

Appendix C – Hydraulic Calculations

- Normal Depth Calculations – Streets
- Normal Depth Calculations – Onsite

Worksheet for EXISTING GC-1 - Grand Canyon Drive 80' ROW (1/2 street) 10 YR

| Project Description | |
|---------------------|-----------------|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

| Input Data | |
|---------------|----------|
| Channel Slope | 4.290 % |
| Discharge | 5.00 cfs |

Section Definitions

| | Station (ft) | Elevation (ft) |
|--|--------------|----------------|
| | 0+06.38 | 2,574.99 |
| | 0+18.47 | 2,574.15 |
| | 0+20.86 | 2,573.96 |
| | 0+25.14 | 2,574.40 |
| | 0+39.47 | 2,574.36 |

Roughness Segment Definitions

| Start Station | Ending Station | Roughness Coefficient |
|---------------------|---------------------|-----------------------|
| (0+06.38, 2,574.99) | (0+25.14, 2,574.40) | 0.025 |
| (0+25.14, 2,574.40) | (0+39.47, 2,574.36) | 0.015 |

| Options | |
|-----------------------------------|---------------------|
| Current Roughness Weighted Method | Pavlovskii's Method |
| Open Channel Weighting Method | Pavlovskii's Method |
| Closed Channel Weighting Method | Pavlovskii's Method |

| Results | |
|-----------------------|-------------------------|
| Normal Depth | 0.34 ft |
| Roughness Coefficient | 0.025 |
| Elevation | 2,574.30 ft |
| Elevation Range | 2,573.96 to 2,574.99 ft |
| Flow Area | 1.3 ft ² |
| Wetted Perimeter | 7.97 ft |
| Hydraulic Radius | 0.17 ft |
| Top Width | 7.94 ft |
| Normal Depth | 0.34 ft |
| Critical Depth | 0.45 ft |
| Critical Slope | 1.918 % |
| Velocity | 3.74 ft/s |
| Velocity Head | 0.22 ft |
| Specific Energy | 0.56 ft |

Worksheet for EXISTING GC-1 - Grand Canyon Drive 80' ROW (1/2 street) 10 YR

| Results | |
|---------------|---------------|
| Froude Number | 1.608 |
| Flow Type | Supercritical |

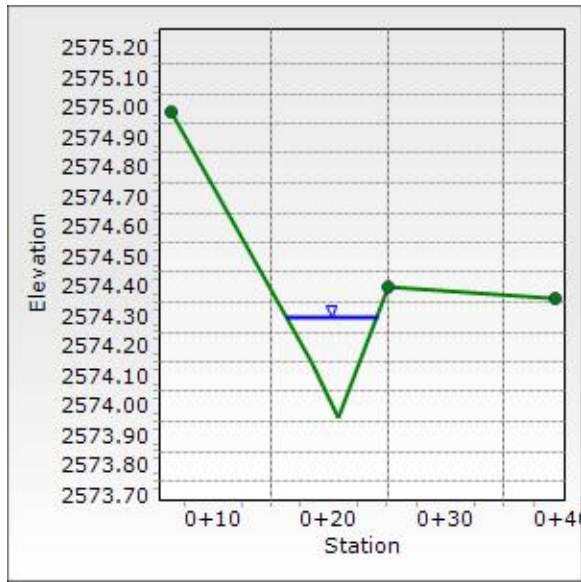
| GVF Input Data | |
|------------------|---------|
| Downstream Depth | 0.00 ft |
| Length | 0.00 ft |
| Number Of Steps | 0 |

| GVF Output Data | |
|---------------------|---------------|
| Upstream Depth | 0.00 ft |
| Profile Description | N/A |
| Profile Headloss | 0.00 ft |
| Downstream Velocity | Infinity ft/s |
| Upstream Velocity | Infinity ft/s |
| Normal Depth | 0.34 ft |
| Critical Depth | 0.45 ft |
| Channel Slope | 4.290 % |
| Critical Slope | 1.918 % |

Cross Section for EXISTING GC-1 - Grand Canyon Drive 80' ROW (1/2 street) 10 YR

| Project Description | |
|---------------------|-----------------|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

| Input Data | |
|---------------|----------|
| Channel Slope | 4.290 % |
| Normal Depth | 0.34 ft |
| Discharge | 5.00 cfs |



Worksheet for EXISTING GC-1 - Grand Canyon Drive 80' ROW (1/2 street) 100 YR

| Project Description | |
|---------------------|-----------------|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

| Input Data | |
|---------------|-----------|
| Channel Slope | 4.290 % |
| Discharge | 18.00 cfs |

Section Definitions

| | Station (ft) | Elevation (ft) |
|--|--------------|----------------|
| | 0+06.38 | 2,574.99 |
| | 0+18.47 | 2,574.15 |
| | 0+20.86 | 2,573.96 |
| | 0+25.14 | 2,574.40 |
| | 0+39.47 | 2,574.36 |

Roughness Segment Definitions

| Start Station | Ending Station | Roughness Coefficient |
|---------------------|---------------------|-----------------------|
| (0+06.38, 2,574.99) | (0+25.14, 2,574.40) | 0.025 |
| (0+25.14, 2,574.40) | (0+39.47, 2,574.36) | 0.015 |

| Options | |
|-----------------------------------|---------------------|
| Current Roughness Weighted Method | Pavlovskii's Method |
| Open Channel Weighting Method | Pavlovskii's Method |
| Closed Channel Weighting Method | Pavlovskii's Method |

| Results | |
|-----------------------|-------------------------|
| Normal Depth | 0.50 ft |
| Roughness Coefficient | 0.020 |
| Elevation | 2,574.46 ft |
| Elevation Range | 2,573.96 to 2,574.99 ft |
| Flow Area | 4.0 ft ² |
| Wetted Perimeter | 25.61 ft |
| Hydraulic Radius | 0.16 ft |
| Top Width | 25.47 ft |
| Normal Depth | 0.50 ft |
| Critical Depth | 0.59 ft |
| Critical Slope | 0.947 % |
| Velocity | 4.47 ft/s |
| Velocity Head | 0.31 ft |
| Specific Energy | 0.81 ft |

Worksheet for EXISTING GC-1 - Grand Canyon Drive 80' ROW (1/2 street) 100 YR

| Results | |
|---------------|---------------|
| Froude Number | 1.984 |
| Flow Type | Supercritical |

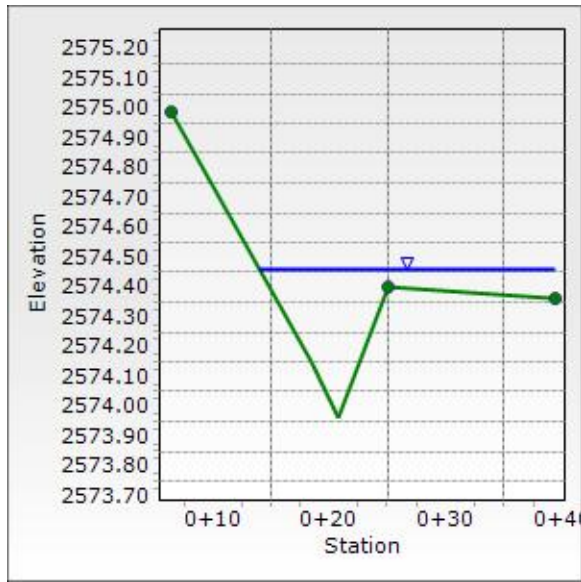
| GVF Input Data | |
|------------------|---------|
| Downstream Depth | 0.00 ft |
| Length | 0.00 ft |
| Number Of Steps | 0 |

| GVF Output Data | |
|---------------------|---------------|
| Upstream Depth | 0.00 ft |
| Profile Description | N/A |
| Profile Headloss | 0.00 ft |
| Downstream Velocity | Infinity ft/s |
| Upstream Velocity | Infinity ft/s |
| Normal Depth | 0.50 ft |
| Critical Depth | 0.59 ft |
| Channel Slope | 4.290 % |
| Critical Slope | 0.947 % |

Cross Section for EXISTING GC-1 - Grand Canyon Drive 80' ROW (1/2 street) 100 YR

| Project Description | |
|---------------------|-----------------|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

| Input Data | |
|---------------|-----------|
| Channel Slope | 4.290 % |
| Normal Depth | 0.50 ft |
| Discharge | 18.00 cfs |



Worksheet for EXISTING GC-3 - Grand Canyon Drive 80' ROW (1/2 street) 100 YR Contained West Side

| Project Description | |
|---------------------|-----------------|
| Friction Method | Manning Formula |
| Solve For | Discharge |

| Input Data | |
|---------------|---------|
| Channel Slope | 3.500 % |
| Normal Depth | 0.20 ft |

Section Definitions

| Station (ft) | Elevation (ft) |
|--------------|----------------|
| 0+21.93 | 2,566.70 |
| 0+26.14 | 2,566.41 |
| 0+30.08 | 2,566.53 |
| 0+31.35 | 2,566.61 |

Roughness Segment Definitions

| Start Station | Ending Station | Roughness Coefficient |
|---------------------|---------------------|-----------------------|
| (0+21.93, 2,566.70) | (0+31.35, 2,566.61) | 0.025 |

| Options | |
|-----------------------------------|---------------------|
| Current Roughness Weighted Method | Pavlovskii's Method |
| Open Channel Weighting Method | Pavlovskii's Method |
| Closed Channel Weighting Method | Pavlovskii's Method |

| Results | |
|-----------------------|-------------------------|
| Discharge | 2.28 cfs |
| Roughness Coefficient | 0.025 |
| Elevation Range | 2,566.41 to 2,566.70 ft |
| Flow Area | 0.9 ft ² |
| Wetted Perimeter | 8.12 ft |
| Hydraulic Radius | 0.11 ft |
| Top Width | 8.11 ft |
| Normal Depth | 0.20 ft |
| Critical Depth | 0.23 ft |
| Critical Slope | 1.806 % |
| Velocity | 2.55 ft/s |
| Velocity Head | 0.10 ft |
| Specific Energy | 0.30 ft |
| Froude Number | 1.356 |
| Flow Type | Supercritical |

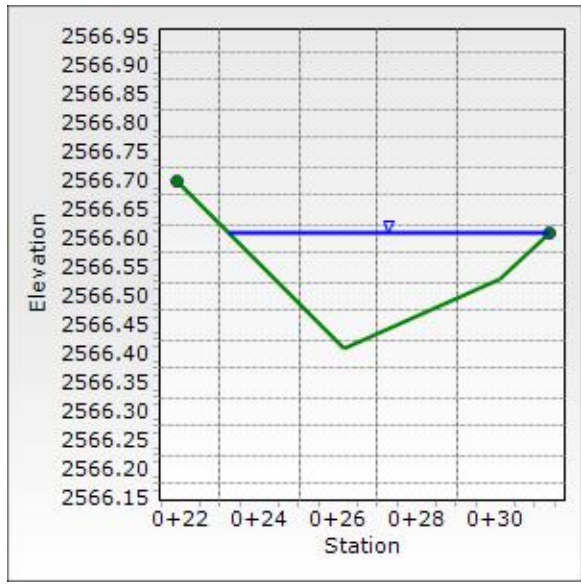
Worksheet for EXISTING GC-3 - Grand Canyon Drive 80' ROW (1/2 street) 100 YR Contained West Side

| GVF Input Data | |
|------------------|---------|
| Downstream Depth | 0.00 ft |
| Length | 0.00 ft |
| Number Of Steps | 0 |

| GVF Output Data | |
|---------------------|---------------|
| Upstream Depth | 0.00 ft |
| Profile Description | N/A |
| Profile Headloss | 0.00 ft |
| Downstream Velocity | Infinity ft/s |
| Upstream Velocity | Infinity ft/s |
| Normal Depth | 0.20 ft |
| Critical Depth | 0.23 ft |
| Channel Slope | 3.500 % |
| Critical Slope | 1.806 % |

Cross Section for EXISTING GC-3 - Grand Canyon Drive 80' ROW (1/2 street) 100 YR Contained West Side

| Project Description | |
|---------------------|-----------------|
| Friction Method | Manning Formula |
| Solve For | Discharge |
| Input Data | |
| Channel Slope | 3.500 % |
| Normal Depth | 0.20 ft |
| Discharge | 2.28 cfs |



Worksheet for GC-1 - Grand Canyon Drive 80' ROW (1/2 street) 10 YR

Project Description

| | |
|-----------------|--------------------|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

Input Data

| | |
|---------------|----------|
| Channel Slope | 3.520 % |
| Discharge | 5.00 cfs |

Section Definitions

| Station (ft) | Elevation (ft) |
|-----------------|-------------------|
| 0+00.00 | 6.60 |
| 0+20.00 | 0.00 |
| 0+29.00 | 0.18 |
| 0+40.00 | 0.40 |

Roughness Segment Definitions

| Start Station | Ending Station | Roughness Coefficient |
|-----------------|-----------------|-----------------------|
| (0+00.00, 6.60) | (0+29.00, 0.18) | 0.025 |
| (0+29.00, 0.18) | (0+40.00, 0.40) | 0.016 |

Options

| | |
|-----------------------------------|---------------------|
| Current Roughness Weighted Method | Pavlovskii's Method |
| Open Channel Weighting Method | Pavlovskii's Method |
| Closed Channel Weighting Method | Pavlovskii's Method |

Results

| | |
|-----------------------|---------------------|
| Normal Depth | 0.25 ft |
| Roughness Coefficient | 0.023 |
| Elevation | 0.25 ft |
| Elevation Range | 0.00 to 6.60 ft |
| Flow Area | 1.7 ft ² |
| Wetted Perimeter | 13.28 ft |
| Hydraulic Radius | 0.12 ft |
| Top Width | 13.24 ft |
| Normal Depth | 0.25 ft |
| Critical Depth | 0.29 ft |
| Critical Slope | 1.464 % |
| Velocity | 3.02 ft/s |
| Velocity Head | 0.14 ft |
| Specific Energy | 0.39 ft |
| Froude Number | 1.509 |
| Flow Type | Supercritical |

Worksheet for GC-1 - Grand Canyon Drive 80' ROW (1/2 street) 10 YR

GVF Input Data

| | |
|------------------|---------|
| Downstream Depth | 0.00 ft |
| Length | 0.00 ft |
| Number Of Steps | 0 |

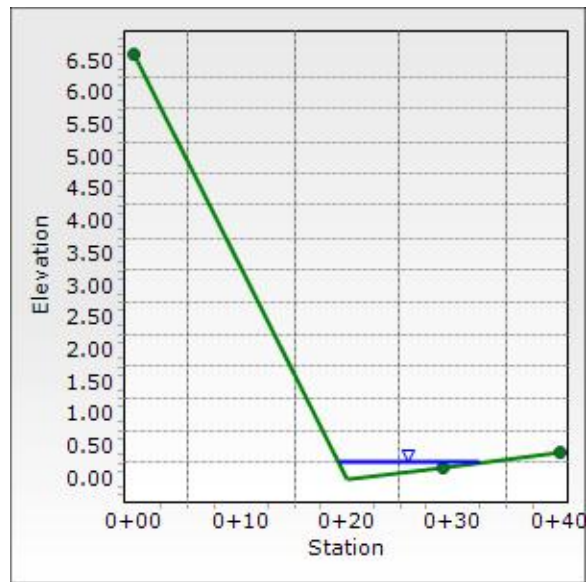
GVF Output Data

| | |
|---------------------|---------------|
| Upstream Depth | 0.00 ft |
| Profile Description | N/A |
| Profile Headloss | 0.00 ft |
| Downstream Velocity | Infinity ft/s |
| Upstream Velocity | Infinity ft/s |
| Normal Depth | 0.25 ft |
| Critical Depth | 0.29 ft |
| Channel Slope | 3.520 % |
| Critical Slope | 1.464 % |

Cross Section for GC-1 - Grand Canyon Drive 80' ROW (1/2 street) 10 YR

| Project Description | |
|---------------------|-----------------|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

| Input Data | |
|---------------|----------|
| Channel Slope | 3.520 % |
| Normal Depth | 0.25 ft |
| Discharge | 5.00 cfs |



Worksheet for GC-1 - Grand Canyon Drive 80' ROW (1/2 street) 100 YR

Project Description

| | |
|-----------------|--------------------|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

Input Data

| | |
|---------------|-----------|
| Channel Slope | 3.520 % |
| Discharge | 19.00 cfs |

Section Definitions

| Station (ft) | Elevation (ft) |
|-----------------|-------------------|
| 0+00.00 | 0.90 |
| 0+14.50 | 0.32 |
| 0+24.00 | 0.51 |
| 0+40.00 | 0.83 |

Roughness Segment Definitions

| Start Station | Ending Station | Roughness Coefficient |
|-----------------|-----------------|-----------------------|
| (0+00.00, 0.90) | (0+24.00, 0.51) | 0.025 |
| (0+24.00, 0.51) | (0+40.00, 0.83) | 0.015 |

Options

| | |
|-----------------------------------|---------------------|
| Current Roughness Weighted Method | Pavlovskii's Method |
| Open Channel Weighting Method | Pavlovskii's Method |
| Closed Channel Weighting Method | Pavlovskii's Method |

Results

| | |
|-----------------------|---------------------|
| Normal Depth | 0.36 ft |
| Roughness Coefficient | 0.022 |
| Elevation | 0.68 ft |
| Elevation Range | 0.32 to 0.90 ft |
| Flow Area | 4.8 ft ² |
| Wetted Perimeter | 26.84 ft |
| Hydraulic Radius | 0.18 ft |
| Top Width | 26.83 ft |
| Normal Depth | 0.36 ft |
| Critical Depth | 0.44 ft |
| Critical Slope | 1.210 % |
| Velocity | 3.96 ft/s |
| Velocity Head | 0.24 ft |
| Specific Energy | 0.60 ft |
| Froude Number | 1.651 |
| Flow Type | Supercritical |

Worksheet for GC-1 - Grand Canyon Drive 80' ROW (1/2 street) 100 YR

GVF Input Data

| | |
|------------------|---------|
| Downstream Depth | 0.00 ft |
| Length | 0.00 ft |
| Number Of Steps | 0 |

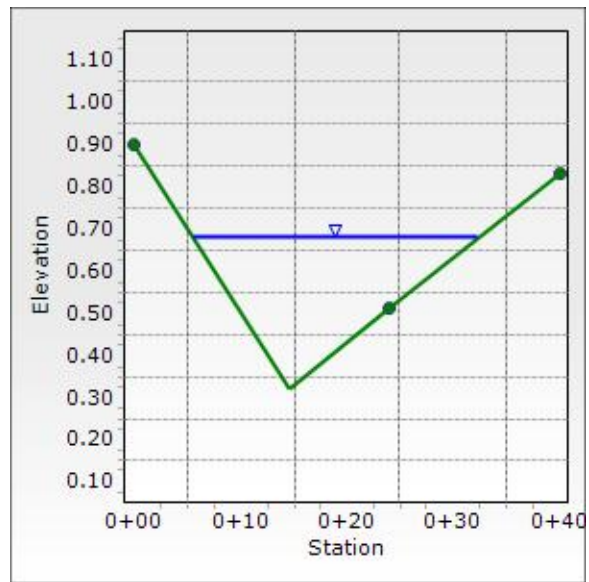
GVF Output Data

| | |
|---------------------|---------------|
| Upstream Depth | 0.00 ft |
| Profile Description | N/A |
| Profile Headloss | 0.00 ft |
| Downstream Velocity | Infinity ft/s |
| Upstream Velocity | Infinity ft/s |
| Normal Depth | 0.36 ft |
| Critical Depth | 0.44 ft |
| Channel Slope | 3.520 % |
| Critical Slope | 1.210 % |

Cross Section for GC-1 - Grand Canyon Drive 80' ROW (1/2 street) 100 YR

| Project Description | |
|---------------------|-----------------|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

| Input Data | |
|---------------|-----------|
| Channel Slope | 3.520 % |
| Normal Depth | 0.36 ft |
| Discharge | 19.00 cfs |



Worksheet for HA4 - Hickam Avenue 60' ROW (1/2 street) 10 YR

| Project Description | |
|---------------------|--------------------|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

| Input Data | |
|---------------|----------|
| Channel Slope | 2.200 % |
| Discharge | 1.00 cfs |

Section Definitions

| | Station (ft) | Elevation (ft) | |
|--|-----------------|-------------------|------|
| | 0+00.00 | | 0.60 |
| | 0+05.00 | | 0.50 |
| | 0+05.50 | | 0.48 |
| | 0+05.50 | | 0.00 |
| | 0+07.00 | | 0.13 |
| | 0+07.00 | | 0.17 |
| | 0+30.00 | | 0.63 |

Roughness Segment Definitions

| Start Station | Ending Station | Roughness Coefficient |
|-----------------|-----------------|-----------------------|
| (0+00.00, 0.60) | (0+30.00, 0.63) | 0.025 |

Options

| | |
|-----------------------------------|------------------------|
| Current Roughness Weighted Method | Pavlovskii's Method |
| Open Channel Weighting Method | Pavlovskii's Method |
| Closed Channel Weighting Method | Pavlovskii's Method |

Results

| | |
|-----------------------|---------------------|
| Normal Depth | 0.28 ft |
| Roughness Coefficient | 0.025 |
| Elevation | 0.28 ft |
| Elevation Range | 0.00 to 0.63 ft |
| Flow Area | 0.6 ft ² |
| Wetted Perimeter | 7.10 ft |
| Hydraulic Radius | 0.08 ft |
| Top Width | 6.78 ft |
| Normal Depth | 0.28 ft |
| Critical Depth | 0.28 ft |
| Critical Slope | 2.200 % |
| Velocity | 1.68 ft/s |
| Velocity Head | 0.04 ft |
| Specific Energy | 0.32 ft |

Worksheet for HA4 - Hickam Avenue 60' ROW (1/2 street) 10 YR

Results

| | |
|---------------|----------|
| Froude Number | 1.002 |
| Flow Type | Critical |

GVF Input Data

| | |
|------------------|---------|
| Downstream Depth | 0.00 ft |
| Length | 0.00 ft |
| Number Of Steps | 0 |

GVF Output Data

| | |
|---------------------|---------------|
| Upstream Depth | 0.00 ft |
| Profile Description | N/A |
| Profile Headloss | 0.00 ft |
| Downstream Velocity | Infinity ft/s |
| Upstream Velocity | Infinity ft/s |
| Normal Depth | 0.28 ft |
| Critical Depth | 0.28 ft |
| Channel Slope | 2.200 % |
| Critical Slope | 2.200 % |

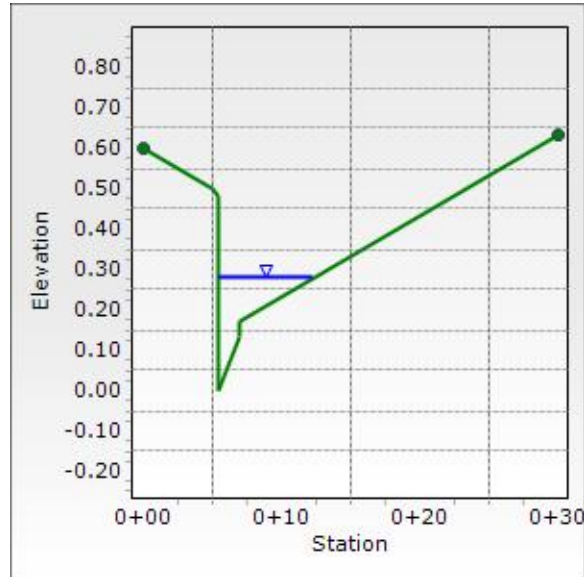
Cross Section for HA4 - Hickam Avenue 60' ROW (1/2 street) 10 YR

Project Description

| | |
|-----------------|--------------------|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

Input Data

| | |
|---------------|----------|
| Channel Slope | 2.200 % |
| Normal Depth | 0.28 ft |
| Discharge | 1.00 cfs |



Worksheet for HA4 - Hickam Avenue 60' ROW (1/2 street) 100 YR

| Project Description | |
|---------------------|--------------------|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

| Input Data | |
|---------------|----------|
| Channel Slope | 2.200 % |
| Discharge | 2.00 cfs |

Section Definitions

| | Station (ft) | Elevation (ft) | |
|--|-----------------|-------------------|------|
| | 0+00.00 | | 0.60 |
| | 0+05.00 | | 0.50 |
| | 0+05.50 | | 0.48 |
| | 0+05.50 | | 0.00 |
| | 0+07.00 | | 0.13 |
| | 0+07.00 | | 0.17 |
| | 0+30.00 | | 0.63 |

Roughness Segment Definitions

| Start Station | Ending Station | Roughness Coefficient |
|-----------------|-----------------|-----------------------|
| (0+00.00, 0.60) | (0+30.00, 0.63) | 0.025 |

Options

| | |
|-----------------------------------|------------------------|
| Current Roughness Weighted Method | Pavlovskii's Method |
| Open Channel Weighting Method | Pavlovskii's Method |
| Closed Channel Weighting Method | Pavlovskii's Method |

Results

| | |
|-----------------------|---------------------|
| Normal Depth | 0.33 ft |
| Roughness Coefficient | 0.025 |
| Elevation | 0.33 ft |
| Elevation Range | 0.00 to 0.63 ft |
| Flow Area | 1.0 ft ² |
| Wetted Perimeter | 9.80 ft |
| Hydraulic Radius | 0.10 ft |
| Top Width | 9.42 ft |
| Normal Depth | 0.33 ft |
| Critical Depth | 0.33 ft |
| Critical Slope | 2.000 % |
| Velocity | 1.96 ft/s |
| Velocity Head | 0.06 ft |
| Specific Energy | 0.39 ft |

Worksheet for HA4 - Hickam Avenue 60' ROW (1/2 street) 100 YR

Results

| | |
|---------------|---------------|
| Froude Number | 1.046 |
| Flow Type | Supercritical |

GVF Input Data

| | |
|------------------|---------|
| Downstream Depth | 0.00 ft |
| Length | 0.00 ft |
| Number Of Steps | 0 |

GVF Output Data

| | |
|---------------------|---------------|
| Upstream Depth | 0.00 ft |
| Profile Description | N/A |
| Profile Headloss | 0.00 ft |
| Downstream Velocity | Infinity ft/s |
| Upstream Velocity | Infinity ft/s |
| Normal Depth | 0.33 ft |
| Critical Depth | 0.33 ft |
| Channel Slope | 2.200 % |
| Critical Slope | 2.000 % |

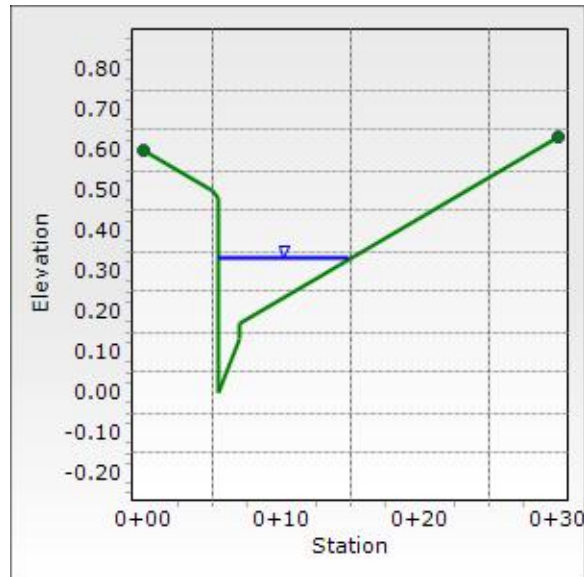
Cross Section for HA4 - Hickam Avenue 60' ROW (1/2 street) 100 YR

Project Description

| | |
|-----------------|--------------------|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

Input Data

| | |
|---------------|----------|
| Channel Slope | 2.200 % |
| Normal Depth | 0.33 ft |
| Discharge | 2.00 cfs |



Worksheet for HA - Hickam Avenue 60' ROW (1/2 street) 10 YR

| Project Description | |
|---------------------|-----------------|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

| Input Data | |
|---------------|----------|
| Channel Slope | 3.040 % |
| Discharge | 2.00 cfs |

Section Definitions

| Station (ft) | Elevation (ft) |
|--------------|----------------|
| 0+00.00 | 0.60 |
| 0+05.00 | 0.50 |
| 0+05.50 | 0.48 |
| 0+05.50 | 0.00 |
| 0+07.00 | 0.13 |
| 0+07.00 | 0.17 |
| 0+30.00 | 0.63 |

Roughness Segment Definitions

| Start Station | Ending Station | Roughness Coefficient |
|-----------------|-----------------|-----------------------|
| (0+00.00, 0.60) | (0+30.00, 0.63) | 0.025 |

Options

| | |
|-----------------------------------|---------------------|
| Current Roughness Weighted Method | Pavlovskii's Method |
| Open Channel Weighting Method | Pavlovskii's Method |
| Closed Channel Weighting Method | Pavlovskii's Method |

Results

| | |
|-----------------------|---------------------|
| Normal Depth | 0.32 ft |
| Roughness Coefficient | 0.025 |
| Elevation | 0.32 ft |
| Elevation Range | 0.00 to 0.63 ft |
| Flow Area | 0.9 ft ² |
| Wetted Perimeter | 9.11 ft |
| Hydraulic Radius | 0.10 ft |
| Top Width | 8.75 ft |
| Normal Depth | 0.32 ft |
| Critical Depth | 0.33 ft |
| Critical Slope | 2.000 % |
| Velocity | 2.22 ft/s |
| Velocity Head | 0.08 ft |
| Specific Energy | 0.39 ft |

Worksheet for HA - Hickam Avenue 60' ROW (1/2 street) 10 YR

Results

| | |
|---------------|---------------|
| Froude Number | 1.220 |
| Flow Type | Supercritical |

GVF Input Data

| | |
|------------------|---------|
| Downstream Depth | 0.00 ft |
| Length | 0.00 ft |
| Number Of Steps | 0 |

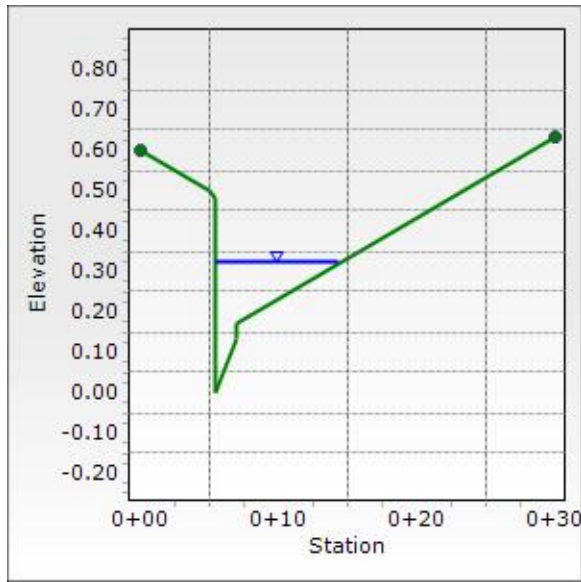
GVF Output Data

| | |
|---------------------|---------------|
| Upstream Depth | 0.00 ft |
| Profile Description | N/A |
| Profile Headloss | 0.00 ft |
| Downstream Velocity | Infinity ft/s |
| Upstream Velocity | Infinity ft/s |
| Normal Depth | 0.32 ft |
| Critical Depth | 0.33 ft |
| Channel Slope | 3.040 % |
| Critical Slope | 2.000 % |

Cross Section for HA - Hickam Avenue 60' ROW (1/2 street) 10 YR

| Project Description | |
|---------------------|-----------------|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

| Input Data | |
|---------------|----------|
| Channel Slope | 3.040 % |
| Normal Depth | 0.32 ft |
| Discharge | 2.00 cfs |



Worksheet for HA - Hickam Avenue 60' ROW (1/2 street) 100 YR

| Project Description | |
|---------------------|-----------------|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

| Input Data | |
|---------------|----------|
| Channel Slope | 3.040 % |
| Discharge | 3.50 cfs |

Section Definitions

| Station (ft) | Elevation (ft) |
|--------------|----------------|
| 0+00.00 | 0.60 |
| 0+05.00 | 0.50 |
| 0+05.50 | 0.48 |
| 0+05.50 | 0.00 |
| 0+07.00 | 0.13 |
| 0+07.00 | 0.17 |
| 0+30.00 | 0.63 |

Roughness Segment Definitions

| Start Station | Ending Station | Roughness Coefficient |
|-----------------|-----------------|-----------------------|
| (0+00.00, 0.60) | (0+30.00, 0.63) | 0.025 |

Options

| | |
|-----------------------------------|---------------------|
| Current Roughness Weighted Method | Pavlovskii's Method |
| Open Channel Weighting Method | Pavlovskii's Method |
| Closed Channel Weighting Method | Pavlovskii's Method |

Results

| | |
|-----------------------|---------------------|
| Normal Depth | 0.36 ft |
| Roughness Coefficient | 0.025 |
| Elevation | 0.36 ft |
| Elevation Range | 0.00 to 0.63 ft |
| Flow Area | 1.4 ft ² |
| Wetted Perimeter | 11.61 ft |
| Hydraulic Radius | 0.12 ft |
| Top Width | 11.20 ft |
| Normal Depth | 0.36 ft |
| Critical Depth | 0.39 ft |
| Critical Slope | 1.858 % |
| Velocity | 2.52 ft/s |
| Velocity Head | 0.10 ft |
| Specific Energy | 0.46 ft |

Worksheet for HA - Hickam Avenue 60' ROW (1/2 street) 100 YR

Results

| | |
|---------------|---------------|
| Froude Number | 1.261 |
| Flow Type | Supercritical |

GVF Input Data

| | |
|------------------|---------|
| Downstream Depth | 0.00 ft |
| Length | 0.00 ft |
| Number Of Steps | 0 |

GVF Output Data

| | |
|---------------------|---------------|
| Upstream Depth | 0.00 ft |
| Profile Description | N/A |
| Profile Headloss | 0.00 ft |
| Downstream Velocity | Infinity ft/s |
| Upstream Velocity | Infinity ft/s |
| Normal Depth | 0.36 ft |
| Critical Depth | 0.39 ft |
| Channel Slope | 3.040 % |
| Critical Slope | 1.858 % |

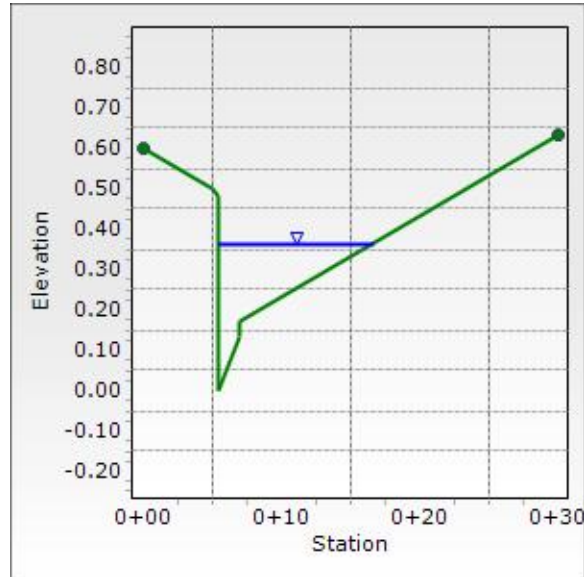
Cross Section for HA - Hickam Avenue 60' ROW (1/2 street) 100 YR

Project Description

| | |
|-----------------|--------------------|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

Input Data

| | |
|---------------|----------|
| Channel Slope | 3.040 % |
| Normal Depth | 0.36 ft |
| Discharge | 3.50 cfs |



Worksheet for OFF2 - Tee Pee Lane 60 ROW (1/2 street) 10 YR

| Project Description | |
|---------------------|--------------------|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

| Input Data | |
|---------------|----------|
| Channel Slope | 1.600 % |
| Discharge | 4.00 cfs |

Section Definitions

| | Station (ft) | Elevation (ft) |
|--|-----------------|-------------------|
| | 0+00.00 | 2,550.93 |
| | 0+17.58 | 2,549.09 |
| | 0+25.55 | 2,549.88 |
| | 0+38.37 | 2,550.09 |

Roughness Segment Definitions

| Start Station | Ending Station | Roughness Coefficient |
|---------------------|---------------------|-----------------------|
| (0+00.00, 2,550.93) | (0+25.55, 2,549.88) | 0.025 |
| (0+25.55, 2,549.88) | (0+38.37, 2,550.09) | 0.016 |

| Options | |
|-----------------------------------|------------------------|
| Current Roughness Weighted Method | Pavlovskii's Method |
| Open Channel Weighting Method | Pavlovskii's Method |
| Closed Channel Weighting Method | Pavlovskii's Method |

| Results | |
|-----------------------|----------------------------|
| Normal Depth | 0.40 ft |
| Roughness Coefficient | 0.025 |
| Elevation | 2,549.49 ft |
| Elevation Range | 2,549.09 to 2,550.93 ft |
| Flow Area | 1.6 ft ² |
| Wetted Perimeter | 7.88 ft |
| Hydraulic Radius | 0.20 ft |
| Top Width | 7.84 ft |
| Normal Depth | 0.40 ft |
| Critical Depth | 0.40 ft |
| Critical Slope | 1.568 % |
| Velocity | 2.56 ft/s |
| Velocity Head | 0.10 ft |
| Specific Energy | 0.50 ft |
| Froude Number | 1.010 |
| Flow Type | Supercritical |

Worksheet for OFF2 - Tee Pee Lane 60 ROW (1/2 street) 10 YR

GVF Input Data

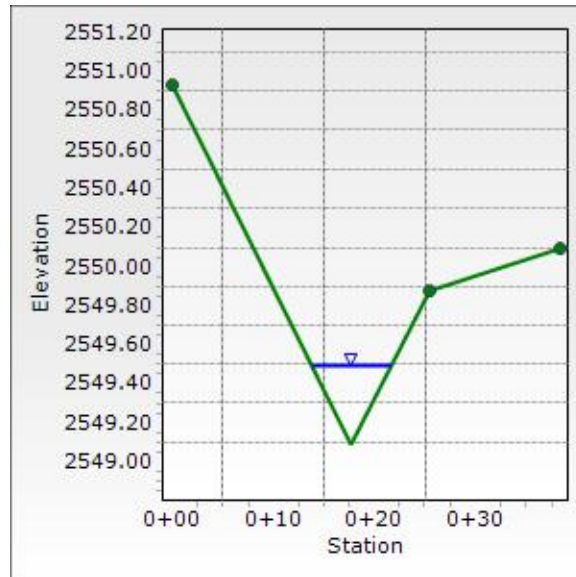
| | |
|------------------|---------|
| Downstream Depth | 0.00 ft |
| Length | 0.00 ft |
| Number Of Steps | 0 |

GVF Output Data

| | |
|---------------------|---------------|
| Upstream Depth | 0.00 ft |
| Profile Description | N/A |
| Profile Headloss | 0.00 ft |
| Downstream Velocity | Infinity ft/s |
| Upstream Velocity | Infinity ft/s |
| Normal Depth | 0.40 ft |
| Critical Depth | 0.40 ft |
| Channel Slope | 1.600 % |
| Critical Slope | 1.568 % |

Cross Section for OFF2 - Tee Pee Lane 60 ROW (1/2 street) 10 YR

| Project Description | |
|---------------------|-----------------|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |
| Input Data | |
| Channel Slope | 1.600 % |
| Normal Depth | 0.40 ft |
| Discharge | 4.00 cfs |



Worksheet for OFF2 - Tee Pee Lane 60 ROW (1/2 street) 100 YR

| Project Description | |
|---------------------|-----------------|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

| Input Data | |
|---------------|-----------|
| Channel Slope | 1.600 % |
| Discharge | 14.00 cfs |

Section Definitions

| Station (ft) | Elevation (ft) |
|--------------|----------------|
| 0+00.00 | 2,550.93 |
| 0+17.58 | 2,549.09 |
| 0+25.55 | 2,549.88 |
| 0+38.37 | 2,550.09 |

Roughness Segment Definitions

| Start Station | Ending Station | Roughness Coefficient |
|---------------------|---------------------|-----------------------|
| (0+00.00, 2,550.93) | (0+25.55, 2,549.88) | 0.025 |
| (0+25.55, 2,549.88) | (0+38.37, 2,550.09) | 0.016 |

| Options | |
|-----------------------------------|---------------------|
| Current Roughness Weighted Method | Pavlovskii's Method |
| Open Channel Weighting Method | Pavlovskii's Method |
| Closed Channel Weighting Method | Pavlovskii's Method |

| Results | |
|-----------------------|-------------------------|
| Normal Depth | 0.64 ft |
| Roughness Coefficient | 0.025 |
| Elevation | 2,549.73 ft |
| Elevation Range | 2,549.09 to 2,550.93 ft |
| Flow Area | 4.0 ft ² |
| Wetted Perimeter | 12.60 ft |
| Hydraulic Radius | 0.32 ft |
| Top Width | 12.53 ft |
| Normal Depth | 0.64 ft |
| Critical Depth | 0.66 ft |
| Critical Slope | 1.326 % |
| Velocity | 3.50 ft/s |
| Velocity Head | 0.19 ft |
| Specific Energy | 0.83 ft |
| Froude Number | 1.093 |
| Flow Type | Supercritical |

Worksheet for OFF2 - Tee Pee Lane 60 ROW (1/2 street) 100 YR

GVF Input Data

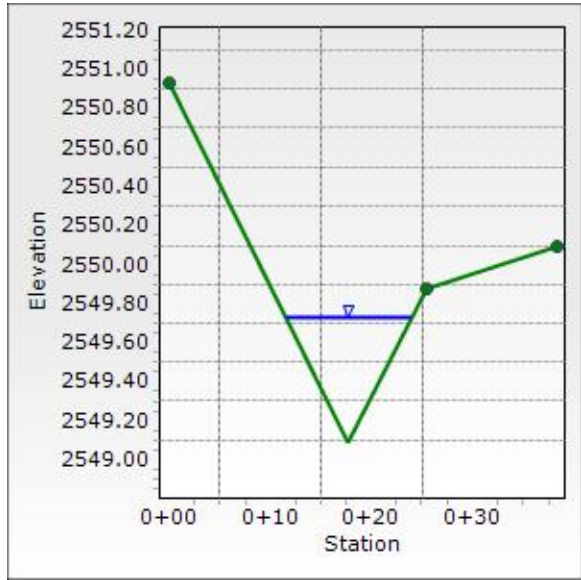
| | |
|------------------|---------|
| Downstream Depth | 0.00 ft |
| Length | 0.00 ft |
| Number Of Steps | 0 |

GVF Output Data

| | |
|---------------------|---------------|
| Upstream Depth | 0.00 ft |
| Profile Description | N/A |
| Profile Headloss | 0.00 ft |
| Downstream Velocity | Infinity ft/s |
| Upstream Velocity | Infinity ft/s |
| Normal Depth | 0.64 ft |
| Critical Depth | 0.66 ft |
| Channel Slope | 1.600 % |
| Critical Slope | 1.326 % |

Cross Section for OFF2 - Tee Pee Lane 60 ROW (1/2 street) 100 YR

| Project Description | |
|---------------------|-----------------|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |
| Input Data | |
| Channel Slope | 1.600 % |
| Normal Depth | 0.64 ft |
| Discharge | 14.00 cfs |



Worksheet for OFF - Grand Canyon Drive 80' ROW (1/2 street) 10 YR

| Project Description | |
|---------------------|-----------------|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

| Input Data | |
|---------------|----------|
| Channel Slope | 2.940 % |
| Discharge | 3.00 cfs |

Section Definitions

| Station (ft) | Elevation (ft) |
|--------------|----------------|
| 0+00.00 | 0.90 |
| 0+14.50 | 0.32 |
| 0+24.00 | 0.51 |
| 0+40.00 | 0.83 |

Roughness Segment Definitions

| Start Station | Ending Station | Roughness Coefficient |
|-----------------|-----------------|-----------------------|
| (0+00.00, 0.90) | (0+24.00, 0.51) | 0.025 |
| (0+24.00, 0.51) | (0+40.00, 0.83) | 0.015 |

| Options | |
|-----------------------------------|---------------------|
| Current Roughness Weighted Method | Pavlovskii's Method |
| Open Channel Weighting Method | Pavlovskii's Method |
| Closed Channel Weighting Method | Pavlovskii's Method |

| Results | |
|-----------------------|---------------------|
| Normal Depth | 0.19 ft |
| Roughness Coefficient | 0.025 |
| Elevation | 0.51 ft |
| Elevation Range | 0.32 to 0.90 ft |
| Flow Area | 1.4 ft ² |
| Wetted Perimeter | 14.48 ft |
| Hydraulic Radius | 0.10 ft |
| Top Width | 14.47 ft |
| Normal Depth | 0.19 ft |
| Critical Depth | 0.21 ft |
| Critical Slope | 1.923 % |
| Velocity | 2.15 ft/s |
| Velocity Head | 0.07 ft |
| Specific Energy | 0.26 ft |
| Froude Number | 1.220 |
| Flow Type | Supercritical |

Worksheet for OFF - Grand Canyon Drive 80' ROW (1/2 street) 10 YR

GVF Input Data

| | |
|------------------|---------|
| Downstream Depth | 0.00 ft |
| Length | 0.00 ft |
| Number Of Steps | 0 |

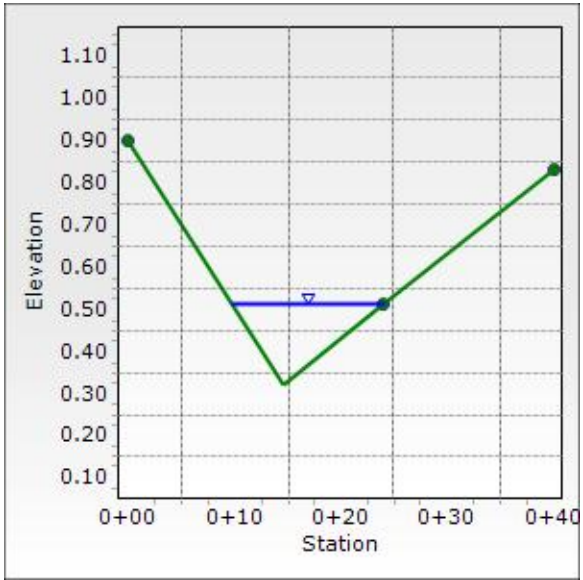
GVF Output Data

| | |
|---------------------|---------------|
| Upstream Depth | 0.00 ft |
| Profile Description | N/A |
| Profile Headloss | 0.00 ft |
| Downstream Velocity | Infinity ft/s |
| Upstream Velocity | Infinity ft/s |
| Normal Depth | 0.19 ft |
| Critical Depth | 0.21 ft |
| Channel Slope | 2.940 % |
| Critical Slope | 1.923 % |

Cross Section for OFF - Grand Canyon Drive 80' ROW (1/2 street) 10 YR

| Project Description | |
|---------------------|-----------------|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

| Input Data | |
|---------------|----------|
| Channel Slope | 2.940 % |
| Normal Depth | 0.19 ft |
| Discharge | 3.00 cfs |



Worksheet for OFF - Grand Canyon Drive 80' ROW (1/2 street) 100 YR

Project Description

| | |
|-----------------|--------------------|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

Input Data

| | |
|---------------|-----------|
| Channel Slope | 2.940 % |
| Discharge | 12.00 cfs |

Section Definitions

| Station (ft) | Elevation (ft) |
|-----------------|-------------------|
| 0+00.00 | 0.90 |
| 0+14.50 | 0.32 |
| 0+24.00 | 0.51 |
| 0+40.00 | 0.83 |

Roughness Segment Definitions

| Start Station | Ending Station | Roughness Coefficient |
|-----------------|-----------------|-----------------------|
| (0+00.00, 0.90) | (0+24.00, 0.51) | 0.025 |
| (0+24.00, 0.51) | (0+40.00, 0.83) | 0.015 |

Options

| | |
|-----------------------------------|---------------------|
| Current Roughness Weighted Method | Pavlovskii's Method |
| Open Channel Weighting Method | Pavlovskii's Method |
| Closed Channel Weighting Method | Pavlovskii's Method |

Results

| | |
|-----------------------|---------------------|
| Normal Depth | 0.31 ft |
| Roughness Coefficient | 0.023 |
| Elevation | 0.63 ft |
| Elevation Range | 0.32 to 0.90 ft |
| Flow Area | 3.7 ft ² |
| Wetted Perimeter | 23.56 ft |
| Hydraulic Radius | 0.16 ft |
| Top Width | 23.55 ft |
| Normal Depth | 0.31 ft |
| Critical Depth | 0.36 ft |
| Critical Slope | 1.337 % |
| Velocity | 3.25 ft/s |
| Velocity Head | 0.16 ft |
| Specific Energy | 0.48 ft |
| Froude Number | 1.444 |
| Flow Type | Supercritical |

Worksheet for OFF - Grand Canyon Drive 80' ROW (1/2 street) 100 YR

GVF Input Data

| | |
|------------------|---------|
| Downstream Depth | 0.00 ft |
| Length | 0.00 ft |
| Number Of Steps | 0 |

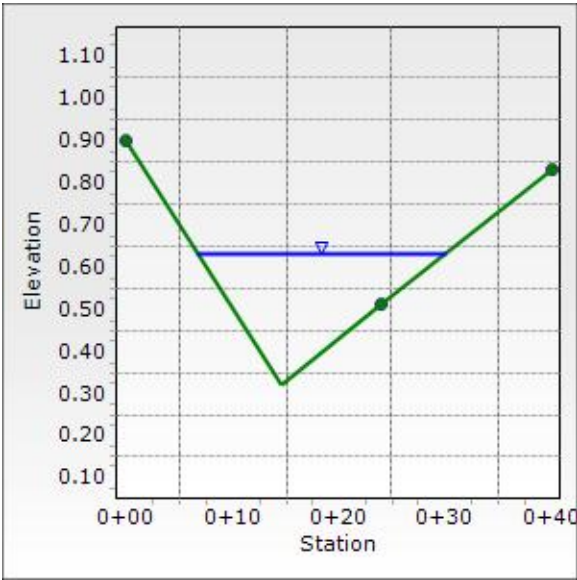
GVF Output Data

| | |
|---------------------|---------------|
| Upstream Depth | 0.00 ft |
| Profile Description | N/A |
| Profile Headloss | 0.00 ft |
| Downstream Velocity | Infinity ft/s |
| Upstream Velocity | Infinity ft/s |
| Normal Depth | 0.31 ft |
| Critical Depth | 0.36 ft |
| Channel Slope | 2.940 % |
| Critical Slope | 1.337 % |

Cross Section for OFF - Grand Canyon Drive 80' ROW (1/2 street) 100 YR

| Project Description | |
|---------------------|-----------------|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

| Input Data | |
|---------------|-----------|
| Channel Slope | 2.940 % |
| Normal Depth | 0.31 ft |
| Discharge | 12.00 cfs |



Worksheet for TPL - Tee Pee Lane 60 ROW 10 YR

Project Description

| | |
|-----------------|--------------------|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

Input Data

| | |
|---------------|----------|
| Channel Slope | 2.320 % |
| Discharge | 7.00 cfs |

Section Definitions

| Station (ft) | Elevation (ft) |
|-----------------|-------------------|
| 0+00.00 | 2,550.00 |
| 0+27.15 | 2,549.00 |
| 0+48.49 | 2,548.76 |
| 0+74.25 | 2,549.56 |

Roughness Segment Definitions

| Start Station | Ending Station | Roughness Coefficient |
|---------------------|---------------------|-----------------------|
| (0+00.00, 2,550.00) | (0+74.25, 2,549.56) | 0.016 |

Options

| | |
|-----------------------------------|------------------------|
| Current Roughness Weighted Method | Pavlovskii's Method |
| Open Channel Weighting Method | Pavlovskii's Method |
| Closed Channel Weighting Method | Pavlovskii's Method |

Results

| | |
|-----------------------|----------------------------|
| Normal Depth | 0.20 ft |
| Roughness Coefficient | 0.016 |
| Elevation | 2,548.96 ft |
| Elevation Range | 2,548.76 to 2,550.00 ft |
| Flow Area | 2.3 ft ² |
| Wetted Perimeter | 23.76 ft |
| Hydraulic Radius | 0.10 ft |
| Top Width | 23.75 ft |
| Normal Depth | 0.20 ft |
| Critical Depth | 0.24 ft |
| Critical Slope | 0.754 % |
| Velocity | 3.01 ft/s |
| Velocity Head | 0.14 ft |
| Specific Energy | 0.34 ft |
| Froude Number | 1.692 |
| Flow Type | Supercritical |

Worksheet for TPL - Tee Pee Lane 60 ROW 10 YR

GVF Input Data

| | |
|------------------|---------|
| Downstream Depth | 0.00 ft |
| Length | 0.00 ft |
| Number Of Steps | 0 |

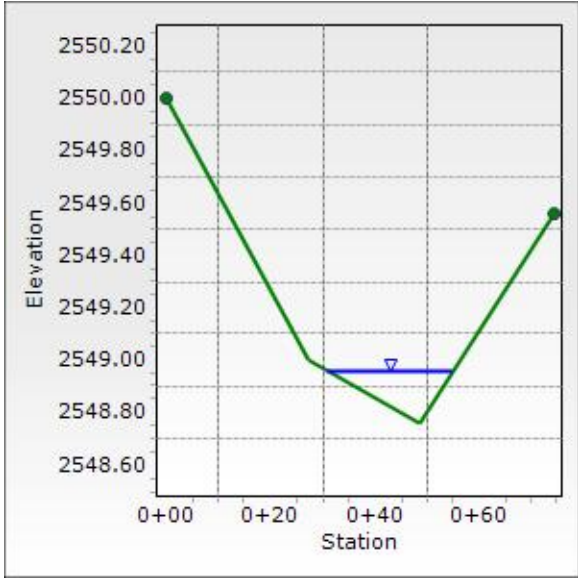
GVF Output Data

| | |
|---------------------|---------------|
| Upstream Depth | 0.00 ft |
| Profile Description | N/A |
| Profile Headloss | 0.00 ft |
| Downstream Velocity | Infinity ft/s |
| Upstream Velocity | Infinity ft/s |
| Normal Depth | 0.20 ft |
| Critical Depth | 0.24 ft |
| Channel Slope | 2.320 % |
| Critical Slope | 0.754 % |

Cross Section for TPL - Tee Pee Lane 60 ROW 10 YR

| Project Description | |
|---------------------|-----------------|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

| Input Data | |
|---------------|----------|
| Channel Slope | 2.320 % |
| Normal Depth | 0.20 ft |
| Discharge | 7.00 cfs |



Worksheet for TPL - Tee Pee Lane 60 ROW 100 YR

| Project Description | |
|---------------------|-----------------|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

| Input Data | |
|---------------|-----------|
| Channel Slope | 2.320 % |
| Discharge | 18.00 cfs |

Section Definitions

| Station (ft) | Elevation (ft) |
|--------------|----------------|
| 0+00.00 | 2,550.00 |
| 0+27.15 | 2,549.00 |
| 0+48.49 | 2,548.76 |
| 0+74.25 | 2,549.56 |

Roughness Segment Definitions

| Start Station | Ending Station | Roughness Coefficient |
|---------------------|---------------------|-----------------------|
| (0+00.00, 2,550.00) | (0+74.25, 2,549.56) | 0.016 |

Options

| | |
|-----------------------------------|---------------------|
| Current Roughness Weighted Method | Pavlovskii's Method |
| Open Channel Weighting Method | Pavlovskii's Method |
| Closed Channel Weighting Method | Pavlovskii's Method |

Results

| | |
|-----------------------|-------------------------|
| Normal Depth | 0.28 ft |
| Roughness Coefficient | 0.016 |
| Elevation | 2,549.04 ft |
| Elevation Range | 2,548.76 to 2,550.00 ft |
| Flow Area | 4.6 ft ² |
| Wetted Perimeter | 31.22 ft |
| Hydraulic Radius | 0.15 ft |
| Top Width | 31.21 ft |
| Normal Depth | 0.28 ft |
| Critical Depth | 0.35 ft |
| Critical Slope | 0.639 % |
| Velocity | 3.93 ft/s |
| Velocity Head | 0.24 ft |
| Specific Energy | 0.52 ft |
| Froude Number | 1.811 |
| Flow Type | Supercritical |

Worksheet for TPL - Tee Pee Lane 60 ROW 100 YR

GVF Input Data

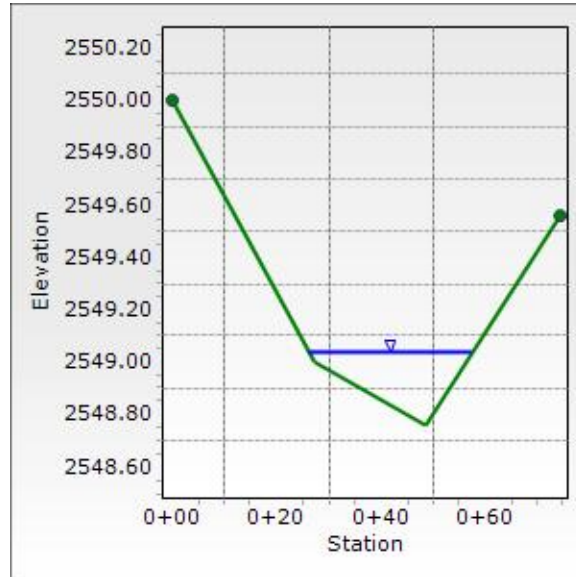
| | |
|------------------|---------|
| Downstream Depth | 0.00 ft |
| Length | 0.00 ft |
| Number Of Steps | 0 |

GVF Output Data

| | |
|---------------------|---------------|
| Upstream Depth | 0.00 ft |
| Profile Description | N/A |
| Profile Headloss | 0.00 ft |
| Downstream Velocity | Infinity ft/s |
| Upstream Velocity | Infinity ft/s |
| Normal Depth | 0.28 ft |
| Critical Depth | 0.35 ft |
| Channel Slope | 2.320 % |
| Critical Slope | 0.639 % |

Cross Section for TPL - Tee Pee Lane 60 ROW 100 YR

| Project Description | |
|---------------------|-----------------|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |
| Input Data | |
| Channel Slope | 2.320 % |
| Normal Depth | 0.28 ft |
| Discharge | 18.00 cfs |



Worksheet for ON11

| Project Description | |
|---------------------|--------------------|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

| Input Data | |
|---------------|----------|
| Channel Slope | 2.390 % |
| Discharge | 4.00 cfs |

Section Definitions

| | Station (ft) | Elevation (ft) |
|--|-----------------|-------------------|
| | 0+00.00 | 0.50 |
| | 0+00.50 | 0.48 |
| | 0+00.50 | 0.00 |
| | 0+02.00 | 0.13 |
| | 0+02.00 | 0.17 |
| | 0+24.50 | 0.62 |
| | 0+24.50 | 1.12 |
| | 0+25.00 | 1.12 |

Roughness Segment Definitions

| Start Station | Ending Station | Roughness Coefficient |
|-----------------|-----------------|-----------------------|
| (0+00.00, 0.50) | (0+25.00, 1.12) | 0.016 |

Options

| | |
|-----------------------------------|------------------------|
| Current Roughness Weighted Method | Pavlovskii's Method |
| Open Channel Weighting Method | Pavlovskii's Method |
| Closed Channel Weighting Method | Pavlovskii's Method |

Results

| | |
|-----------------------|---------------------|
| Normal Depth | 0.35 ft |
| Roughness Coefficient | 0.016 |
| Elevation | 0.35 ft |
| Elevation Range | 0.00 to 1.12 ft |
| Flow Area | 1.2 ft ² |
| Wetted Perimeter | 10.71 ft |
| Hydraulic Radius | 0.11 ft |
| Top Width | 10.32 ft |
| Normal Depth | 0.35 ft |
| Critical Depth | 0.40 ft |
| Critical Slope | 0.748 % |
| Velocity | 3.34 ft/s |
| Velocity Head | 0.17 ft |

Worksheet for ON11

Results

| | |
|-----------------|---------------|
| Specific Energy | 0.52 ft |
| Froude Number | 1.725 |
| Flow Type | Supercritical |

GVF Input Data

| | |
|------------------|---------|
| Downstream Depth | 0.00 ft |
| Length | 0.00 ft |
| Number Of Steps | 0 |

GVF Output Data

| | |
|---------------------|---------------|
| Upstream Depth | 0.00 ft |
| Profile Description | N/A |
| Profile Headloss | 0.00 ft |
| Downstream Velocity | Infinity ft/s |
| Upstream Velocity | Infinity ft/s |
| Normal Depth | 0.35 ft |
| Critical Depth | 0.40 ft |
| Channel Slope | 2.390 % |
| Critical Slope | 0.748 % |

Cross Section for ON11

| Project Description | |
|---------------------|-----------------|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |
| Input Data | |
| Channel Slope | 2.390 % |
| Normal Depth | 0.35 ft |
| Discharge | 4.00 cfs |

