49              | 2.00          | 3.14           | 5.41          | 0.46                | 104.94              | 0.565     | 372         | 103.94                 | 106.59              | 2.00          | 3.14           | 5.41          | 0.46                | 107.04              | 0.565     | 0.565            | 2.102                 | 0.85               | 0.39                  |

Project File: New.stm I-D-F File: New.IDF.IDF Total number of lines: 3 Run Date: 11-28-2005

NOTES: Initial tailwater elevation = 102 (ft), \* Crown depth assumed., \*\* Critical depth assumed.

**HYDRAULIC STRUCTURES  
(EXISTING CONDITIONS)**

TABLE 3 (cont.)  
Existing Culvert Description and Split Flow Conditions for Q100

| Basin/Structure | Station | Description         | Q100<br>(cfs) | WSE<br>(ft) | Existing Conditions (Q100 cfs) |               |                 | Hydraulic<br>Capacity** | Recurrence<br>Interval |
|-----------------|---------|---------------------|---------------|-------------|--------------------------------|---------------|-----------------|-------------------------|------------------------|
|                 |         |                     |               |             | Structure                      | Break<br>Out* | Over-<br>flow** |                         |                        |
| Cortaro Rd.     | 4915+25 | Roadway Interchange | 1430          | 2158.35     | --                             | 404           | 1430            | --                      | 2 yr                   |
| NR5 4905+00     | SPRR    | 1- 9' X 2'          | 4105          | 2157.0      | 190                            | 2565          | 1350            | 150                     | 0 yr                   |
|                 | WBFR    | 3-5.5' X 3.5'       | 1540          | 2155.45     | 355                            | 715           | 715             | 300                     | 2 yr                   |
|                 | I-10    | --                  | 1474          | --          | --                             | 1474          | --              | --                      | --                     |
| NR4 4892+30     | SPRR    | 2- 8' X 2'          | 4065          | 2148.38     | 450                            | 3362          | 253             | 400                     | 0 yr                   |
|                 | WBFR    | 1- 6' X 4'          | 1418          | 2147.54     | 156                            | 959           | 303             | 140                     | 0 yr                   |
|                 | I-10    | --                  | 1933          | --          | --                             | 1933          | --              | --                      | --                     |
| NR3 4880+82     | SPRR    | 2- 14' X 4'         | 4862          | 2144.44     | 1090                           | 3387          | 385             | 1000                    | 2 yr                   |
|                 | WBFR    | 2- 4' X 2'          | 2434          | 2143.37     | 145                            | 796           | 1493            | 100                     | 0 yr                   |
|                 | I-10    | 2- 6' x 3'          | 3571          | 2142.64     | 400                            | 2470          | 701             | 300                     | 0 yr                   |
| NR2 4875+20     | SPRR    | 2- 13' X 4'         | CBC 4887      | 2141.92     | 1246                           | 2548          | 1093            | 1000                    | 2 yr                   |
|                 | WBFR    | --                  | 3135          | 2140.42     | --                             | 1847          | 1288            | --                      | --                     |
|                 | I-10    | --                  | 3758          | --          | --                             | 3758          | --              | --                      | --                     |
| NR1 4868+72     | SPRR    | 2- 14' X 2'         | 4048          | 2138.91     | 670                            | 2905          | 473             | 600                     | 0 yr                   |
|                 | WBFR    | 3- 6' X 3'          | 2990          | 2137.88     | 545                            | 1078          | 1367            | 400                     | 0 yr                   |
|                 | I-10    | 2- 8' X 3'          | 5670          | 2139.02     | 555                            | 3014          | 2101            | 400                     | 0 yr                   |
| CAÑADA AGUA     |         |                     |               |             |                                |               |                 |                         |                        |
| CA8 4848+12     | SPRR    | 1- 9' X 4'          | 10738         | 2132.88     | 482                            | 5123          | 5135            | 380                     | 0 yr                   |
|                 | WBFR    | 3- 6' X 3'          | 6695          | 2129.79     | 605                            | 1195          | 3333            | 450                     | 0 yr                   |
|                 | I-10    | 2- 8' X 3'          | 4357          | 2129.81     | 565                            | 1952          | 1840            | 450                     | 0 yr                   |
| CA7 4833+00     | SPRR    | 2- 8' X 3'          | 3830          | 2125.26     | 580                            | 1220          | 2030            | 520                     | 0 yr                   |
|                 | WBFR    | 3- 8' X 4'          | 3510          | 2123.40     | 880                            | 548           | 2082            | 570                     | 0 yr                   |
|                 | I-10    | 3- 9' X 4'          | 3072          | 2123.44     | 760                            | 1752          | 560             | 650                     | 0 yr                   |
| CA6 4813+00     | SPRR    | 2- 13' x 3'         | 3338          | 2115.61     | 865                            | 2398          | 75              | 800                     | 2 yr                   |
|                 | WBFR    | 2- 8' x 3'          | 1488          | 2112.66     | 432                            | 250           | 806             | 350                     | 2 yr                   |
|                 | I-10    | 2- 8' x 4'          | 1530          | 2111.44     | 545                            | 812           | 173             | 400                     | 2 yr                   |

701  
+ 400  
1101 cfs

2101  
+ 555  
2656 cfs

RESULTS

=====

Entrance Type: SQUARE HEADWALL (RCP)  
Discharge is 26.00 cfs  
1 X 24 " RCP X 50 FT. LONG  
Manning's 'n' 0.012  
Inlet Control HW/D 2.02  
Inlet Control HW 4.04  
Ke 0.50  
H 2.16  
Critical Depth 1.79  
Dc+D/2 1.89  
Tailwater 1.25  
H0 1.89  
L\*S0 0.15  
Outlet HW 3.90

INLET CONTROL GOVERNS HW= 4.04  
Outlet Velocity 8.28 fps

Assume 26 cfs  
Enters from existing  
24" RCP at NR4.

RESULTS

=====

Entrance Type: SQUARE HEADWALL (RCP)  
Discharge is 26.00 cfs  
1 X 24 " RCP X 50 FT. LONG  
Manning's 'n' 0.012  
Inlet Control HW/D 2.02  
Inlet Control HW 4.04  
Ke 0.50  
H 2.16  
Critical Depth 1.79  
Dc+D/2 1.89  
Tailwater 1.25  
H0 1.89  
L\*S0 0.15  
Outlet HW 3.90

INLET CONTROL GOVERNS HW= 4.04  
Outlet Velocity 8.28 fps