# TECHNICAL MEMORANDUM


TO: Santa Clara Valley Water District

FROM: Matt Smeltzer, P.E.
Engineer/Geomorphologist

DATE: ~~March 4, 2021~~ Revised June 9, 2021

SUBJECT: Hydraulic Model Evaluation of Diaz Residence Riparian Vegetation Planting Plan

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**Memo and Model Revisions Made in Response to Comments**

The March 4, 2021 technical memorandum was revised as shown herein to respond to comments of Benjamin Hwang, Santa Clara Valley Water District contained in the April 30, 2021 letter to Patricia Diaz from Colleen Tsuchimoto, County of Santa Clara Planning Department:

6.(a) – The last sentence of the March 4, 2021 version "Introduction" section was deleted as shown below.

6.(b) – The boundary conditions in the hydraulic model were misstated in the March 4, 2021 memo version. The memo was revised as shown at p. 9 to correctly state the slopes entered into the hydraulic model at the upstream and downstream normal depth boundary conditions: 0.010 ft/ft at the upstream boundary condition and 0.008 ft/ft at the downstream boundary condition.

6.(c) – The downstream reach lengths in the geometry files were revised so that none of the cross-section cut-lines displayed in the geometry editor cross one another. This was accomplished by editing the fifth-point Schematic Y values in the XS Cut Lines Tables for STA 14+29 and STA 14+43 in the GIS Tools menu, and making corresponding measured revisions to the right overbank downstream reach lengths in the Cross-Section Data editor for STA 14+59, STA 14+43, and STA 14+29. See appended screenshot of geometry editor appended to this memo (Appendix C-1).

Revising the description in the March 4, 2021 memo version of the boundary condition slopes did not change the model output referred to in the memo because no changes were made to the model input files, only the memo.

Revising the XS Cut Line coordinates and right overbank downstream reach lengths to produce an agreeable graphical representation of the geometry did change the model input data but did not change any of the model outputs referred to in the memo because only the highest flows analyzed (e.g., 100-year flow) were high enough to produce flow in the model-designated right overbank areas, and the changes were marginal and did not change the model computed water surface elevations, velocities, or shear stresses. See appended table showing that the revised model produces the same model output as the original model documented in the March 4, 2021 memo (Appendix C-2).

## Introduction

A hydraulic model analysis was completed to evaluate feasibility and effects of native riparian revegetation for bank erosion protection on the left bank of "South Fork" Hale Creek downstream from the Magdalena Avenue culvert in Los Altos.

The riparian planting improvements are proposed to be part of the Diaz Residence development project on Gronwall Lane~~, specifically for responding to comments from Santa Clara Valley Water District (Valley Water) seeking mitigation for ongoing bank erosion and poorly vegetated creek bank conditions at the proposed development site.~~.

## Native Riparian Planting Plan

In association with Geomorph Design Group (GDG), Wood Biological Consulting prepared a Native Riparian Planting Plan and a Riparian Revegetation Monitoring Plan to provide the requested bank erosion mitigation. The Planting Plan and the Monitoring Plan are dated March 4, 2021.

The Planting Plan calls for minor hand-work clearing and grubbing, seeding 100 lineal feet (842 square feet) of creek bank with native erosion control seed mix, covering with a double-layer of 100% biodegradable coconut fiber erosion control fabric, and planting with native riparian plants grown from local-source parent propagules. The erosion control fabric types and installation methods were selected for resisting the anticipated, model-computed creek flow velocities at the site. The plant species and planting patterns were selected primarily for mimicking successful natural plant establishment near the site, and secondarily for minimizing the increase in hydraulic roughness compared to existing conditions.

The Monitoring Plan sets forth a schedule of maintenance and reporting activities for achieving and documenting successful riparian plant community establishment throughout the 842-sq ft improvement area.

***Photo 1.*** *Looking upstream to Magdalena Avenue box culvert outlet (February 2021).*

## Hydraulic Setting

Hale Creek flows are severely confined by the 104-foot-long concrete box culvert running under Magdalena Avenue. The culvert is 8-feet-wide (span) and 7-feet-high (rise). The culvert tailwall lacks wingwalls. Rather, both creek banks extending 30 feet downstream from the outlet are lined with steeply-sloped "sackrete" revetments and the channel bed is concrete-lined (Photo 1). The resulting "sackrete" channel is narrower than the culvert and does not gradually expand in the downstream direction. The channel toe width varies between 5-6 feet.

At the downstream end of the "sackrete" channel, the channel bed elevation abruptly drops 2 feet off of the concrete channel floor. The steep channel walls end without stabilized transitions to the more gradually sloped natural channel banks immediately downstream.

The plunging drop and rapid flow expansion cause turbulent eddying flow and bed and bank erosion immediately downstream from the "sackrete" channel. Large rip-rap was placed on the lower part of the right bank downstream from the channel outlet. It appears that the rip-rap was placed directly on the natural channel banks, reducing the channel width and causing increased bank erosion on the left bank. The pattern of left bank erosion matches the pattern of rip-rap on the right bank (e.g., Photo 2).

***Photo 2.*** *Looking downstream to Hale Creek from the downstream end of the "Sackrete" channel (February 2021).*

Erosion of the lower part of the left bank exposes moderately dense clay alluvial soil having substantial natural erosion resistance. While it appears that lower bank erosion may have

occurred rapidly following installation of the "sackrete" channel and the right bank rip-rap, recent and ongoing lower bank erosion is less rapid and not severe because the channel has become wider than it was after the right bank rip-rap was installed. Looser sandy loam soils comprising the upper bank materials continue eroding to form a self-stabilizing/stabilized slope fitting to the lower bank.

Relatively steep creek bank slopes – varying between 1.25(H):1(V) and 1.75(H):1(V) – are typical for Hale Creek in its current natural condition. Like other San Francisco Bay tributary streams, Hale Creek is a deeply incised creek impacted by urbanization.

***Photo 3.*** *Looking downstream from the tributary confluence at the Gronwall Lane site (February 2021).*

Turbulence caused by the abrupt "sackrete" channel terminus dissipates within about 45 feet downstream. The channel banks are increasingly vegetated downstream from the turbulence zone, becoming more substantially vegetated beginning about 65 feet downstream from the

"sackrete" channel. A tributary stream – "North Fork" Hale Creek -- joins with Hale Creek 100 feet downstream, marking the downstream end of the Gronwall Lane site and the riparian planting area.

FEMA publishes base flood elevations for "North Fork" Hale Creek upstream from the site and base flood elevations for Hale Creek downstream from the site. In the site vicinity, FEMA maps a Zone A floodplain for "South Fork" Hale Creek, but not "North Fork" Hale Creek. FEMA's Zone A map limits suggest graphically that South Fork Hale Creek overflows Magdalena Avenue and Hale Creek overflows Magdalena Court during the 100-year flood, but the basis of the mapping is not published. The Zone A limits also indicate that 100-year flows area primarily contained within the channel upstream and downstream from road crossings. See Appendix A for FEMA FIRM and other map information.

## Hydraulic Model Development

Geometry. The HEC-RAS hydraulic model obtained from Waterways Consulting, Inc. contained 13 field-surveyed cross-sections and surveyed layout for the Magdalena Avenue box culvert and the Magdalena Ct bridge (Table 1). GDG added 4 cross-sections to the model to improve modeling of expansion and contraction zones for permitting sensitivity analysis on expansion and contraction loss coefficients and improve representation of the rapidly varying and near critical flow conditions within the sackrete channel that dominate the Magdalena Avenue box culvert hydraulics and resulting 100-year flood (weir) overflow over Magdalena Avenue roadway.

**Table 1.**
**Hydraulic Model Cross-Sections.**

| River Station (ft) | Cross-Section Location | Cross-Section Data Source Notes |
|---|---|---|
| 1593 | Channel - Contraction Zone | Estimated Section Added by GDG |
| 1573 | Magdalena Culvert Headwall | Field Surveyed by Waterways |
| 1568 | Culvert | Model computed |
| 1459 | Magdalena Culvert Tailwall | Field Surveyed by Waterways |
| 1443 | "Sackrete" Channel | Field Surveyed by Waterways |
| 1429 | "Sackrete" Channel | Field Surveyed by Waterways |
| 1422 | "Sackrete" Channel Terminus | Added by GDG form Sandis Topo Survey Data |
| 1415 | Channel - Expansion Zone | Added by GDG form Sandis Topo Survey Data |
| 1403 | Channel - Expansion Zone | Added by GDG form Sandis Topo Survey Data |
| 1390 | Channel | Field Surveyed by Waterways |
| 1363 | Channel | Field Surveyed by Waterways |
| 1350 | Channel | Field Surveyed by Waterways |
| 1322 | Confluence/Junction | Field Surveyed by Waterways |

| | | |
|---|---|---|
| 1290 | Channel | Field Surveyed by Waterways |
| 1227 | Channel | Field Surveyed by Waterways |
| 1210 | Bridge | Model computed |
| 1194 | Channel | Field Surveyed by Waterways |
| 1140.66 | Channel | From Waterways Model |
| 1042 | Channel | From Waterways Model |

Note: Gray fill denotes cross-sections within the 100-foot-long native riparian planting area between the "sackrete" channel terminus (STA 14+29) and the confluence with North Fork Hale Creek (STA 13+22).

Ineffective flow areas were set upstream and downstream from bridge and culverts per typical HEC-RAS modeling methods.

Roughness. GDG used field inspection, site photographs, and professional judgement to assign horizontally varied Manning's n roughness coefficients to individual surfaces occurring on each model cross-section (Table 2).

**Table 2.**
**Manning's Roughness Coefficients.**

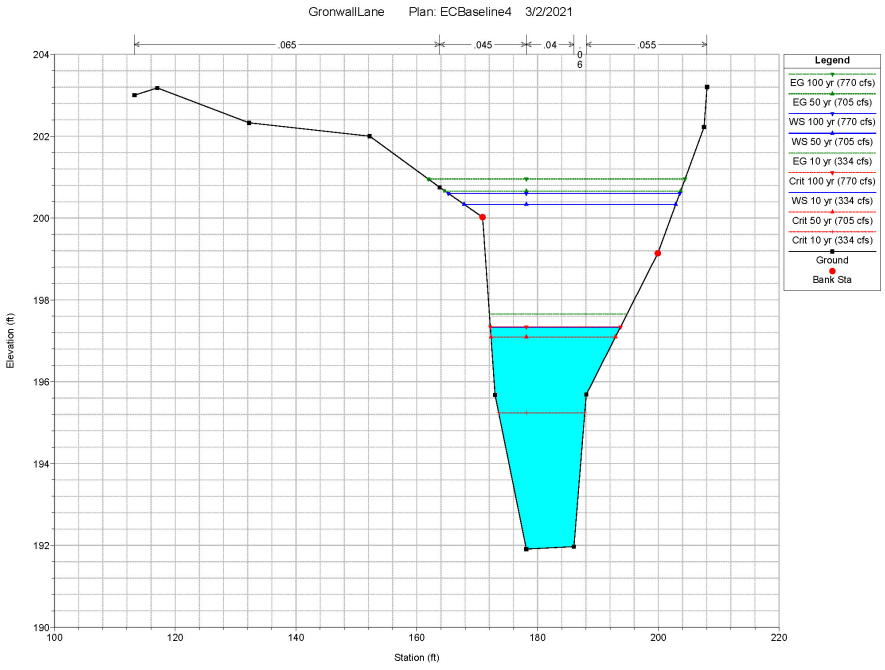
| Surface | n |
|---|---|
| Bank: Established Vegetation, Few Trees | 0.065 |
| Bank: Large Rip-Rap, Unvegetated | 0.060 |
| Bank: Moderately Vegetated, Few Trees | 0.055 |
| Bank: Poorly Vegetated, Few Trees | 0.045 |
| Bed: Existing Gravely-Sand with Boulders | 0.040 |
| Sackrete Channel Walls & Floor | 0.018 |
| Concrete Box Culvert Walls & Floor | 0.011 |

**Table 3.**
**Horizontally-Varied Roughness Coefficients for Existing Conditions Baseline Model.**

| River Station (ft) | n #1 | n #2 | n #3 | n #4 | n #5 | n #6 | n #7 |
|---|---|---|---|---|---|---|---|
| 1593 | 0.055 | 0.040 | 0.055 | 0.045 | | | |
| 1573 | 0.065 | 0.055 | 0.040 | 0.045 | 0.045 | 0.065 | |
| 1568 | | | | | | | |
| 1459 | 0.055 | 0.018 | 0.055 | | | | |
| 1443 | 0.055 | 0.018 | 0.055 | | | | |
| 1429 | 0.055 | 0.018 | 0.055 | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1422 | 0.065 | 0.045 | 0.040 | 0.060 | 0.045 | | |
| 1415 | 0.065 | 0.045 | 0.040 | 0.060 | 0.055 | 0.065 | |
| 1403 | 0.065 | 0.045 | 0.040 | 0.060 | 0.055 | 0.065 | |
| 1390 | 0.065 | 0.045 | 0.040 | 0.060 | 0.055 | | |
| 1363 | 0.065 | 0.055 | 0.040 | 0.060 | 0.055 | 0.065 | |
| 1350 | 0.065 | 0.055 | 0.040 | 0.060 | 0.055 | 0.065 | |
| 1322 | 0.065 | 0.055 | 0.040 | 0.060 | 0.055 | 0.065 | |
| 1290 | 0.065 | 0.055 | 0.040 | 0.060 | 0.055 | 0.065 | |
| 1227 | 0.065 | 0.055 | 0.040 | 0.055 | 0.065 | | |
| 1210 | | | | | | | |
| 1194 | 0.065 | 0.055 | 0.045 | 0.040 | 0.055 | 0.065 | |
| 1140.66 | 0.065 | 0.055 | 0.045 | 0.040 | 0.045 | 0.055 | 0.065 |
| 1042 | 0.065 | 0.055 | 0.040 | 0.055 | | | |

**Figure 1.**
**Horizontally-Varied Roughness Coefficients at Existing Conditions STA 13+90.**




As denoted by gray fill in Table 3, existing conditions roughness values assigned to the poorly vegetated and moderately vegetated bank surfaces within the 100-foot-long planting plan area were 0.045 in the upstream 65 feet and 0.055 in the downstream 35 feet, according to field inspection. Figure 1 shows the existing conditions model cross-section at STA 13+90.

Design Flows. The HEC-RAS model obtained from Waterways Consulting, Inc. contained 10-yr, 50-yr, and 100-yr design flows from FEMA Flood Insurance Study sources. Recall that FEMA published hydrology and hydraulic computations for Hale Creek upstream and downstream from the site. The flow file contained a 770-cfs 100-year flood flow for "South Fork" Hale Creek upstream from the Magdalena Avenue culvert, increasing to 903 cfs at the confluence with "North Fork" Hale Creek (Table 4).

**Table 4.**
**Design Flood Flows.**

| River Station (ft) | Location | 10 yr (cfs) | 50 yr (cfs) | 100 yr (cfs) |
|---|---|---|---|---|
| 1593 | South Fork Hale Creek | 334 | 705 | 770 |
| 1322 | Hale Creek at Confluence | 392 | 827 | 903 |

Baseline Existing Conditions Model Development. GDG performed several sensitivity analyses for arriving at a suitable baseline existing conditions model:

- *Boundary Conditions*. GDG used normal depth computed water surface elevations at the upstream and downstream boundary conditions for slopes determined from survey data. The upstream boundary condition was the normal depth for slope 0.010 ft/ft and the downstream boundary condition was the normal depth for slope 0.008 ft/ft. ~~between 0.0010 and 0.0011 ft/ft~~. The model results were insensitive to the upstream boundary condition because the hydraulics are dominated by the narrow "sackrete" channel at the outlet of the Magdalena Avenue concrete box culvert. For all scenarios, including multiple culvert modeling methods, Magdalena Avenue roadway overtops for the 50-year and 100-year peak flows modeled (705 cfs and 770 cfs, respectively).

  The model-computed 770-cfs water surface elevation profile generally corresponds to the FEMA Zone A map limits (Appendix A), and an "average" 202.5-foot water surface elevation implied by the Zone A limits mapped at the site by Sandis.

  The model-computed water surface elevations and velocities begin to gradually respond to the downstream boundary condition when the water surface elevation at the downstream model cross-section (STA 10+42) is set to a value more than about 1.0 feet higher than the model-computed normal depth. Using the model-computed normal depth downstream boundary condition produces "free-flowing" hydraulic computations at the planting plan area site, for which differences in surface roughness can be discerned by the model. Under different downstream boundary conditions, such as severe debris blockages forcing overflow of the Magdalena Ct bridge surface, would

reduce model-computed velocities at the site and reduce differences in model-computed water surface elevations caused by vegetation establishment at the site.

- *Bridge and Culvert Modeling Methods.* GDG configured the bridge and culvert modeling methods according to standard practice and HEC-RAS manual recommendations. The Magdalena Avenue culvert was modeled using model-computed culvert flow, pressure flow computations, and weir flow beginning when the headwall elevation is crested at the low-point on the floodprone section within the FEMA Zone A limits. Chart 11, Scale 1 culvert flow computations for model-determined inlet-outlet control were used for best representing the 45-degree-skewed headwall/tailwall. Weir flow width was restricted to 100 feet, according to the FEMA Zone A limits and field and air photo map evaluation of probable overflow limits. The downstream bridge is modeled as a simple abutment and deck blockage with upstream and downstream cross-sections and appropriate ineffective flow areas. Then GDG applied a range of culvert and bridge modeling methods but could not produce substantially different model results.

- *Contraction and Expansion Loss Coefficients.* GDG updated the right bank, channel centerline, and left bank downstream distances, and then experimented with moving the LB and RB top of bank locations closer to the channel and increasing the contraction and expansion loss coefficients from standard values (0.1 and 0.3) to typical higher values 0.3 and 0.5. Because the channel is relatively straight and a very high percentage of the flow conveyance is within the main channel area, a substantial difference in results could not be produced. The higher loss coefficients were retained at sections upstream and downstream from bridges and culverts, as well as for the sections at and immediately downstream from the "sackrete" channel terminus.

**Table 5.**
**Native Riparian Planting Area Roughness Coefficients.**

| River Station (ft) | Existing Conditions n #2 | Proposed – Initial n #2 | Proposed – Established n #2 |
|---|---|---|---|
| 1422 | 0.045 | 0.055 | 0.065 |
| 1415 | 0.045 | 0.055 | 0.065 |
| 1403 | 0.045 | 0.055 | 0.065 |
| 1390 | 0.045 | 0.055 | 0.065 |
| 1363 | 0.055 | 0.055 | 0.065 |
| 1350 | 0.055 | 0.055 | 0.065 |

Proposed Conditions Model Development. To simulate the reach-scale hydraulic effect of the proposed native riparian planting plan implementation, GDG prepared two proposed conditions geometry files – one representing the increased bank surface roughness caused by the initial

planting installation, and one representing rougher, more established vegetation conditions years after installation. Table 5 summarizes the roughness coefficients applied to the portion of the model cross-section surfaces within the planting area for each condition modeled.

## Hydraulic Model Evaluation

*Resistance to Flow Velocity and Shear Stress*. The model-computed 10-year flood averaged channel flow velocities vary from 3.8 to 5.0 feet per second in the planting area reach (Table 6). The average channel shear stresses vary from 0.7 to 1.4 pounds per square feet.

**Table 6.**
**Hydraulic Model Computed Velocity and Shear Stress.**

| River Station (ft) | Flow (cfs) | W.S. Elev (ft NAVD88) | Velocity (ft/s) | Shear Stress (lb/sq ft) |
|---|---|---|---|---|
| 1593 | 334 | 200.9 | 3.5 | 0.6 |
| 1573 | 334 | 200.6 | 4.8 | 0.8 |
| 1568 | Culvert | | | |
| 1459 | 334 | 196.0 | 13.1 | 1.3 |
| 1443 | 334 | 197.4 | 7.9 | 0.4 |
| 1429 | 334 | 197.2 | 8.5 | 0.5 |
| 1422 | 334 | 197.5 | 4.7 | 1.0 |
| 1415 | 334 | 197.5 | 3.9 | 0.7 |
| 1403 | 334 | 197.5 | 3.8 | 0.7 |
| 1390 | 334 | 197.3 | 4.6 | 1.0 |
| 1363 | 334 | 197.1 | 5.0 | 1.4 |
| 1350 | 334 | 197.1 | 4.6 | 1.1 |
| 1322 | 392 | 196.9 | 4.8 | 1.1 |
| 1290 | 392 | 196.3 | 6.5 | 2.1 |
| 1227 | 392 | 195.7 | 5.6 | 1.4 |
| 1210 | Bridge | | | |
| 1194 | 392 | 194.7 | 7.9 | 2.2 |
| 1140.66 | 392 | 194.4 | 5.8 | 1.3 |
| 1042 | 392 | 193.7 | 5.4 | 1.4 |

The native riparian planting plan calls for installing a double-layer of biodegradable erosion control fabric on the creek bank surfaces within the planting area. The plan-specified erosion control fabrics meet ASTM testing standards for resisting velocities up to 10.0 feet/second and resisting surface shear stresses up to 2.35 pounds/square foot.

*Effects of Planting Plan on Water Surface Elevation*. The model-computed 100-year flood water surface elevations vary less than 0.1 vertical feet in the planting area for the range of conditions tested (Table 7). The computed 100-year water surface elevation difference at the Magdalena Avenue culvert headwall is 0.02 feet for initial conditions and 0.00 feet for established conditions.

**Table 7.**
**Hydraulic Model Computed 100-year Flood Water Surface Elevations.**

| | | Existing Conditions | Proposed Conditions - Initial - | Proposed Conditions - Established - |
|---|---|---|---|---|
| River Station (ft) | Flow (cfs) | W.S. Elev (ft NAVD88) | W.S. Elev (ft NAVD88) | W.S. Elev (ft NAVD88) |
| 1593 | 770 | 204.10 | 204.08 | 204.10 |
| 1573 | 770 | 203.80 | 203.78 | 203.80 |
| 1568 | Culvert | | | |
| 1459 | 770 | 200.36 | 200.39 | 200.46 |
| 1443 | 770 | 200.37 | 200.40 | 200.47 |
| 1429 | 770 | 200.31 | 200.34 | 200.41 |
| 1422 | 770 | 200.70 | 200.72 | 200.78 |
| 1415 | 770 | 200.71 | 200.73 | 200.78 |
| 1403 | 770 | 200.68 | 200.70 | 200.75 |
| 1390 | 770 | 200.60 | 200.61 | 200.66 |
| 1363 | 770 | 200.36 | 200.36 | 200.38 |
| 1350 | 770 | 200.32 | 200.32 | 200.33 |
| 1322 | 903 | 200.20 | 200.20 | 200.20 |
| 1290 | 903 | 199.78 | 199.78 | 199.78 |
| 1227 | 903 | 199.43 | 199.43 | 199.43 |
| 1210 | Bridge | | | |
| 1194 | 903 | 197.24 | 197.24 | 197.24 |
| 1140.66 | 903 | 196.99 | 196.99 | 196.99 |
| 1042 | 903 | 196.35 | 196.35 | 196.35 |

Although the computed differences are less than the absolute accuracy of hydraulic model computations, the relative difference – more than zero but less than 0.1 vertical feet – appears to correctly represent the hydraulic effect of the proposed planting. It should also have been anticipated that the relative difference in the computed water surface elevation at the Magdalena Avenue culvert headwall would be negligible – the water surface elevations are

controlled by the narrow "sackrete" channel downstream from the culvert and the elevation profile of the roadway and culvert headwall controlling the depth of weir overflow.

Overall, these hydraulic model results corroborate observations from professional judgement and experience in similar hydraulic-geomorphic settings – reach-scale flood flow hydraulics are controlled not by creek bank vegetation, but rather by the configuration of civil infrastructure, natural bedrock outcrops, and other non-deformable built features such as rock slope protection and retaining walls, private road and driveway bridges, and debris blockages.

## Conclusions

1. The planting plan-specified erosion control fabrics are rated to resist surface erosion for the model-computed design flow velocities and shear stresses.

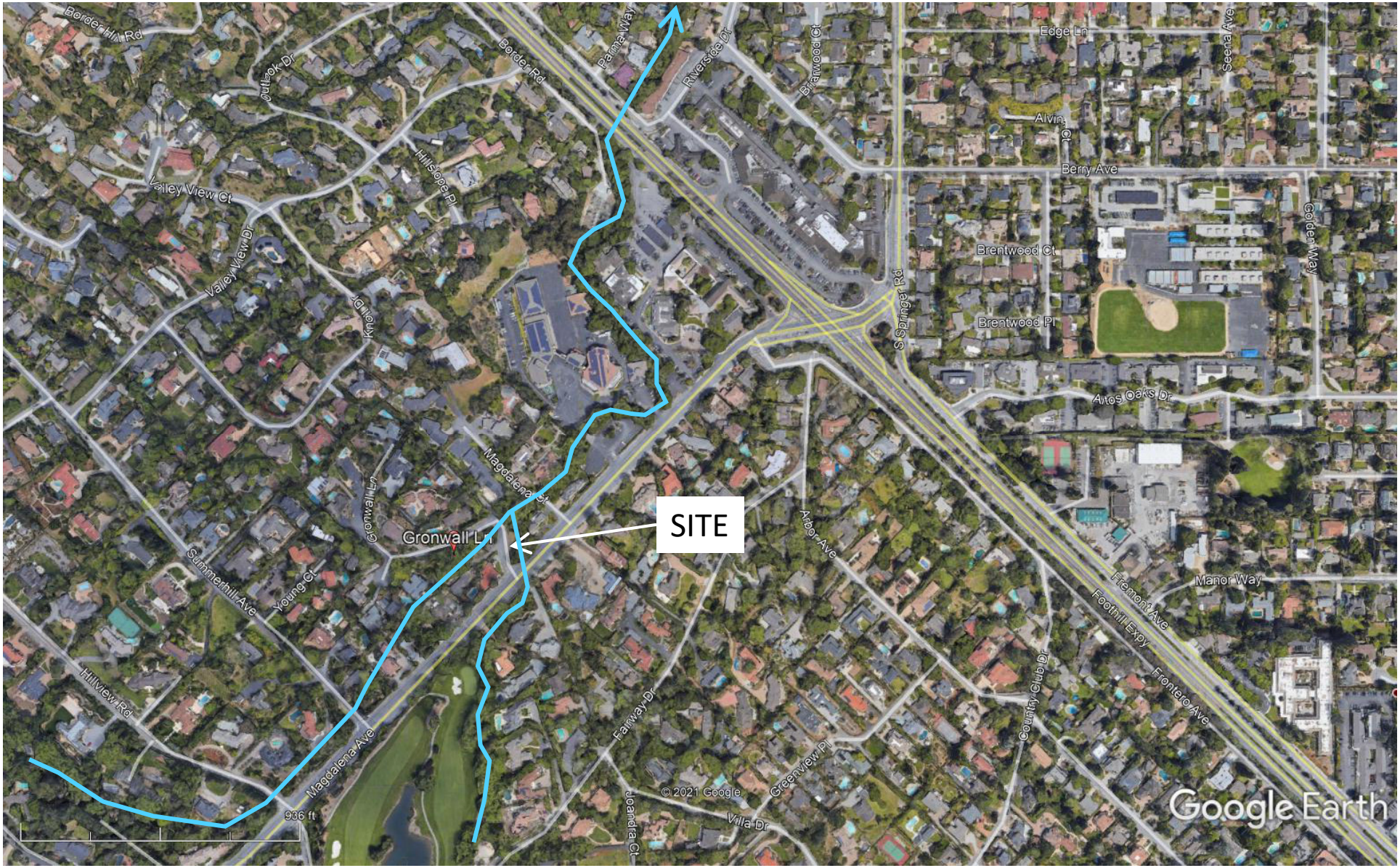
2. Implementing the planting plan will not cause noticeable changes to reach-scale hydraulics – the model-computed 100-year flood flow water surface elevation differences are negligible.

## List of Appendices

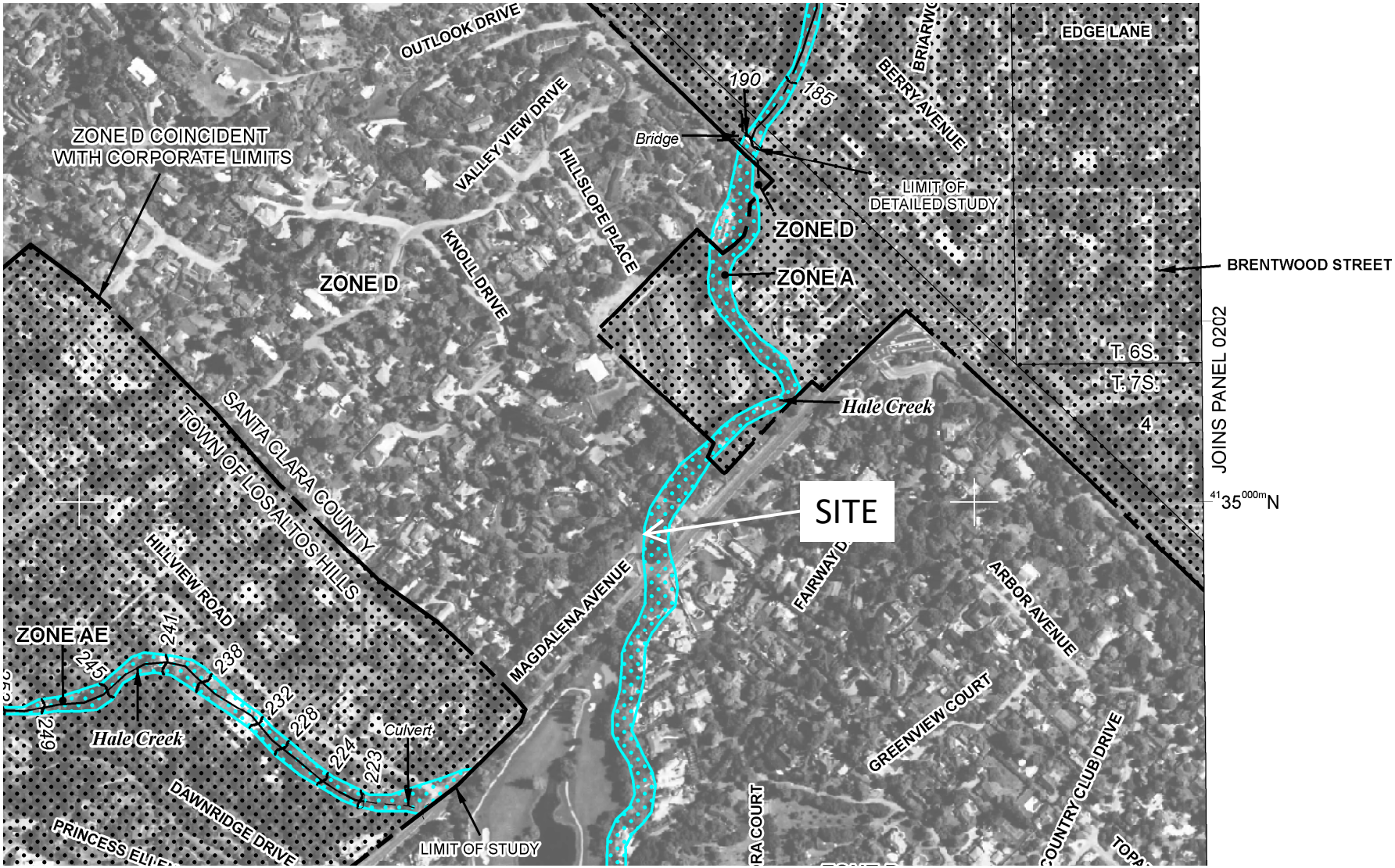
Appendix A. Site Location Maps.

Appendix B. Summary Hydraulic Model Output.

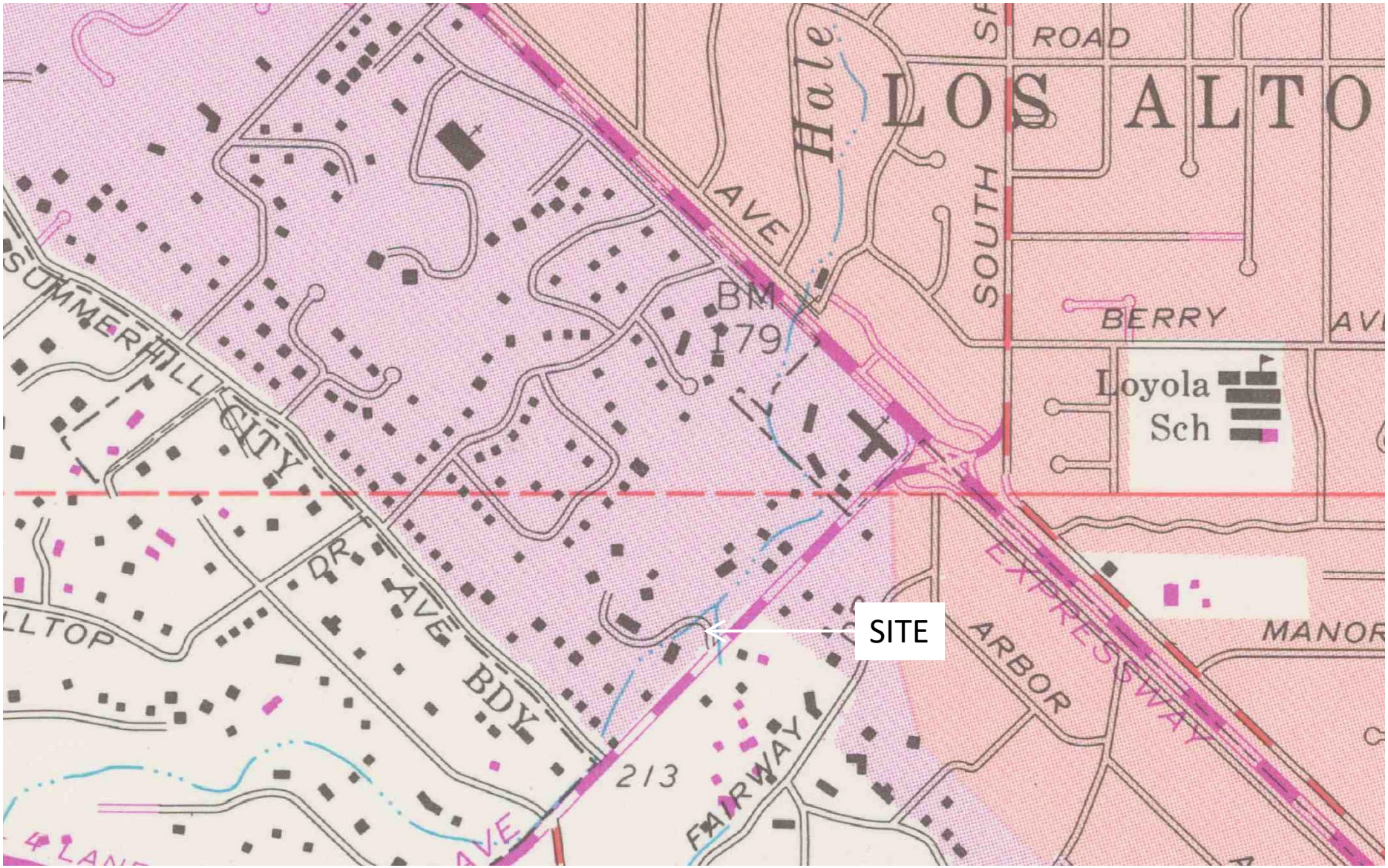
Appendix C. Summary Comparison of Model Output from March 4, 2021 and June 9, 2021 Model Versions.



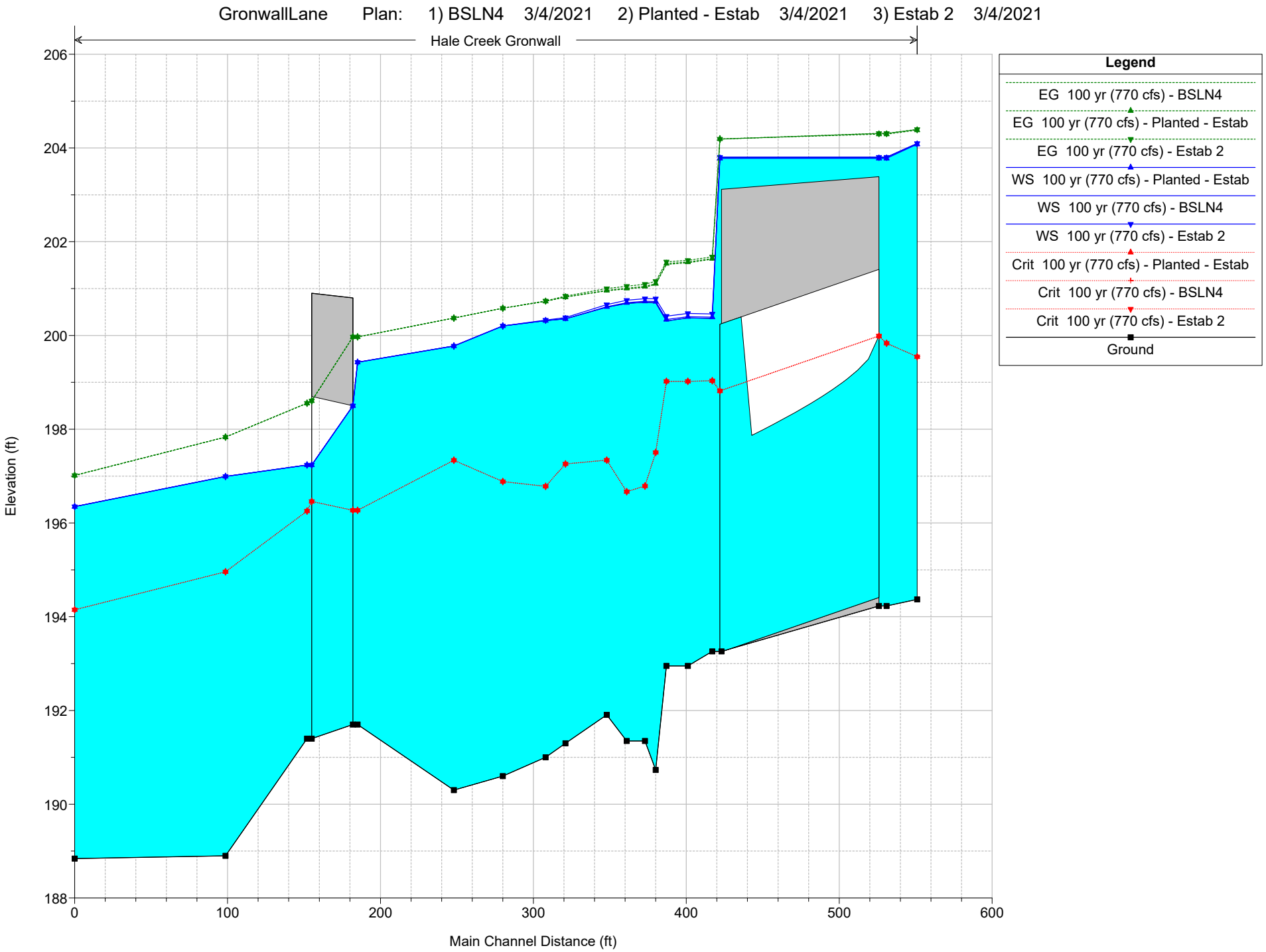

A-1. SITE LOCATION. SITE IS AT CONFLUENCE OF TWO FORKS OF HALE CREEK. BASE: GOOGLE EARTH.




A-2 SITE LOCATION. FEMA PUBLISHES BASE FLOOD ELEVATIONS UPSTREAM AND DOWNSTREAM FROM SITE. BASE: FEMA FIRM 06085C0201H.




A-3 SITE LOCATION. NORTH FORK OF HALE CREEK CULVERTED UPSTREAM FROM SITE. BASE: 1981 CUPERTINO 1:24,000 SCALE QUAD MAP


GronwallLane Plan: 1) BSLN4 3/4/2021 2) Planted - Estab 3/4/2021 3) Estab 2 3/4/2021
Hale Creek Gronwall
Legend
EG 100 yr (770 cfs) - BSLN4
EG 100 yr (770 cfs) - Planted - Estab
EG 100 yr (770 cfs) - Estab 2
WS 100 yr (770 cfs) - Planted - Estab
WS 100 yr (770 cfs) - BSLN4
WS 100 yr (770 cfs) - Estab 2
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Crit 100 yr (770 cfs) - BSLN4
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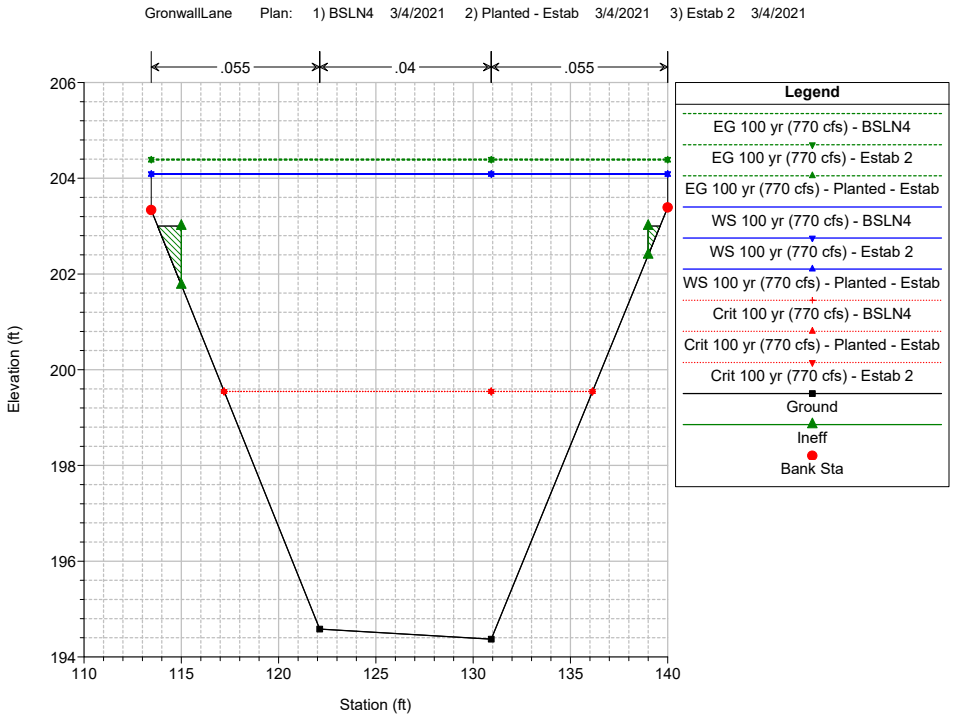
Ground
Elevation (ft)
206
204
202
200
198
196
194
192
190
188
0
100
200
300
400
500
600
Main Channel Distance (ft)


GronwallLane Plan: 1) BSLN4 3/4/2021 2) Planted - Estab 3/4/2021 3) Estab 2 3/4/2021
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Elevation (ft)
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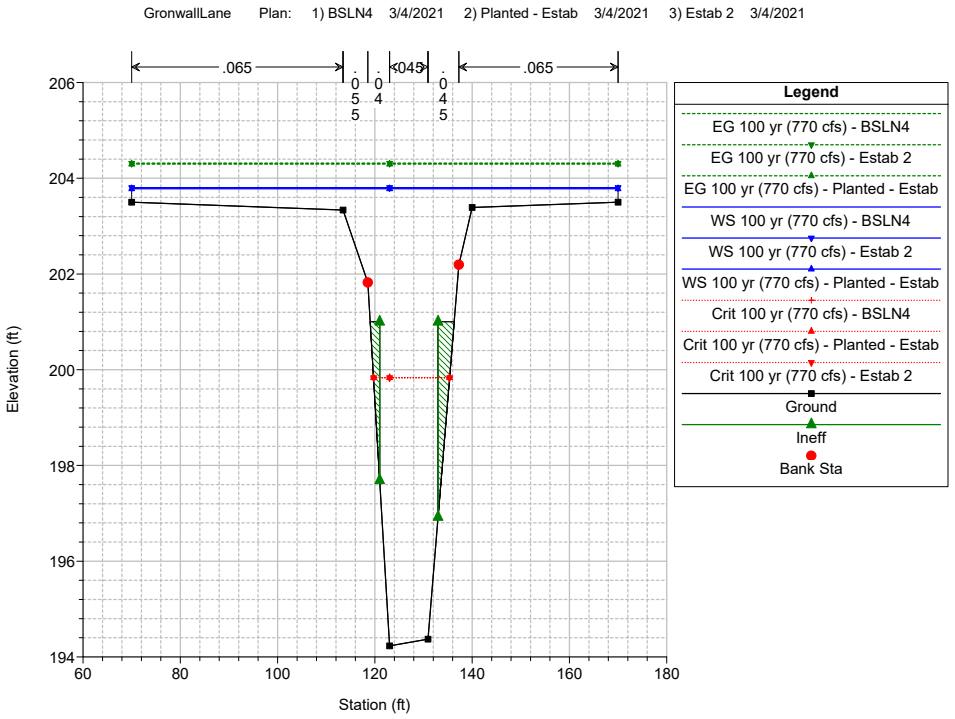
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Elevation (ft)
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EG 100 yr (770 cfs) - BSLN4
EG 100 yr (770 cfs) - Estab 2
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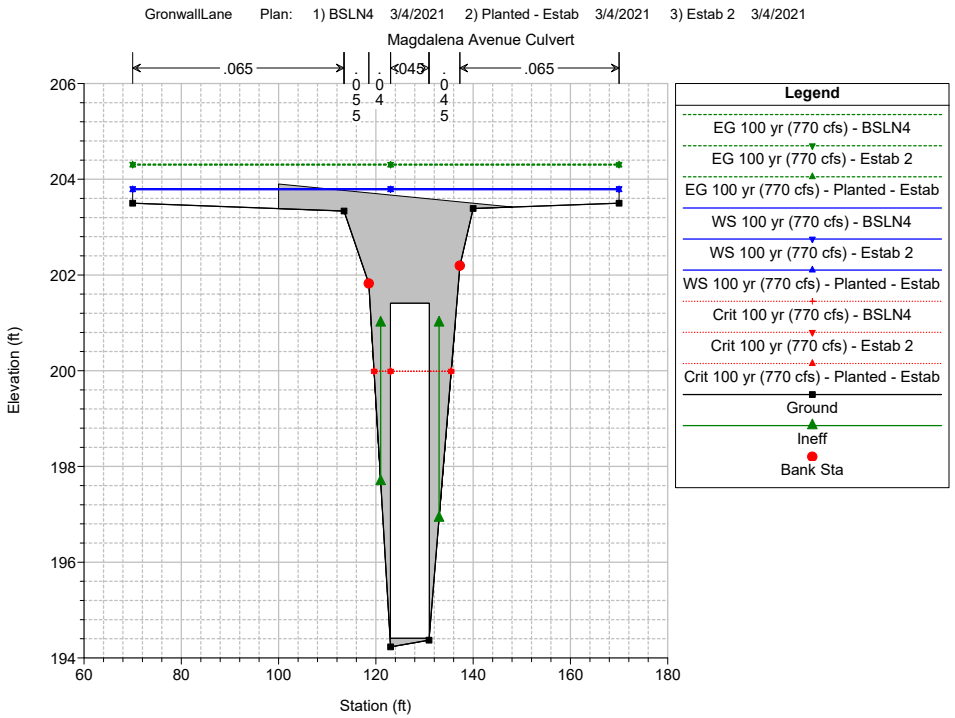
GronwallLane Plan: 1) BSLN4 3/4/2021 2) Planted - Estab 3/4/2021 3) Estab 2 3/4/2021
Magdalena Avenue Culvert
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.055
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.065
Elevation (ft)
Station (ft)
Legend
EG 100 yr (770 cfs) - BSLN4
EG 100 yr (770 cfs) - Estab 2
EG 100 yr (770 cfs) - Planted - Estab
WS 100 yr (770 cfs) - BSLN4
WS 100 yr (770 cfs) - Estab 2
WS 100 yr (770 cfs) - Planted - Estab
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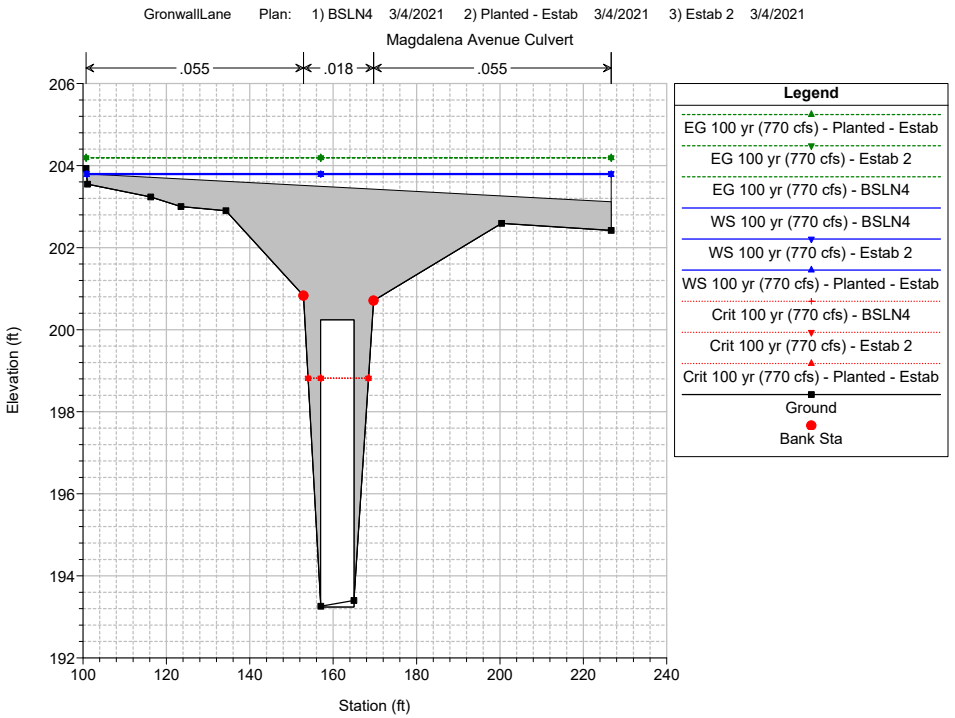
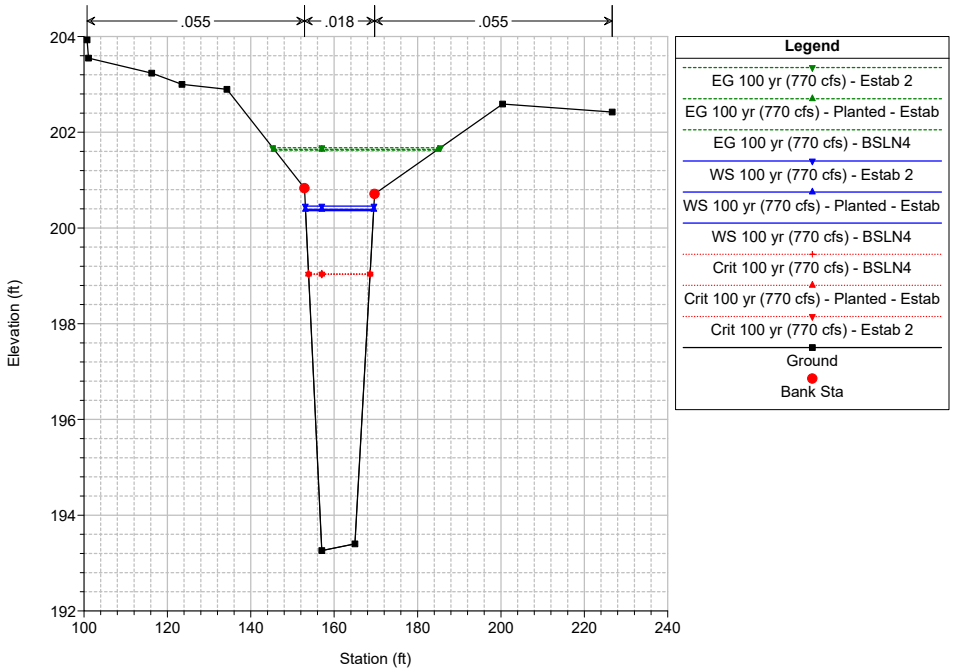
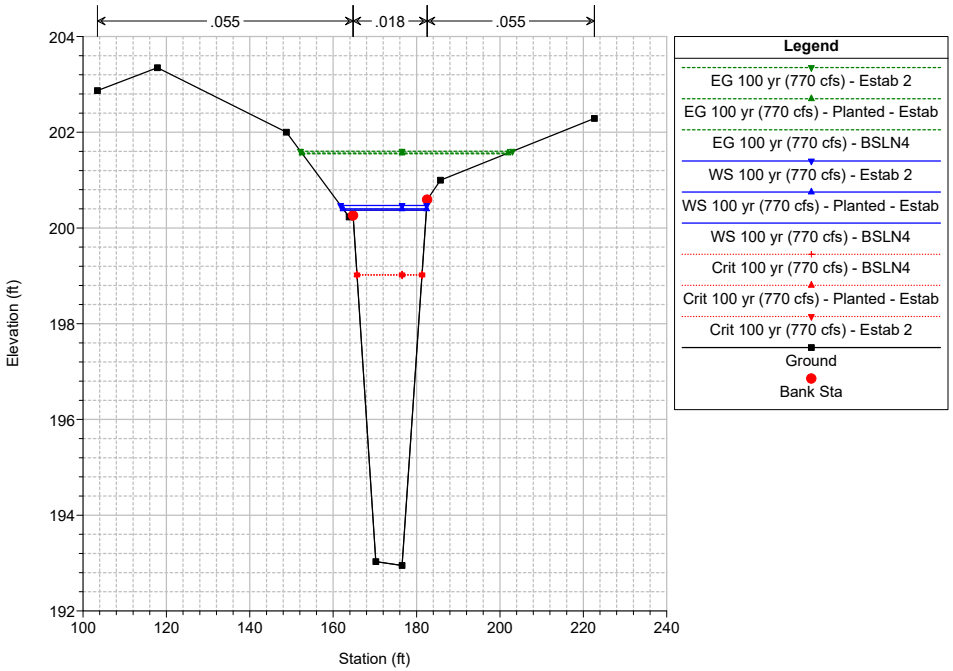
Ineff
Bank Sta


GronwallLane Plan: 1) BSLN4 3/4/2021 2) Planted - Estab 3/4/2021 3) Estab 2 3/4/2021
Magdalena Avenue Culvert
.055
.018
.055
Elevation (ft)
Station (ft)
Legend
EG 100 yr (770 cfs) - Planted - Estab
EG 100 yr (770 cfs) - Estab 2
EG 100 yr (770 cfs) - BSLN4
WS 100 yr (770 cfs) - BSLN4
WS 100 yr (770 cfs) - Estab 2
WS 100 yr (770 cfs) - Planted - Estab
Crit 100 yr (770 cfs) - BSLN4
Crit 100 yr (770 cfs) - Estab 2
Crit 100 yr (770 cfs) - Planted - Estab
Ground
Bank Sta

GronwallLane Plan: 1) BSLN4 3/4/2021 2) Planted - Estab 3/4/2021 3) Estab 2 3/4/2021

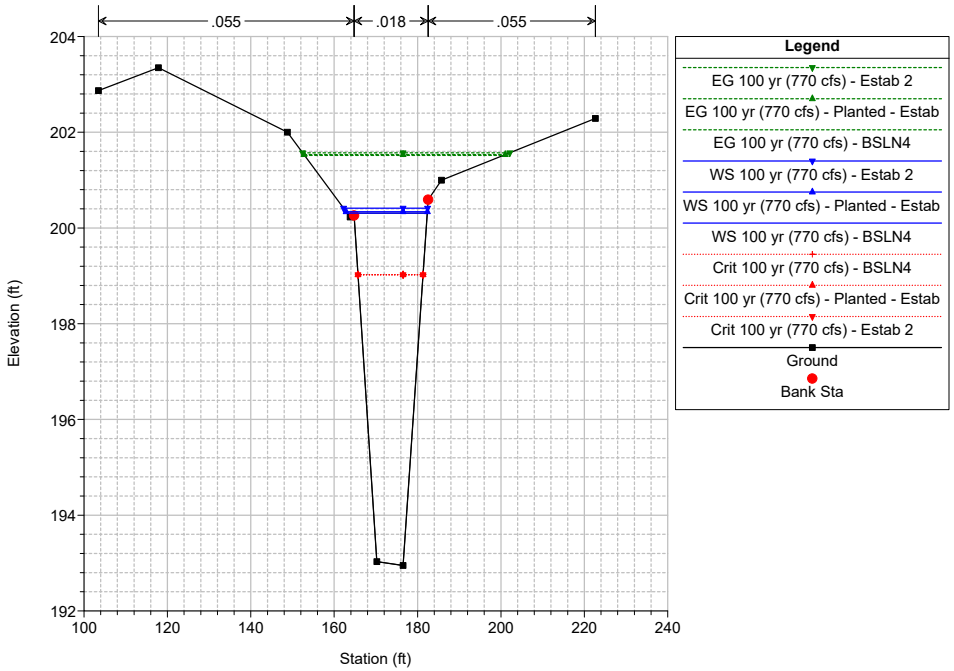



GronwallLane Plan: 1) BSLN4 3/4/2021 2) Planted - Estab 3/4/2021 3) Estab 2 3/4/2021

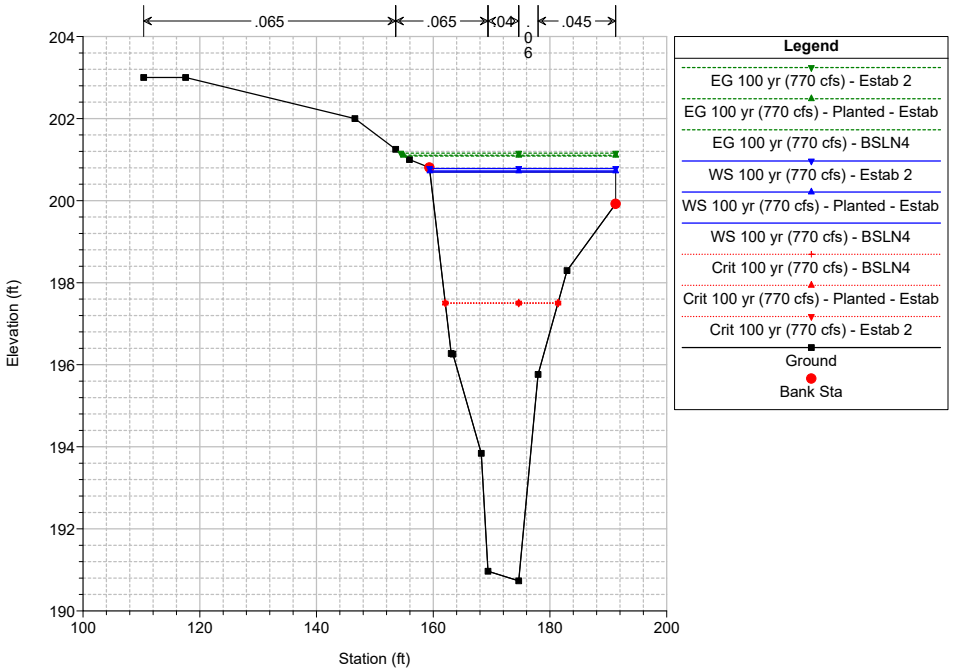



GronwallLane Plan: 1) BSLN4 3/4/2021 2) Planted - Estab 3/4/2021 3) Estab 2 3/4/2021

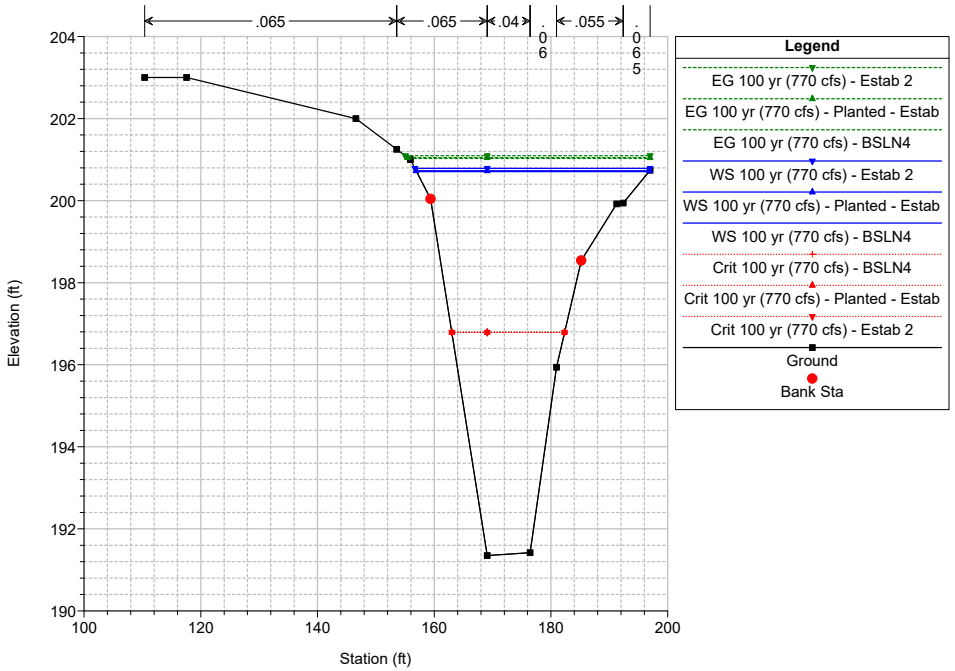
End of Sackrete and lined channel



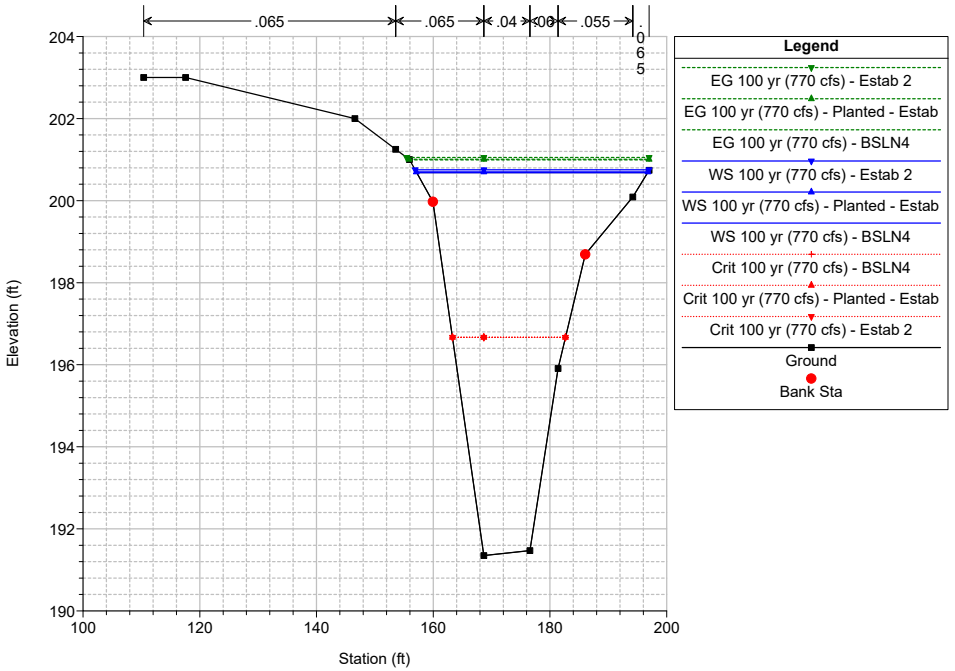

GronwallLane Plan: 1) BSLN4 3/4/2021 2) Planted - Estab 3/4/2021 3) Estab 2 3/4/2021



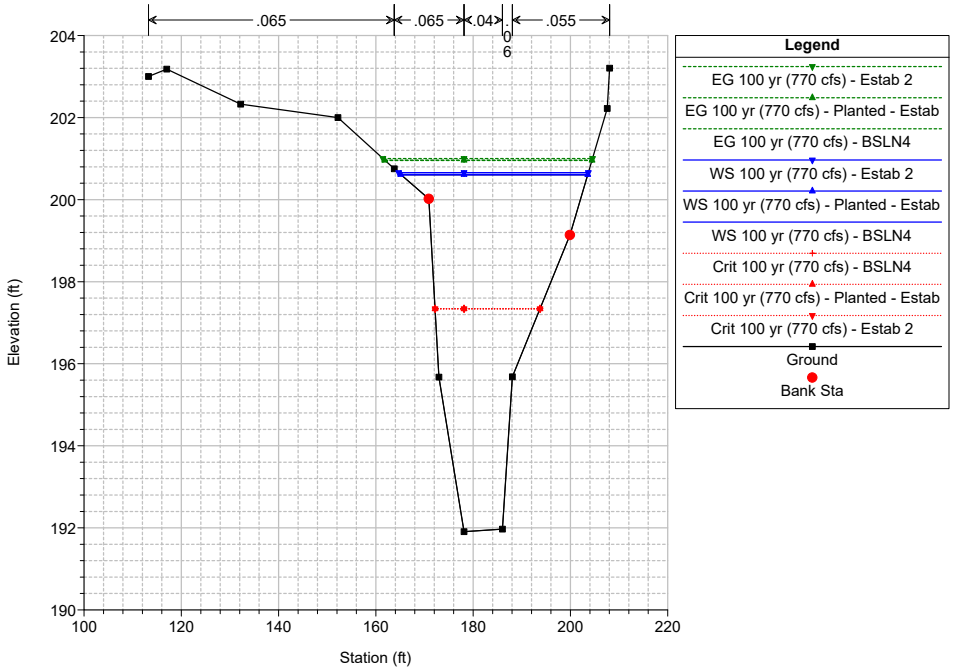
GronwallLane Plan: 1) BSLN4 3/4/2021 2) Planted - Estab 3/4/2021 3) Estab 2 3/4/2021



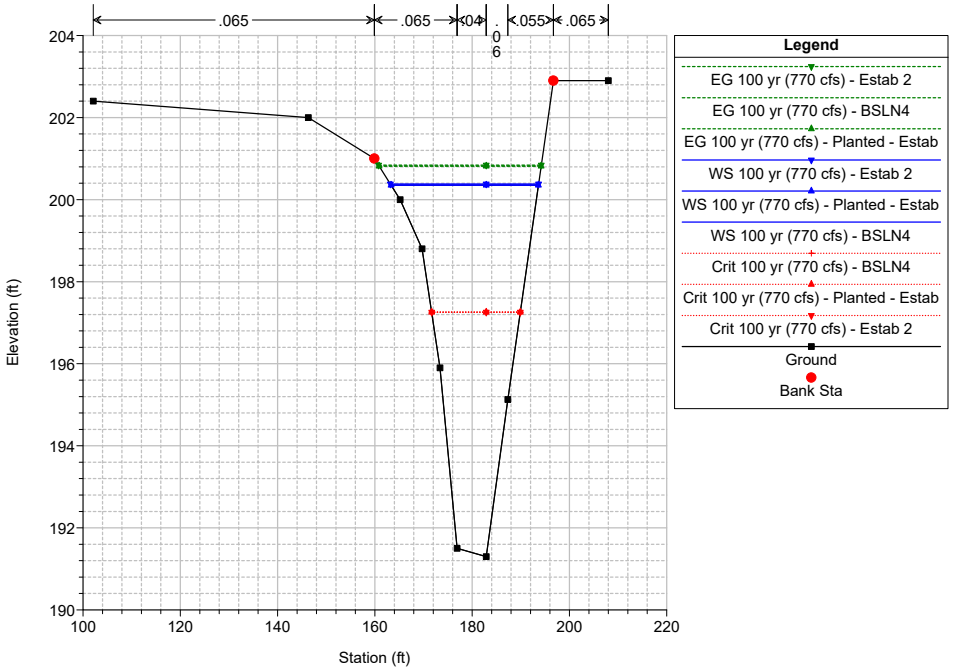

GronwallLane Plan: 1) BSLN4 3/4/2021 2) Planted - Estab 3/4/2021 3) Estab 2 3/4/2021



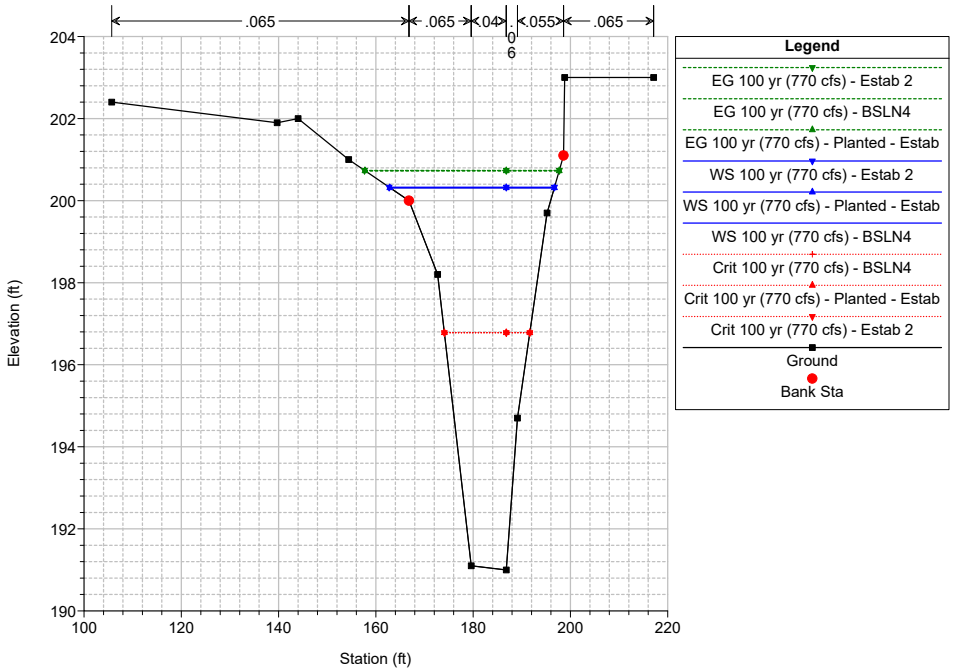

GronwallLane Plan: 1) BSLN4 3/4/2021 2) Planted - Estab 3/4/2021 3) Estab 2 3/4/2021



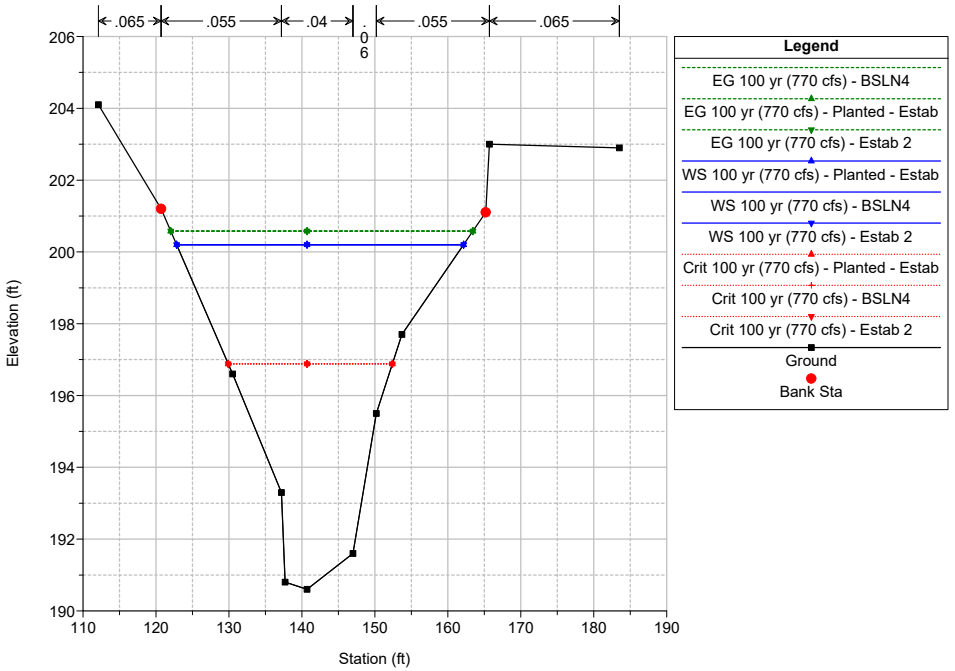

GronwallLane Plan: 1) BSLN4 3/4/2021 2) Planted - Estab 3/4/2021 3) Estab 2 3/4/2021



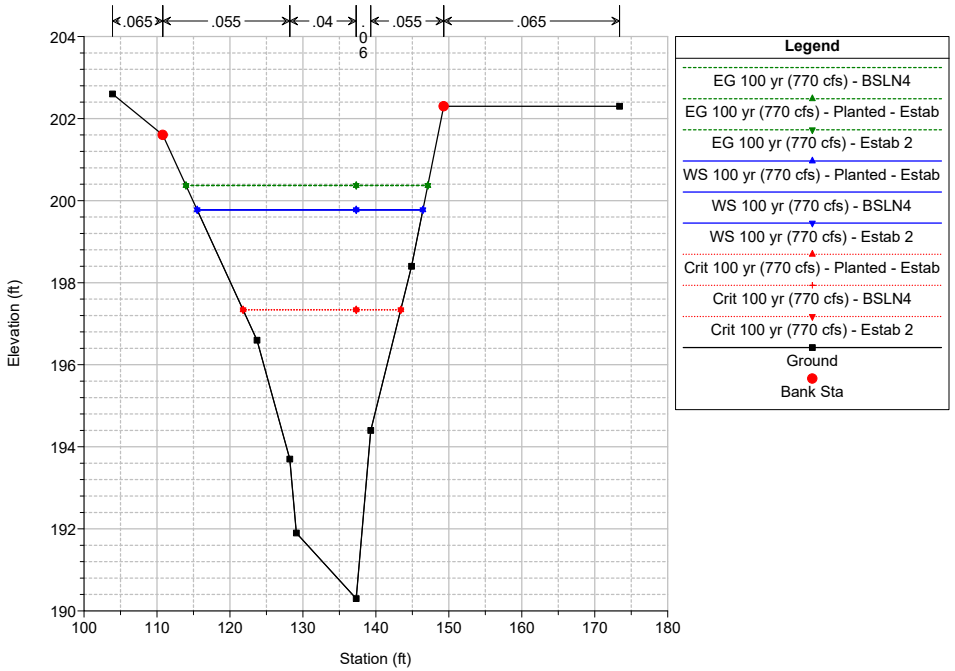
GronwallLane Plan: 1) BSLN4 3/4/2021 2) Planted - Estab 3/4/2021 3) Estab 2 3/4/2021



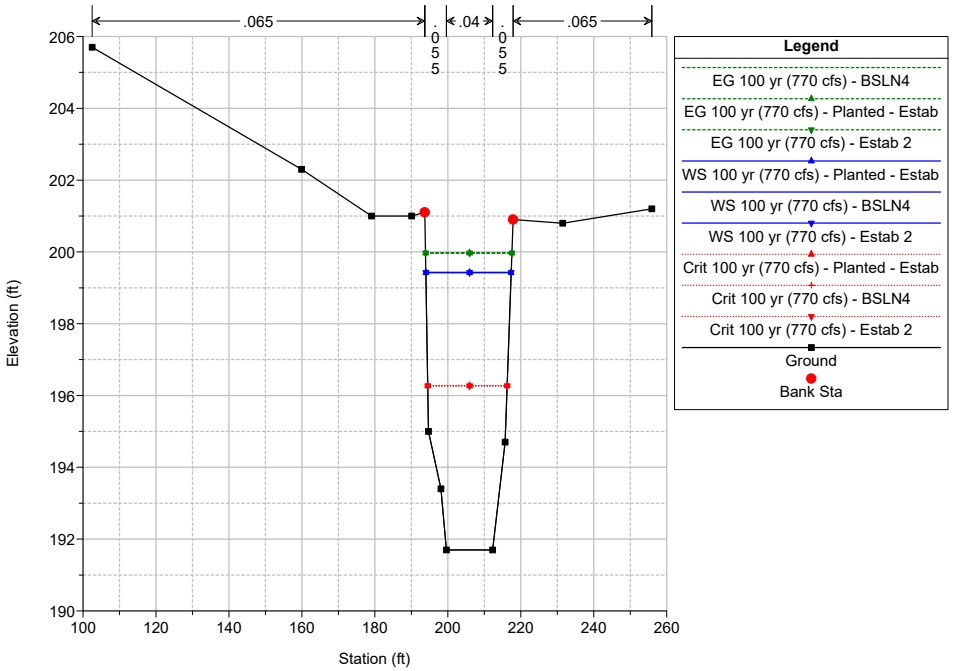

GronwallLane Plan: 1) BSLN4 3/4/2021 2) Planted - Estab 3/4/2021 3) Estab 2 3/4/2021




GronwallLane Plan: 1) BSLN4 3/4/2021 2) Planted - Estab 3/4/2021 3) Estab 2 3/4/2021

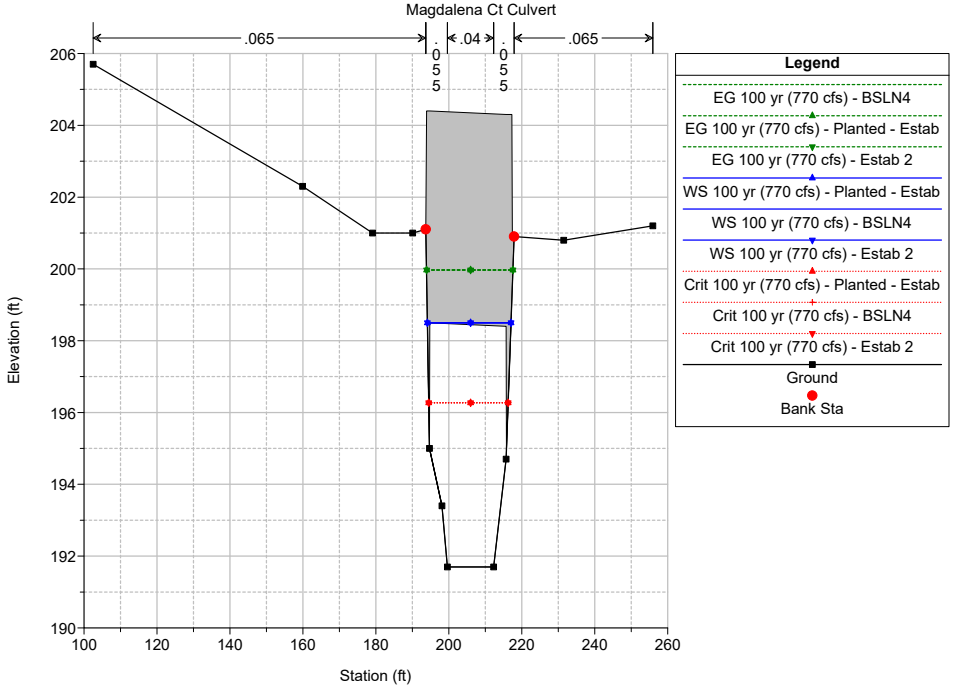



GronwallLane Plan: 1) BSLN4 3/4/2021 2) Planted - Estab 3/4/2021 3) Estab 2 3/4/2021



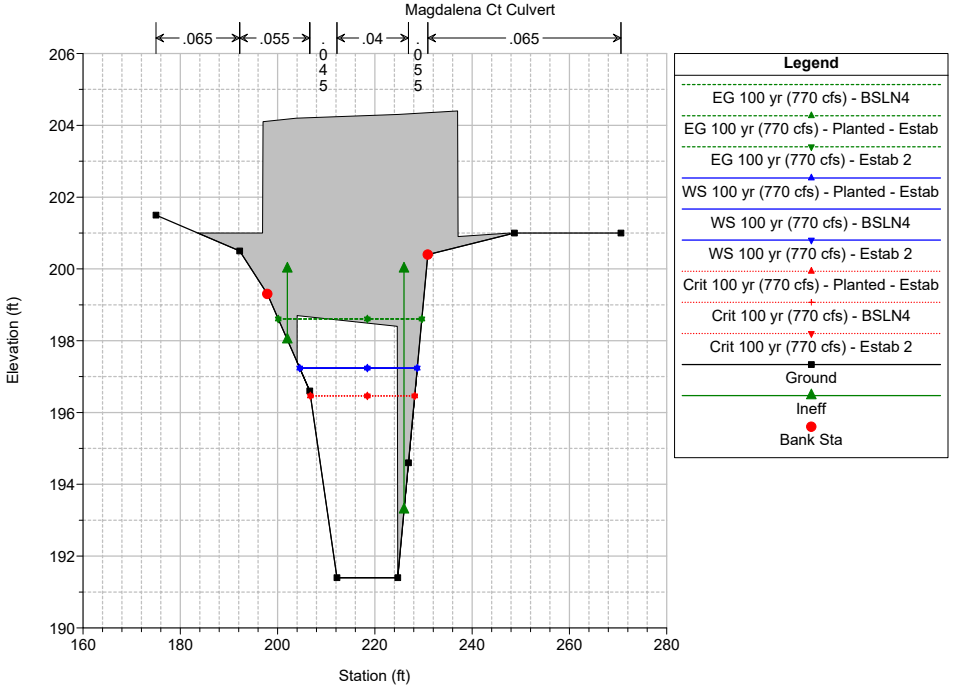
GronwallLane Plan: 1) BSLN4 3/4/2021 2) Planted - Estab 3/4/2021 3) Estab 2 3/4/2021

Magdalena Ct Culvert

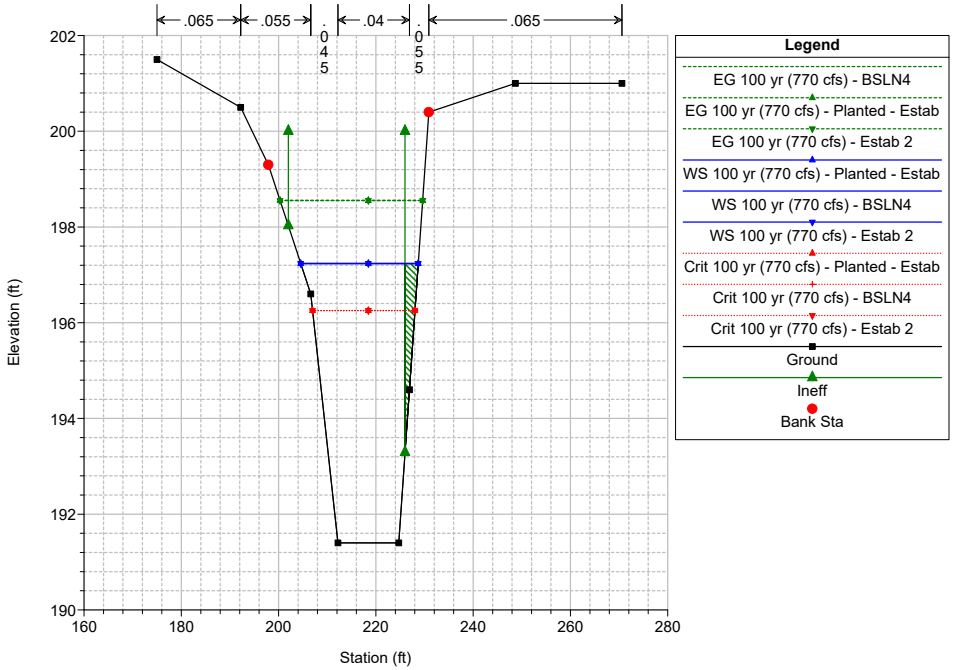



GronwallLane Plan: 1) BSLN4 3/4/2021 2) Planted - Estab 3/4/2021 3) Estab 2 3/4/2021

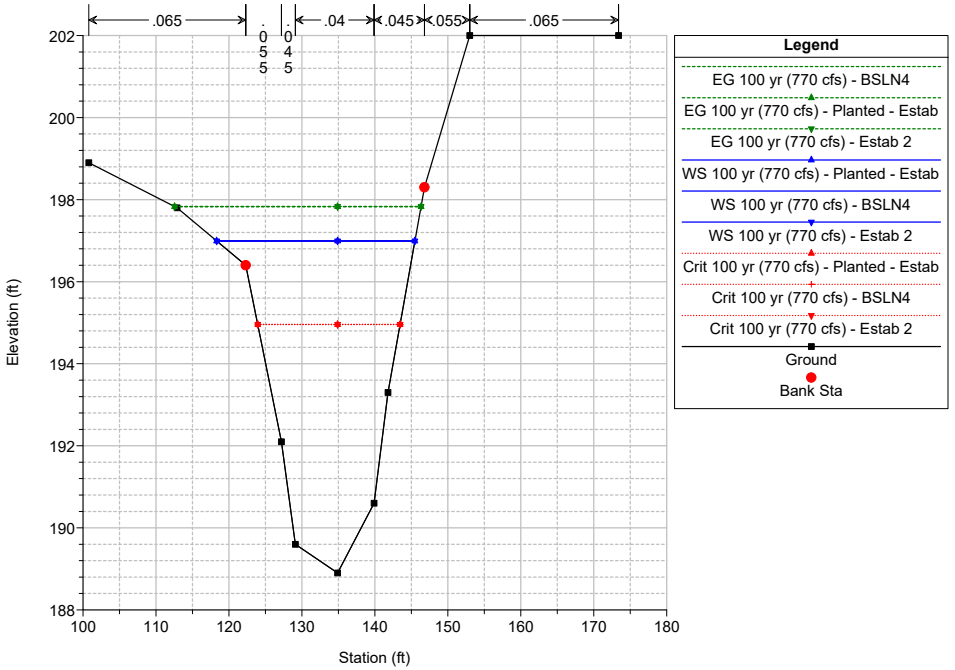
Magdalena Ct Culvert



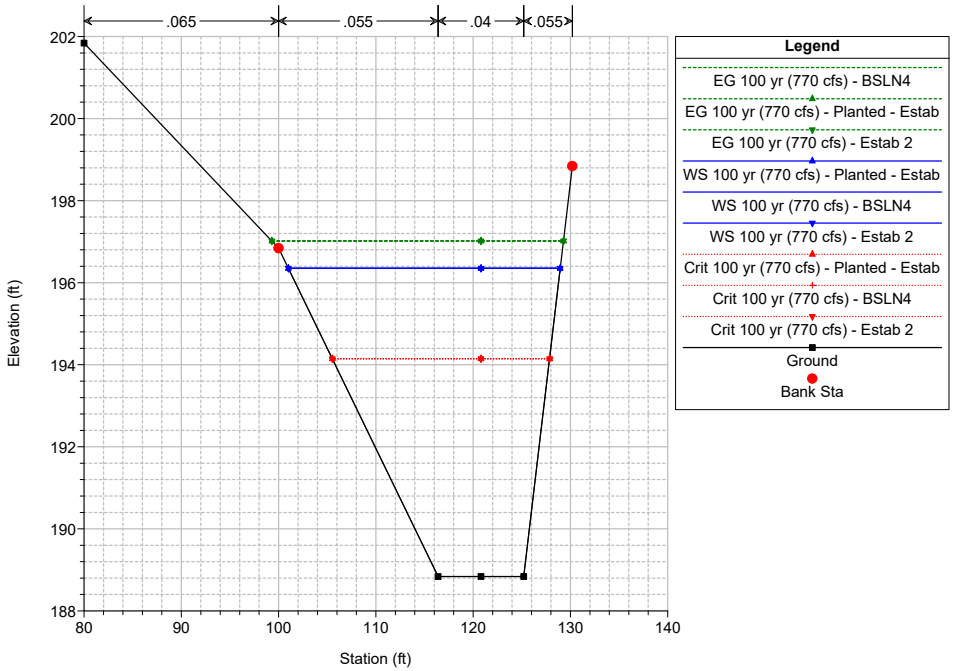

GronwallLane Plan: 1) BSLN4 3/4/2021 2) Planted - Estab 3/4/2021 3) Estab 2 3/4/2021




GronwallLane Plan: 1) BSLN4 3/4/2021 2) Planted - Estab 3/4/2021 3) Estab 2 3/4/2021



GronwallLane Plan: 1) BSLN4 3/4/2021 2) Planted - Estab 3/4/2021 3) Estab 2 3/4/2021



HEC-RAS River: Hale Creek Reach: Gronwall Profile: 100 yr (770 cfs)

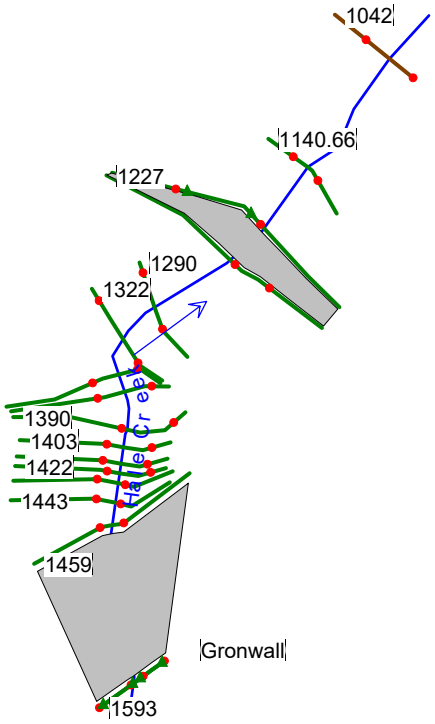
| Reach | River Sta | Profile | Plan | E.G. Elev | W.S. Elev | Vel Head | Frctn Loss | C & E Loss | Q Left | Q Channel | Q Right | Top Width |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | (ft) | (ft) | (ft) | (ft) | (ft) | (cfs) | (cfs) | (cfs) | (ft) |
| Gronwall | 1593 | 100 yr (770 cfs) | BSLN4 | 204.39 | 204.10 | 0.30 | 0.06 | 0.02 | | 770.00 | | 26.55 |
| Gronwall | 1593 | 100 yr (770 cfs) | Planted - Estab | 204.38 | 204.08 | 0.30 | 0.06 | 0.02 | | 770.00 | | 26.55 |
| Gronwall | 1593 | 100 yr (770 cfs) | Estab 2 | 204.39 | 204.10 | 0.30 | 0.06 | 0.02 | | 770.00 | | 26.55 |
| | | | | | | | | | | | | |
| Gronwall | 1573 | 100 yr (770 cfs) | BSLN4 | 204.31 | 203.80 | 0.51 | | | 23.91 | 735.71 | 10.38 | 100.00 |
| Gronwall | 1573 | 100 yr (770 cfs) | Planted - Estab | 204.30 | 203.78 | 0.52 | | | 22.46 | 738.07 | 9.47 | 100.00 |
| Gronwall | 1573 | 100 yr (770 cfs) | Estab 2 | 204.31 | 203.80 | 0.51 | | | 23.84 | 735.82 | 10.34 | 100.00 |
| | | | | | | | | | | | | |
| Gronwall | 1568 | | | Culvert | | | | | | | | |
| | | | | | | | | | | | | |
| Gronwall | 1459 | 100 yr (770 cfs) | BSLN4 | 201.63 | 200.36 | 1.26 | 0.03 | 0.04 | | 770.00 | | 16.34 |
| Gronwall | 1459 | 100 yr (770 cfs) | Planted - Estab | 201.64 | 200.39 | 1.25 | 0.03 | 0.04 | | 770.00 | | 16.37 |
| Gronwall | 1459 | 100 yr (770 cfs) | Estab 2 | 201.68 | 200.46 | 1.22 | 0.03 | 0.04 | | 770.00 | | 16.45 |
| | | | | | | | | | | | | |
| Gronwall | 1443 | 100 yr (770 cfs) | BSLN4 | 201.55 | 200.37 | 1.18 | 0.03 | 0.01 | 0.06 | 769.94 | | 19.79 |
| Gronwall | 1443 | 100 yr (770 cfs) | Planted - Estab | 201.57 | 200.40 | 1.16 | 0.03 | 0.01 | 0.08 | 769.92 | | 20.04 |
| Gronwall | 1443 | 100 yr (770 cfs) | Estab 2 | 201.60 | 200.47 | 1.13 | 0.03 | 0.01 | 0.16 | 769.84 | | 20.67 |
| | | | | | | | | | | | | |
| Gronwall | 1429 | 100 yr (770 cfs) | BSLN4 | 201.52 | 200.31 | 1.21 | 0.02 | 0.41 | 0.02 | 769.98 | | 19.18 |
| Gronwall | 1429 | 100 yr (770 cfs) | Planted - Estab | 201.53 | 200.34 | 1.19 | 0.02 | 0.40 | 0.03 | 769.97 | | 19.48 |
| Gronwall | 1429 | 100 yr (770 cfs) | Estab 2 | 201.57 | 200.41 | 1.16 | 0.02 | 0.39 | 0.09 | 769.91 | | 20.14 |
| | | | | | | | | | | | | |
| Gronwall | 1422 | 100 yr (770 cfs) | BSLN4 | 201.09 | 200.70 | 0.39 | 0.02 | 0.03 | | 770.00 | | 31.81 |
| Gronwall | 1422 | 100 yr (770 cfs) | Planted - Estab | 201.11 | 200.72 | 0.38 | 0.03 | 0.03 | | 770.00 | | 31.83 |
| Gronwall | 1422 | 100 yr (770 cfs) | Estab 2 | 201.16 | 200.78 | 0.37 | 0.03 | 0.03 | | 770.00 | | 31.88 |
| | | | | | | | | | | | | |
| Gronwall | 1415 | 100 yr (770 cfs) | BSLN4 | 201.03 | 200.71 | 0.32 | 0.03 | 0.01 | 0.63 | 752.05 | 17.32 | 39.82 |
| Gronwall | 1415 | 100 yr (770 cfs) | Planted - Estab | 201.05 | 200.73 | 0.32 | 0.03 | 0.00 | 0.60 | 750.23 | 19.17 | 40.03 |
| Gronwall | 1415 | 100 yr (770 cfs) | Estab 2 | 201.09 | 200.78 | 0.31 | 0.04 | 0.00 | 0.67 | 747.41 | 21.92 | 40.29 |
| | | | | | | | | | | | | |
| Gronwall | 1403 | 100 yr (770 cfs) | BSLN4 | 200.99 | 200.68 | 0.31 | 0.04 | 0.00 | 0.80 | 752.28 | 16.92 | 39.57 |
| Gronwall | 1403 | 100 yr (770 cfs) | Planted - Estab | 201.01 | 200.70 | 0.31 | 0.04 | 0.00 | 0.75 | 750.72 | 18.53 | 39.71 |
| Gronwall | 1403 | 100 yr (770 cfs) | Estab 2 | 201.05 | 200.75 | 0.30 | 0.05 | 0.00 | 0.80 | 748.22 | 20.97 | 40.08 |
| | | | | | | | | | | | | |
| Gronwall | 1390 | 100 yr (770 cfs) | BSLN4 | 200.95 | 200.60 | 0.35 | 0.12 | 0.01 | 1.40 | 765.37 | 3.23 | 38.34 |
| Gronwall | 1390 | 100 yr (770 cfs) | Planted - Estab | 200.96 | 200.61 | 0.35 | 0.13 | 0.01 | 1.27 | 765.25 | 3.49 | 38.46 |
| Gronwall | 1390 | 100 yr (770 cfs) | Estab 2 | 201.00 | 200.66 | 0.34 | 0.15 | 0.01 | 1.36 | 764.69 | 3.95 | 39.00 |
| | | | | | | | | | | | | |
| Gronwall | 1363 | 100 yr (770 cfs) | BSLN4 | 200.82 | 200.36 | 0.46 | 0.08 | 0.02 | | 770.00 | | 30.32 |
| Gronwall | 1363 | 100 yr (770 cfs) | Planted - Estab | 200.82 | 200.36 | 0.46 | 0.08 | 0.02 | | 770.00 | | 30.32 |
| Gronwall | 1363 | 100 yr (770 cfs) | Estab 2 | 200.84 | 200.38 | 0.46 | 0.09 | 0.01 | | 770.00 | | 30.49 |
| | | | | | | | | | | | | |
| Gronwall | 1350 | 100 yr (770 cfs) | BSLN4 | 200.73 | 200.32 | 0.41 | 0.14 | 0.01 | 0.30 | 769.70 | | 33.82 |

HEC-RAS River: Hale Creek Reach: Gronwall Profile: 100 yr (770 cfs) (Continued)

| Reach | River Sta | Profile | Plan | E.G. Elev | W.S. Elev | Vel Head | Frctn Loss | C & E Loss | Q Left | Q Channel | Q Right | Top Width |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | (ft) | (ft) | (ft) | (ft) | (ft) | (cfs) | (cfs) | (cfs) | (ft) |
| Gronwall | 1350 | 100 yr (770 cfs) | Planted - Estab | 200.73 | 200.32 | 0.41 | 0.14 | 0.01 | 0.30 | 769.70 | | 33.82 |
| Gronwall | 1350 | 100 yr (770 cfs) | Estab 2 | 200.74 | 200.33 | 0.41 | 0.15 | 0.01 | 0.36 | 769.64 | | 33.99 |
| | | | | | | | | | | | | |
| Gronwall | 1322 | 100 yr (770 cfs) | BSLN4 | 200.58 | 200.20 | 0.38 | 0.19 | 0.02 | | 903.00 | | 39.35 |
| Gronwall | 1322 | 100 yr (770 cfs) | Planted - Estab | 200.58 | 200.20 | 0.38 | 0.19 | 0.02 | | 903.00 | | 39.35 |
| Gronwall | 1322 | 100 yr (770 cfs) | Estab 2 | 200.58 | 200.20 | 0.38 | 0.19 | 0.02 | | 903.00 | | 39.35 |
| | | | | | | | | | | | | |
| Gronwall | 1290 | 100 yr (770 cfs) | BSLN4 | 200.37 | 199.78 | 0.59 | 0.38 | 0.02 | | 903.00 | | 30.94 |
| Gronwall | 1290 | 100 yr (770 cfs) | Planted - Estab | 200.37 | 199.78 | 0.59 | 0.38 | 0.02 | | 903.00 | | 30.94 |
| Gronwall | 1290 | 100 yr (770 cfs) | Estab 2 | 200.37 | 199.78 | 0.59 | 0.38 | 0.02 | | 903.00 | | 30.94 |
| | | | | | | | | | | | | |
| Gronwall | 1227 | 100 yr (770 cfs) | BSLN4 | 199.97 | 199.43 | 0.54 | | | | 903.00 | | 23.40 |
| Gronwall | 1227 | 100 yr (770 cfs) | Planted - Estab | 199.97 | 199.43 | 0.54 | | | | 903.00 | | 23.40 |
| Gronwall | 1227 | 100 yr (770 cfs) | Estab 2 | 199.97 | 199.43 | 0.54 | | | | 903.00 | | 23.40 |
| | | | | | | | | | | | | |
| Gronwall | 1210 | | | Bridge | | | | | | | | |
| | | | | | | | | | | | | |
| Gronwall | 1194 | 100 yr (770 cfs) | BSLN4 | 198.55 | 197.24 | 1.32 | 0.48 | 0.24 | | 903.00 | | 24.17 |
| Gronwall | 1194 | 100 yr (770 cfs) | Planted - Estab | 198.55 | 197.24 | 1.32 | 0.48 | 0.24 | | 903.00 | | 24.17 |
| Gronwall | 1194 | 100 yr (770 cfs) | Estab 2 | 198.55 | 197.24 | 1.32 | 0.48 | 0.24 | | 903.00 | | 24.17 |
| | | | | | | | | | | | | |
| Gronwall | 1140.66 | 100 yr (770 cfs) | BSLN4 | 197.83 | 196.99 | 0.84 | 0.77 | 0.05 | 1.03 | 901.97 | | 27.17 |
| Gronwall | 1140.66 | 100 yr (770 cfs) | Planted - Estab | 197.83 | 196.99 | 0.84 | 0.77 | 0.05 | 1.03 | 901.97 | | 27.17 |
| Gronwall | 1140.66 | 100 yr (770 cfs) | Estab 2 | 197.83 | 196.99 | 0.84 | 0.77 | 0.05 | 1.03 | 901.97 | | 27.17 |
| | | | | | | | | | | | | |
| Gronwall | 1042 | 100 yr (770 cfs) | BSLN4 | 197.01 | 196.35 | 0.67 | | | | 903.00 | | 27.95 |
| Gronwall | 1042 | 100 yr (770 cfs) | Planted - Estab | 197.01 | 196.35 | 0.67 | | | | 903.00 | | 27.95 |
| Gronwall | 1042 | 100 yr (770 cfs) | Estab 2 | 197.01 | 196.35 | 0.67 | | | | 903.00 | | 27.95 |

HEC-RAS River: Hale Creek Reach: Gronwall Profile: 100 yr (770 cfs)

| Reach | River Sta | Profile | Plan | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| Gronwall | 1593 | 100 yr (770 cfs) | BSLN4 | 770.00 | 194.37 | 204.10 | 199.55 | 204.39 | 0.002657 | 4.38 | 175.73 | 26.55 | 0.30 |
| Gronwall | 1593 | 100 yr (770 cfs) | Planted - Estab | 770.00 | 194.37 | 204.08 | 199.55 | 204.38 | 0.002675 | 4.39 | 175.31 | 26.55 | 0.30 |
| Gronwall | 1593 | 100 yr (770 cfs) | Estab 2 | 770.00 | 194.37 | 204.10 | 199.55 | 204.39 | 0.002657 | 4.38 | 175.71 | 26.55 | 0.30 |
| | | | | | | | | | | | | | |
| Gronwall | 1573 | 100 yr (770 cfs) | BSLN4 | 770.00 | 194.23 | 203.80 | 199.83 | 204.31 | 0.003749 | 5.84 | 162.47 | 100.00 | 0.40 |
| Gronwall | 1573 | 100 yr (770 cfs) | Planted - Estab | 770.00 | 194.23 | 203.78 | 199.83 | 204.30 | 0.003819 | 5.88 | 160.03 | 100.00 | 0.40 |
| Gronwall | 1573 | 100 yr (770 cfs) | Estab 2 | 770.00 | 194.23 | 203.80 | 199.83 | 204.31 | 0.003752 | 5.84 | 162.36 | 100.00 | 0.40 |
| | | | | | | | | | | | | | |
| Gronwall | 1568 | | | Culvert | | | | | | | | | |
| | | | | | | | | | | | | | |
| Gronwall | 1459 | 100 yr (770 cfs) | BSLN4 | 770.00 | 193.26 | 200.36 | 199.04 | 201.63 | 0.002239 | 9.02 | 85.38 | 16.34 | 0.70 |
| Gronwall | 1459 | 100 yr (770 cfs) | Planted - Estab | 770.00 | 193.26 | 200.39 | 199.04 | 201.64 | 0.002209 | 8.97 | 85.81 | 16.37 | 0.69 |
| Gronwall | 1459 | 100 yr (770 cfs) | Estab 2 | 770.00 | 193.26 | 200.46 | 199.04 | 201.68 | 0.002135 | 8.86 | 86.92 | 16.45 | 0.68 |
| | | | | | | | | | | | | | |
| Gronwall | 1443 | 100 yr (770 cfs) | BSLN4 | 770.00 | 192.95 | 200.37 | 199.02 | 201.55 | 0.002038 | 8.70 | 88.69 | 19.79 | 0.68 |
| Gronwall | 1443 | 100 yr (770 cfs) | Planted - Estab | 770.00 | 192.95 | 200.40 | 199.02 | 201.57 | 0.002006 | 8.66 | 89.22 | 20.04 | 0.68 |
| Gronwall | 1443 | 100 yr (770 cfs) | Estab 2 | 770.00 | 192.95 | 200.47 | 199.02 | 201.60 | 0.001927 | 8.54 | 90.61 | 20.67 | 0.67 |
| | | | | | | | | | | | | | |
| Gronwall | 1429 | 100 yr (770 cfs) | BSLN4 | 770.00 | 192.95 | 200.31 | 199.02 | 201.52 | 0.002119 | 8.82 | 87.42 | 19.18 | 0.70 |
| Gronwall | 1429 | 100 yr (770 cfs) | Planted - Estab | 770.00 | 192.95 | 200.34 | 199.02 | 201.53 | 0.002079 | 8.76 | 88.03 | 19.48 | 0.69 |
| Gronwall | 1429 | 100 yr (770 cfs) | Estab 2 | 770.00 | 192.95 | 200.41 | 199.02 | 201.57 | 0.001993 | 8.64 | 89.44 | 20.14 | 0.68 |
| | | | | | | | | | | | | | |
| Gronwall | 1422 | 100 yr (770 cfs) | BSLN4 | 770.00 | 190.73 | 200.70 | 197.50 | 201.09 | 0.004165 | 4.99 | 154.32 | 31.81 | 0.40 |
| Gronwall | 1422 | 100 yr (770 cfs) | Planted - Estab | 770.00 | 190.73 | 200.72 | 197.50 | 201.11 | 0.004763 | 4.96 | 155.12 | 31.83 | 0.40 |
| Gronwall | 1422 | 100 yr (770 cfs) | Estab 2 | 770.00 | 190.73 | 200.78 | 197.50 | 201.16 | 0.005325 | 4.90 | 156.99 | 31.88 | 0.39 |
| | | | | | | | | | | | | | |
| Gronwall | 1415 | 100 yr (770 cfs) | BSLN4 | 770.00 | 191.35 | 200.71 | 196.79 | 201.03 | 0.002553 | 4.60 | 175.87 | 39.82 | 0.32 |
| Gronwall | 1415 | 100 yr (770 cfs) | Planted - Estab | 770.00 | 191.35 | 200.73 | 196.79 | 201.05 | 0.002949 | 4.57 | 176.75 | 40.03 | 0.32 |
| Gronwall | 1415 | 100 yr (770 cfs) | Estab 2 | 770.00 | 191.35 | 200.78 | 196.79 | 201.09 | 0.003325 | 4.51 | 178.97 | 40.29 | 0.31 |
| | | | | | | | | | | | | | |
| Gronwall | 1403 | 100 yr (770 cfs) | BSLN4 | 770.00 | 191.35 | 200.68 | 196.67 | 200.99 | 0.002459 | 4.52 | 178.71 | 39.57 | 0.32 |
| Gronwall | 1403 | 100 yr (770 cfs) | Planted - Estab | 770.00 | 191.35 | 200.70 | 196.67 | 201.01 | 0.002818 | 4.50 | 179.39 | 39.71 | 0.31 |
| Gronwall | 1403 | 100 yr (770 cfs) | Estab 2 | 770.00 | 191.35 | 200.75 | 196.67 | 201.05 | 0.003157 | 4.45 | 181.40 | 40.08 | 0.31 |
| | | | | | | | | | | | | | |
| Gronwall | 1390 | 100 yr (770 cfs) | BSLN4 | 770.00 | 191.91 | 200.60 | 197.34 | 200.95 | 0.003351 | 4.76 | 165.28 | 38.34 | 0.36 |
| Gronwall | 1390 | 100 yr (770 cfs) | Planted - Estab | 770.00 | 191.91 | 200.61 | 197.34 | 200.96 | 0.003763 | 4.75 | 165.66 | 38.46 | 0.35 |
| Gronwall | 1390 | 100 yr (770 cfs) | Estab 2 | 770.00 | 191.91 | 200.66 | 197.34 | 201.00 | 0.004135 | 4.71 | 167.38 | 39.00 | 0.35 |
| | | | | | | | | | | | | | |
| Gronwall | 1363 | 100 yr (770 cfs) | BSLN4 | 770.00 | 191.30 | 200.36 | 197.26 | 200.82 | 0.006503 | 5.46 | 140.92 | 30.32 | 0.45 |
| Gronwall | 1363 | 100 yr (770 cfs) | Planted - Estab | 770.00 | 191.30 | 200.36 | 197.26 | 200.82 | 0.006503 | 5.46 | 140.92 | 30.32 | 0.45 |
| Gronwall | 1363 | 100 yr (770 cfs) | Estab 2 | 770.00 | 191.30 | 200.38 | 197.26 | 200.84 | 0.007616 | 5.43 | 141.72 | 30.49 | 0.44 |
| | | | | | | | | | | | | | |
| Gronwall | 1350 | 100 yr (770 cfs) | BSLN4 | 770.00 | 191.00 | 200.32 | 196.78 | 200.73 | 0.005224 | 5.14 | 150.27 | 33.82 | 0.41 |
| Gronwall | 1350 | 100 yr (770 cfs) | Planted - Estab | 770.00 | 191.00 | 200.32 | 196.78 | 200.73 | 0.005224 | 5.14 | 150.27 | 33.82 | 0.41 |
| Gronwall | 1350 | 100 yr (770 cfs) | Estab 2 | 770.00 | 191.00 | 200.33 | 196.78 | 200.74 | 0.006114 | 5.13 | 150.64 | 33.99 | 0.40 |


1042
1140.66
1227
1290
1322
Hare Cr e
1390
1403
1422
1443
1459
Gronwall
1593

**March 4, 2021 Model Version**

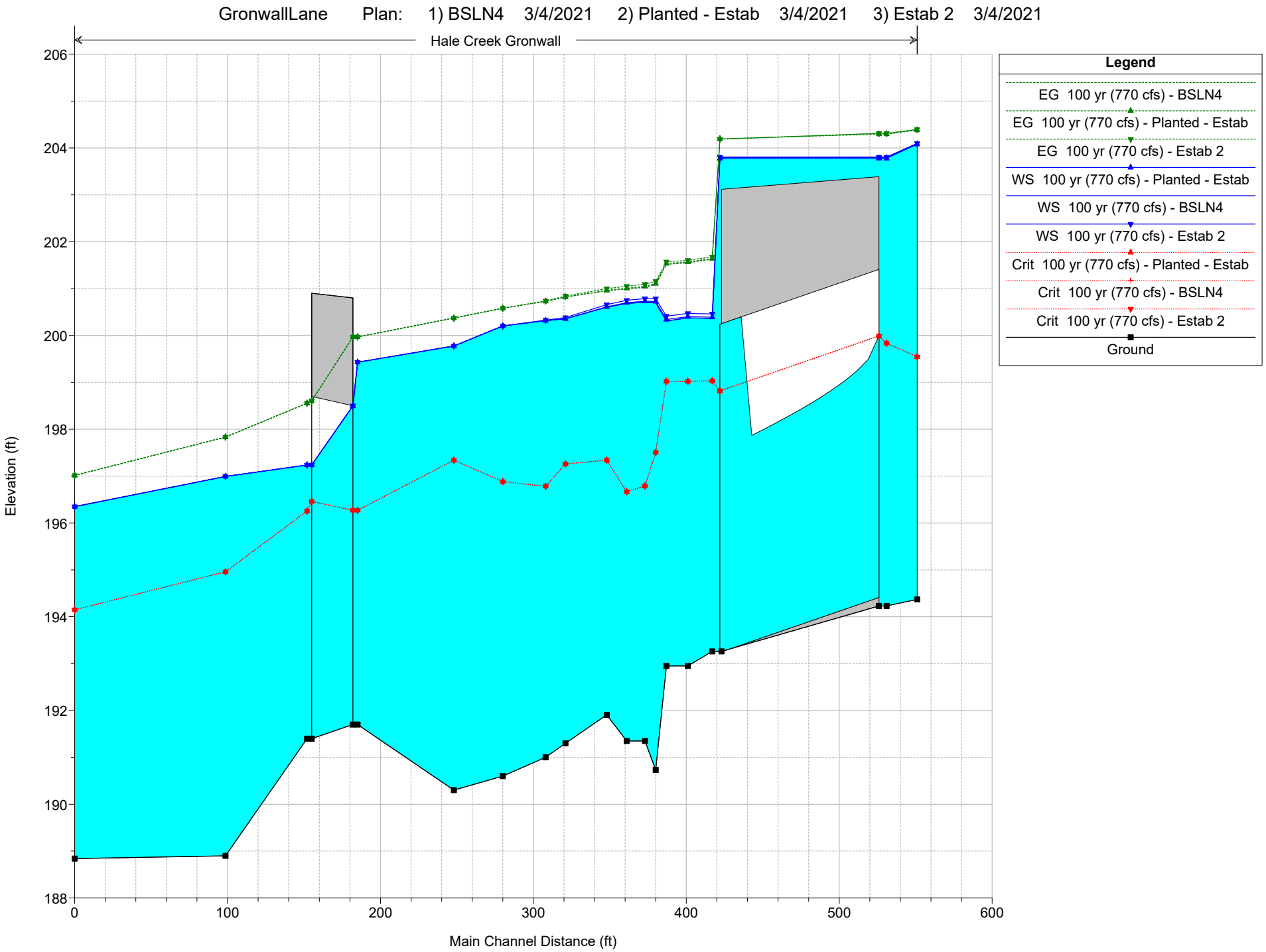
| River Station (ft) | Flow (cfs) | Existing Conditions | | | Proposed - Initial | | | Proposed - Established | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | W.S. Elev (ft NAVD88) | Velocity (ft/s) | Shear Stress (lb/sq ft) | W.S. Elev (ft NAVD88) | Velocity (ft/s) | Shear Stress (lb/sq ft) | W.S. Elev (ft NAVD88) | Velocity (ft/s) | Shear Stress (lb/sq ft) |
| 1593 | 770 | 204.1 | 4.38 | 0.82 | 204.08 | 4.39 | 0.83 | 204.1 | 4.38 | 0.82 |
| 1573 | 770 | 203.8 | 5.84 | 1.1 | 203.78 | 5.88 | 1.12 | 203.8 | 5.84 | 1.1 |
| 1568 | Culvert | | | | | | | | | |
| 1459 | 770 | 200.36 | 9.02 | 0.49 | 200.39 | 8.97 | 0.49 | 200.46 | 8.86 | 0.47 |
| 1443 | 770 | 200.37 | 8.7 | 0.45 | 200.4 | 8.66 | 0.45 | 200.47 | 8.54 | 0.44 |
| 1429 | 770 | 200.31 | 8.82 | 0.47 | 200.34 | 8.76 | 0.46 | 200.41 | 8.64 | 0.45 |
| 1422 | 770 | 200.7 | 4.99 | 0.99 | 200.72 | 4.96 | 1.13 | 200.78 | 4.9 | 1.28 |
| 1415 | 770 | 200.71 | 4.6 | 0.82 | 200.73 | 4.57 | 0.95 | 200.78 | 4.51 | 1.08 |
| 1403 | 770 | 200.68 | 4.52 | 0.8 | 200.7 | 4.5 | 0.91 | 200.75 | 4.45 | 1.03 |
| 1390 | 770 | 200.6 | 4.76 | 0.94 | 200.61 | 4.75 | 1.06 | 200.66 | 4.71 | 1.18 |
| 1363 | 770 | 200.36 | 5.46 | 1.55 | 200.36 | 5.46 | 1.55 | 200.38 | 5.43 | 1.82 |
| 1350 | 770 | 200.32 | 5.14 | 1.31 | 200.32 | 5.14 | 1.31 | 200.33 | 5.13 | 1.54 |
| 1322 | 903 | 200.2 | 4.92 | 1.16 | 200.2 | 4.92 | 1.16 | 200.2 | 4.92 | 1.16 |
| 1290 | 903 | 199.78 | 6.18 | 1.85 | 199.78 | 6.18 | 1.85 | 199.78 | 6.18 | 1.85 |
| 1227 | 903 | 199.43 | 5.9 | 1.44 | 199.43 | 5.9 | 1.44 | 199.43 | 5.9 | 1.44 |
| 1210 | Bridge | | | | | | | | | |
| 1194 | 903 | 197.24 | 9.2 | 2.79 | 197.24 | 9.2 | 2.79 | 197.24 | 9.2 | 2.79 |
| 1140.66 | 903 | 196.99 | 7.36 | 1.97 | 196.99 | 7.36 | 1.97 | 196.99 | 7.36 | 1.97 |
| 1042 | 903 | 196.35 | 6.55 | 2.01 | 196.35 | 6.55 | 2.01 | 196.35 | 6.55 | 2.01 |

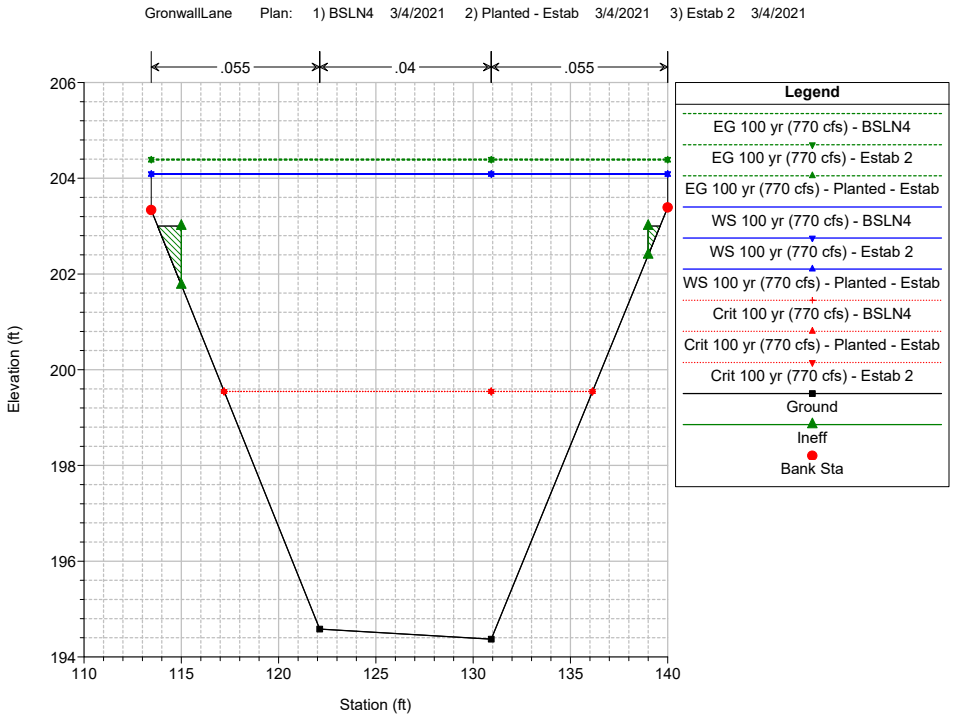
**June 9, 2021 Model Version**

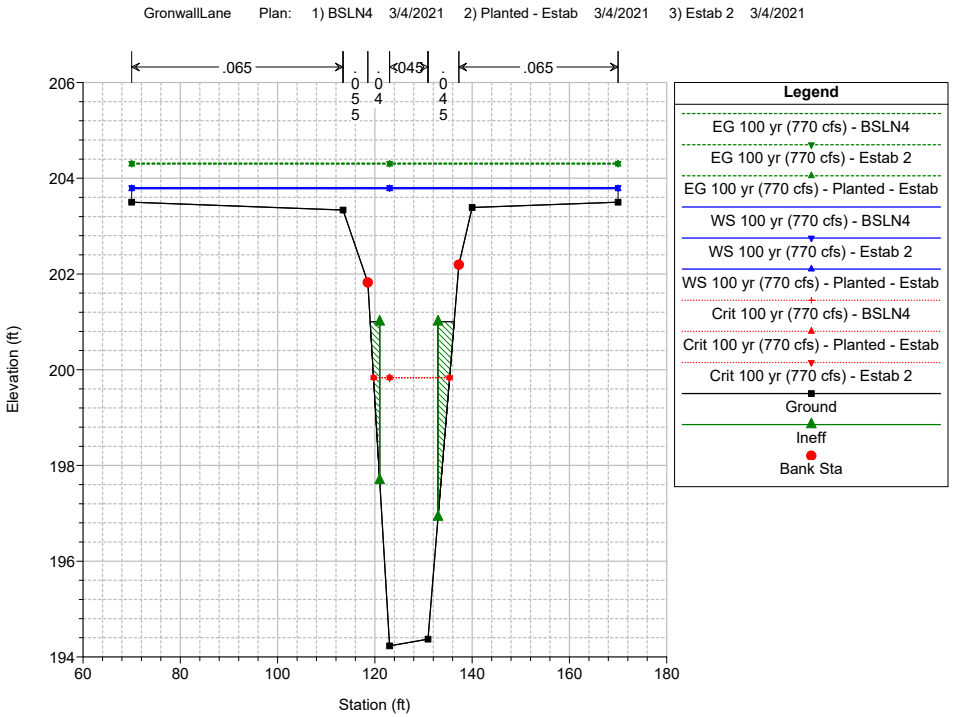
| River Station (ft) | Flow (cfs) | Existing Conditions | | | Proposed - Initial | | | Proposed - Established | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | W.S. Elev (ft NAVD88) | Velocity (ft/s) | Shear Stress (lb/sq ft) | W.S. Elev (ft NAVD88) | Velocity (ft/s) | Shear Stress (lb/sq ft) | W.S. Elev (ft NAVD88) | Velocity (ft/s) | Shear Stress (lb/sq ft) |
| 1593 | 770 | 204.1 | 4.38 | 0.82 | 204.08 | 4.39 | 0.83 | 204.1 | 4.38 | 0.82 |
| 1573 | 770 | 203.8 | 5.84 | 1.1 | 203.78 | 5.88 | 1.12 | 203.8 | 5.84 | 1.1 |
| 1568 | Culvert | | | | Culvert | | | | | |
| 1459 | 770 | 200.36 | 9.02 | 0.49 | 200.39 | 8.97 | 0.49 | 200.46 | 8.86 | 0.47 |
| 1443 | 770 | 200.37 | 8.7 | 0.45 | 200.4 | 8.66 | 0.45 | 200.47 | 8.54 | 0.44 |
| 1429 | 770 | 200.31 | 8.82 | 0.47 | 200.34 | 8.76 | 0.46 | 200.41 | 8.64 | 0.45 |
| 1422 | 770 | 200.7 | 4.99 | 0.99 | 200.72 | 4.96 | 1.13 | 200.78 | 4.9 | 1.28 |
| 1415 | 770 | 200.71 | 4.6 | 0.82 | 200.73 | 4.57 | 0.95 | 200.78 | 4.51 | 1.08 |
| 1403 | 770 | 200.68 | 4.52 | 0.8 | 200.7 | 4.5 | 0.91 | 200.75 | 4.45 | 1.03 |
| 1390 | 770 | 200.6 | 4.76 | 0.94 | 200.61 | 4.75 | 1.06 | 200.66 | 4.71 | 1.18 |
| 1363 | 770 | 200.36 | 5.46 | 1.55 | 200.36 | 5.46 | 1.55 | 200.38 | 5.43 | 1.82 |
| 1350 | 770 | 200.32 | 5.14 | 1.31 | 200.32 | 5.14 | 1.31 | 200.33 | 5.13 | 1.54 |
| 1322 | 903 | 200.2 | 4.92 | 1.16 | 200.2 | 4.92 | 1.16 | 200.2 | 4.92 | 1.16 |
| 1290 | 903 | 199.78 | 6.18 | 1.85 | 199.78 | 6.18 | 1.85 | 199.78 | 6.18 | 1.85 |
| 1227 | 903 | 199.43 | 5.9 | 1.44 | 199.43 | 5.9 | 1.44 | 199.43 | 5.9 | 1.44 |
| 1210 | Bridge | | | | Bridge | | | | | |
| 1194 | 903 | 197.24 | 9.2 | 2.79 | 197.24 | 9.2 | 2.79 | 197.24 | 9.2 | 2.79 |
| 1140.66 | 903 | 196.99 | 7.36 | 1.97 | 196.99 | 7.36 | 1.97 | 196.99 | 7.36 | 1.97 |
| 1042 | 903 | 196.35 | 6.55 | 2.01 | 196.35 | 6.55 | 2.01 | 196.35 | 6.55 | 2.01 |

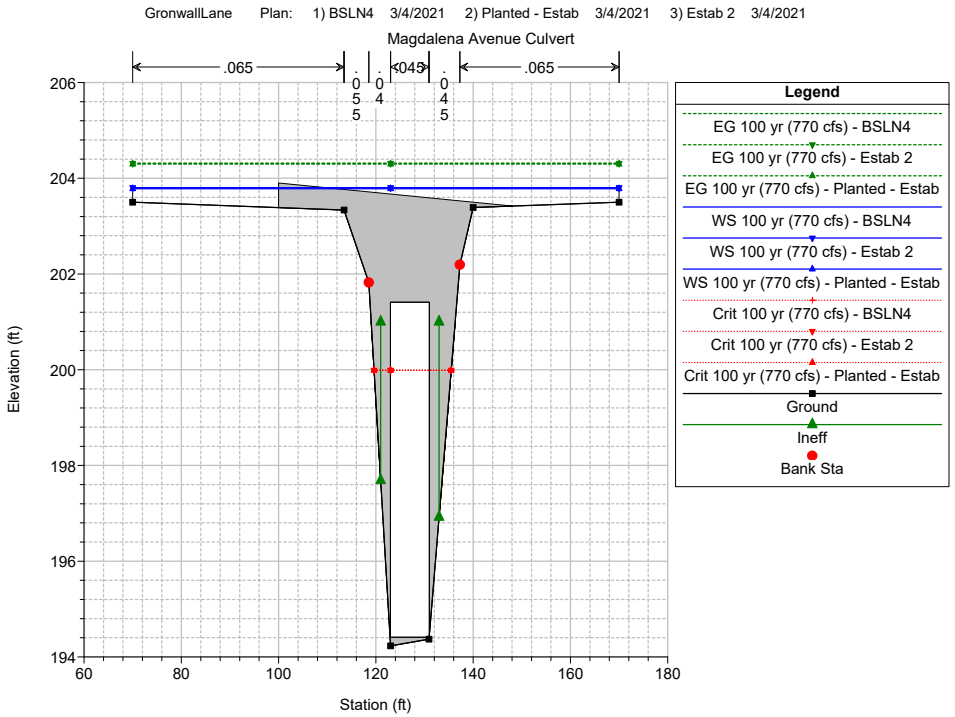
HEC-RAS River: Hale Creek Reach: Gronwall Profile: 100 yr (770 cfs) (Continued)

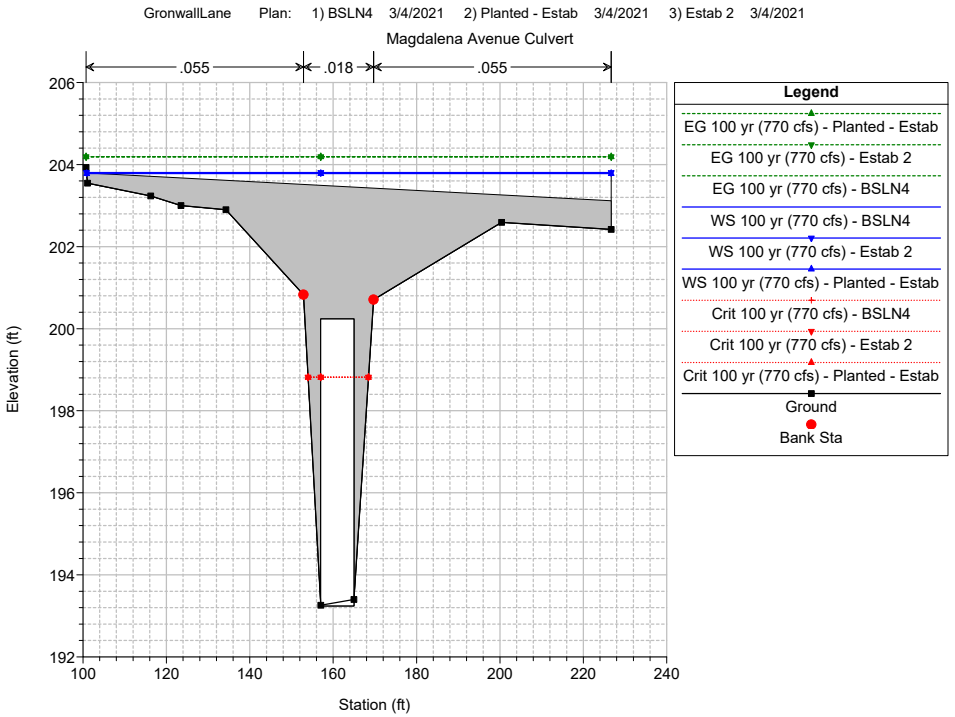
| Reach | River Sta | Profile | Plan | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| | | | | | | | | | | | | | |
| Gronwall | 1322 | 100 yr (770 cfs) | BSLN4 | 903.00 | 190.60 | 200.20 | 196.88 | 200.58 | 0.004656 | 4.92 | 183.48 | 39.35 | 0.40 |
| Gronwall | 1322 | 100 yr (770 cfs) | Planted - Estab | 903.00 | 190.60 | 200.20 | 196.88 | 200.58 | 0.004656 | 4.92 | 183.48 | 39.35 | 0.40 |
| Gronwall | 1322 | 100 yr (770 cfs) | Estab 2 | 903.00 | 190.60 | 200.20 | 196.88 | 200.58 | 0.004656 | 4.92 | 183.48 | 39.35 | 0.40 |
| | | | | | | | | | | | | | |
| Gronwall | 1290 | 100 yr (770 cfs) | BSLN4 | 903.00 | 190.30 | 199.78 | 197.34 | 200.37 | 0.007711 | 6.18 | 146.06 | 30.94 | 0.50 |
| Gronwall | 1290 | 100 yr (770 cfs) | Planted - Estab | 903.00 | 190.30 | 199.78 | 197.34 | 200.37 | 0.007711 | 6.18 | 146.06 | 30.94 | 0.50 |
| Gronwall | 1290 | 100 yr (770 cfs) | Estab 2 | 903.00 | 190.30 | 199.78 | 197.34 | 200.37 | 0.007711 | 6.18 | 146.06 | 30.94 | 0.50 |
| | | | | | | | | | | | | | |
| Gronwall | 1227 | 100 yr (770 cfs) | BSLN4 | 903.00 | 191.70 | 199.43 | 196.27 | 199.97 | 0.004945 | 5.90 | 152.99 | 23.40 | 0.41 |
| Gronwall | 1227 | 100 yr (770 cfs) | Planted - Estab | 903.00 | 191.70 | 199.43 | 196.27 | 199.97 | 0.004945 | 5.90 | 152.99 | 23.40 | 0.41 |
| Gronwall | 1227 | 100 yr (770 cfs) | Estab 2 | 903.00 | 191.70 | 199.43 | 196.27 | 199.97 | 0.004945 | 5.90 | 152.99 | 23.40 | 0.41 |
| | | | | | | | | | | | | | |
| Gronwall | 1210 | | | Bridge | | | | | | | | | |
| | | | | | | | | | | | | | |
| Gronwall | 1194 | 100 yr (770 cfs) | BSLN4 | 903.00 | 191.40 | 197.24 | 196.25 | 198.55 | 0.011194 | 9.20 | 98.12 | 24.17 | 0.76 |
| Gronwall | 1194 | 100 yr (770 cfs) | Planted - Estab | 903.00 | 191.40 | 197.24 | 196.25 | 198.55 | 0.011194 | 9.20 | 98.12 | 24.17 | 0.76 |
| Gronwall | 1194 | 100 yr (770 cfs) | Estab 2 | 903.00 | 191.40 | 197.24 | 196.25 | 198.55 | 0.011194 | 9.20 | 98.12 | 24.17 | 0.76 |
| | | | | | | | | | | | | | |
| Gronwall | 1140.66 | 100 yr (770 cfs) | BSLN4 | 903.00 | 188.90 | 196.99 | 194.96 | 197.83 | 0.007523 | 7.36 | 123.81 | 27.17 | 0.56 |
| Gronwall | 1140.66 | 100 yr (770 cfs) | Planted - Estab | 903.00 | 188.90 | 196.99 | 194.96 | 197.83 | 0.007523 | 7.36 | 123.81 | 27.17 | 0.56 |
| Gronwall | 1140.66 | 100 yr (770 cfs) | Estab 2 | 903.00 | 188.90 | 196.99 | 194.96 | 197.83 | 0.007523 | 7.36 | 123.81 | 27.17 | 0.56 |
| | | | | | | | | | | | | | |
| Gronwall | 1042 | 100 yr (770 cfs) | BSLN4 | 903.00 | 188.84 | 196.35 | 194.15 | 197.01 | 0.008011 | 6.55 | 137.96 | 27.95 | 0.52 |
| Gronwall | 1042 | 100 yr (770 cfs) | Planted - Estab | 903.00 | 188.84 | 196.35 | 194.15 | 197.01 | 0.008011 | 6.55 | 137.96 | 27.95 | 0.52 |
| Gronwall | 1042 | 100 yr (770 cfs) | Estab 2 | 903.00 | 188.84 | 196.35 | 194.15 | 197.01 | 0.008011 | 6.55 | 137.96 | 27.95 | 0.52 |

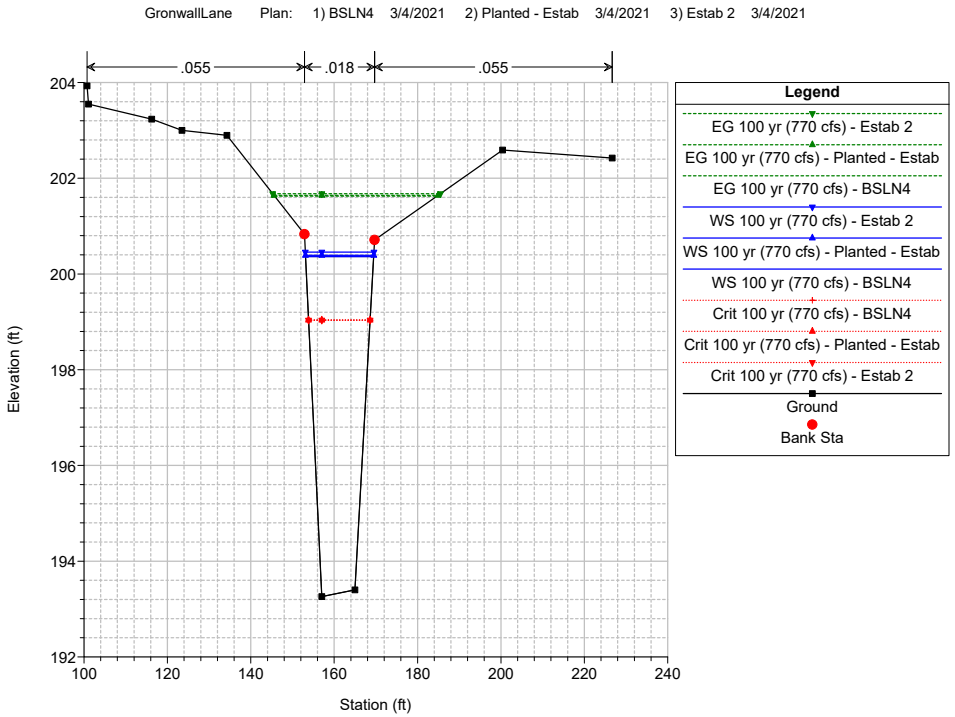

GronwallLane Plan: 1) BSLN4 3/4/2021 2) Planted - Estab 3/4/2021 3) Estab 2 3/4/2021
Hale Creek Gronwall
Legend
EG 100 yr (770 cfs) - BSLN4
EG 100 yr (770 cfs) - Planted - Estab
EG 100 yr (770 cfs) - Estab 2
WS 100 yr (770 cfs) - Planted - Estab
WS 100 yr (770 cfs) - BSLN4
WS 100 yr (770 cfs) - Estab 2
Crit 100 yr (770 cfs) - Planted - Estab
Crit 100 yr (770 cfs) - BSLN4
Crit 100 yr (770 cfs) - Estab 2
Ground
Elevation (ft)
206
204
202
200
198
196
194
192
190
188
0
100
200
300
400
500
600
Main Channel Distance (ft)

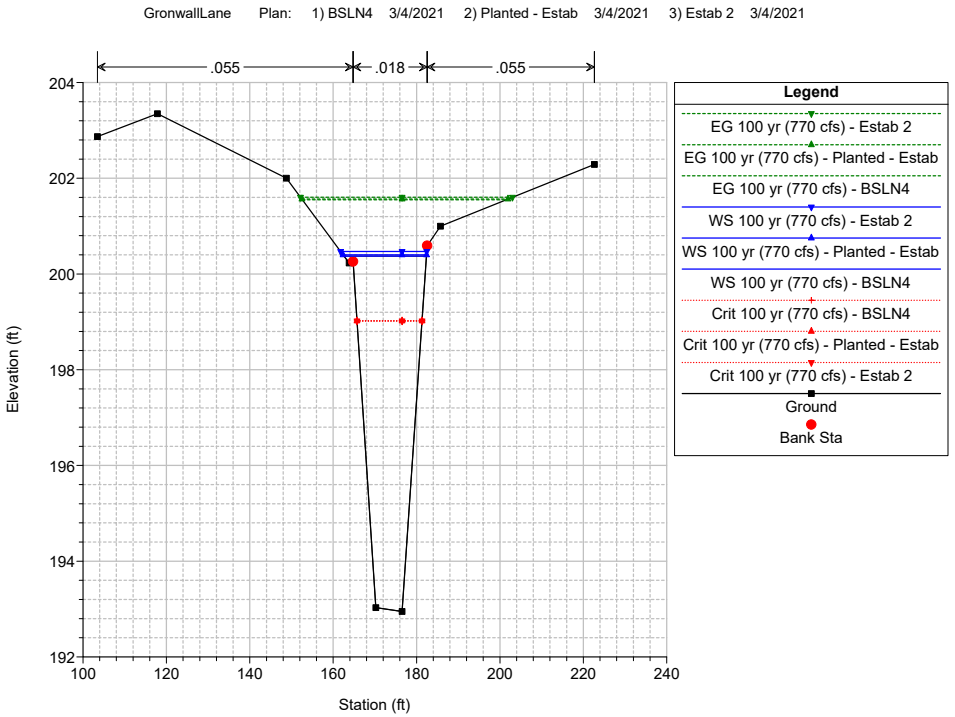

GronwallLane Plan: 1) BSLN4 3/4/2021 2) Planted - Estab 3/4/2021 3) Estab 2 3/4/2021
.055
.04
.055
Elevation (ft)
Station (ft)
Legend
EG 100 yr (770 cfs) - BSLN4
EG 100 yr (770 cfs) - Estab 2
EG 100 yr (770 cfs) - Planted - Estab
WS 100 yr (770 cfs) - BSLN4
WS 100 yr (770 cfs) - Estab 2
WS 100 yr (770 cfs) - Planted - Estab
Crit 100 yr (770 cfs) - BSLN4
Crit 100 yr (770 cfs) - Planted - Estab
Crit 100 yr (770 cfs) - Estab 2
Ground
Ineff
Bank Sta

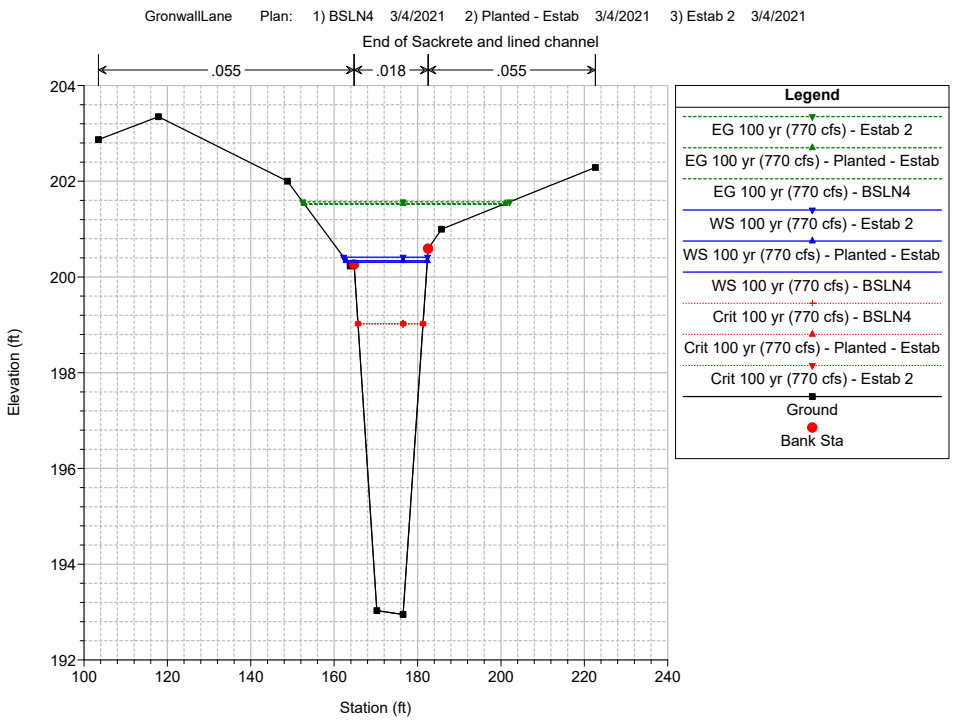

GronwallLane Plan: 1) BSLN4 3/4/2021 2) Planted - Estab 3/4/2021 3) Estab 2 3/4/2021
.065
.055
.04
.045
.065
Elevation (ft)
Station (ft)
Legend
EG 100 yr (770 cfs) - BSLN4
EG 100 yr (770 cfs) - Estab 2
EG 100 yr (770 cfs) - Planted - Estab
WS 100 yr (770 cfs) - BSLN4
WS 100 yr (770 cfs) - Estab 2
WS 100 yr (770 cfs) - Planted - Estab
Crit 100 yr (770 cfs) - BSLN4
Crit 100 yr (770 cfs) - Planted - Estab
Crit 100 yr (770 cfs) - Estab 2
Ground
Ineff
Bank Sta

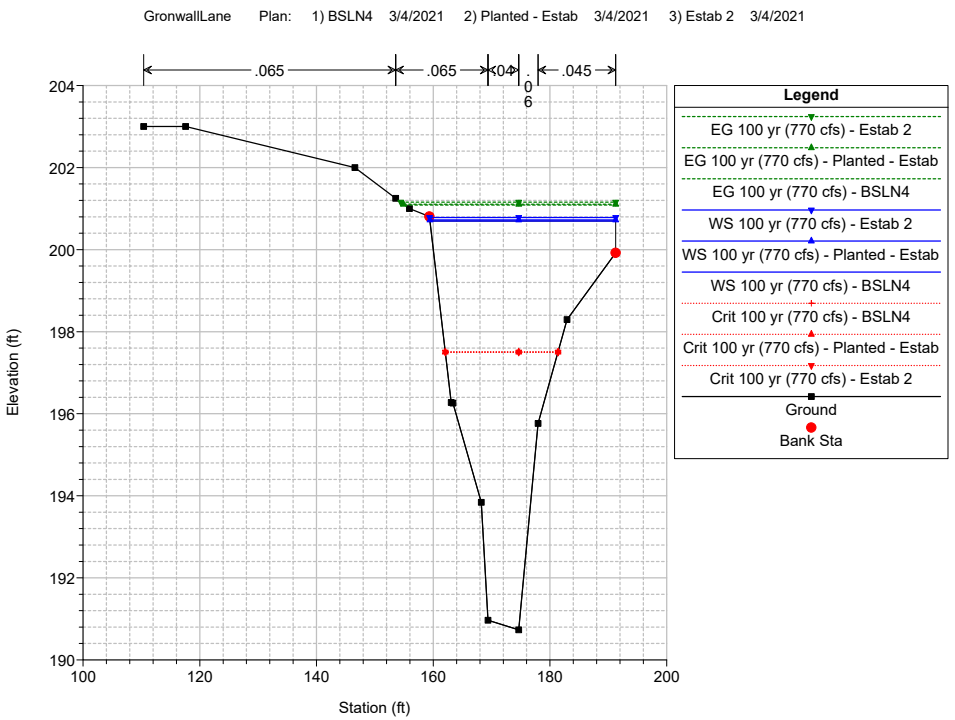

GronwallLane Plan: 1) BSLN4 3/4/2021 2) Planted - Estab 3/4/2021 3) Estab 2 3/4/2021
Magdalena Avenue Culvert
.065
.055
.04
.045
.065
Elevation (ft)
Station (ft)
Legend
EG 100 yr (770 cfs) - BSLN4
EG 100 yr (770 cfs) - Estab 2
EG 100 yr (770 cfs) - Planted - Estab
WS 100 yr (770 cfs) - BSLN4
WS 100 yr (770 cfs) - Estab 2
WS 100 yr (770 cfs) - Planted - Estab
Crit 100 yr (770 cfs) - BSLN4
Crit 100 yr (770 cfs) - Estab 2
Crit 100 yr (770 cfs) - Planted - Estab
Ground
Ineff
Bank Sta

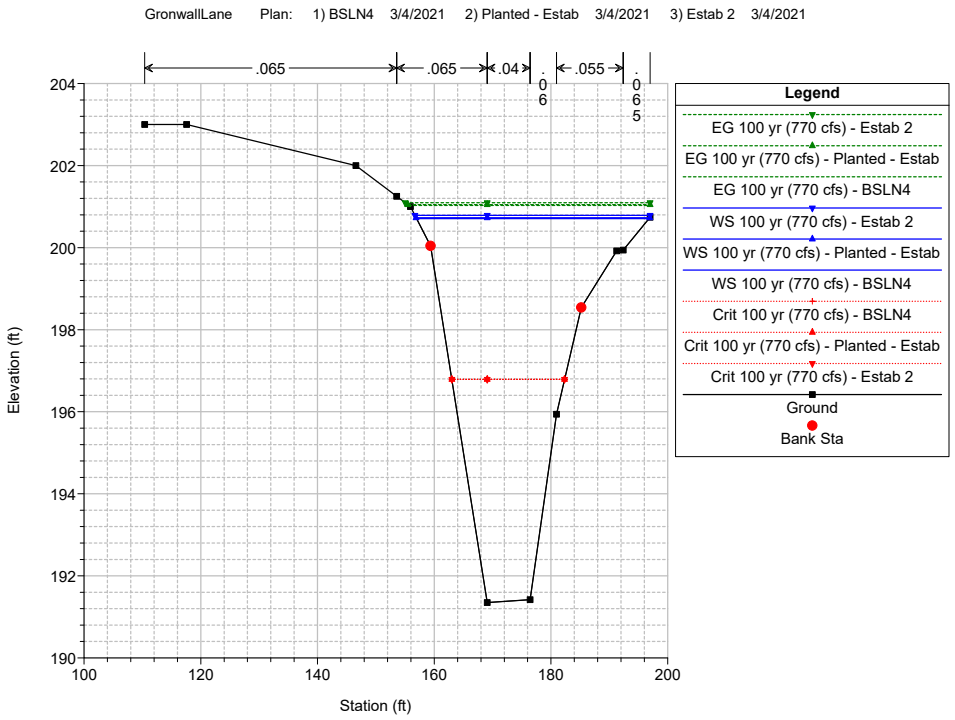

GronwallLane Plan: 1) BSLN4 3/4/2021 2) Planted - Estab 3/4/2021 3) Estab 2 3/4/2021
Magdalena Avenue Culvert
.055
.018
.055
Elevation (ft)
Station (ft)
Legend
EG 100 yr (770 cfs) - Planted - Estab
EG 100 yr (770 cfs) - Estab 2
EG 100 yr (770 cfs) - BSLN4
WS 100 yr (770 cfs) - BSLN4
WS 100 yr (770 cfs) - Estab 2
WS 100 yr (770 cfs) - Planted - Estab
Crit 100 yr (770 cfs) - BSLN4
Crit 100 yr (770 cfs) - Estab 2
Crit 100 yr (770 cfs) - Planted - Estab
Ground
Bank Sta


GronwallLane Plan: 1) BSLN4 3/4/2021 2) Planted - Estab 3/4/2021 3) Estab 2 3/4/2021
.055
.018
.055
Elevation (ft)
Station (ft)
Legend
EG 100 yr (770 cfs) - Estab 2
EG 100 yr (770 cfs) - Planted - Estab
EG 100 yr (770 cfs) - BSLN4
WS 100 yr (770 cfs) - Estab 2
WS 100 yr (770 cfs) - Planted - Estab
WS 100 yr (770 cfs) - BSLN4
Crit 100 yr (770 cfs) - BSLN4
Crit 100 yr (770 cfs) - Planted - Estab
Crit 100 yr (770 cfs) - Estab 2
Ground
Bank Sta


GronwallLane Plan: 1) BSLN4 3/4/2021 2) Planted - Estab 3/4/2021 3) Estab 2 3/4/2021
.055
.018
.055
Elevation (ft)
Station (ft)
Legend
EG 100 yr (770 cfs) - Estab 2
EG 100 yr (770 cfs) - Planted - Estab
EG 100 yr (770 cfs) - BSLN4
WS 100 yr (770 cfs) - Estab 2
WS 100 yr (770 cfs) - Planted - Estab
WS 100 yr (770 cfs) - BSLN4
Crit 100 yr (770 cfs) - BSLN4
Crit 100 yr (770 cfs) - Planted - Estab
Crit 100 yr (770 cfs) - Estab 2
Ground
Bank Sta


GronwallLane Plan: 1) BSLN4 3/4/2021 2) Planted - Estab 3/4/2021 3) Estab 2 3/4/2021
End of Sackrete and lined channel
.055
.018
.055
Elevation (ft)
Station (ft)
Legend
EG 100 yr (770 cfs) - Estab 2
EG 100 yr (770 cfs) - Planted - Estab
EG 100 yr (770 cfs) - BSLN4
WS 100 yr (770 cfs) - Estab 2
WS 100 yr (770 cfs) - Planted - Estab
WS 100 yr (770 cfs) - BSLN4
Crit 100 yr (770 cfs) - BSLN4
Crit 100 yr (770 cfs) - Planted - Estab
Crit 100 yr (770 cfs) - Estab 2
Ground
Bank Sta


GronwallLane Plan: 1) BSLN4 3/4/2021 2) Planted - Estab 3/4/2021 3) Estab 2 3/4/2021
.065
.065
.045
Elevation (ft)
Station (ft)
Legend
EG 100 yr (770 cfs) - Estab 2
EG 100 yr (770 cfs) - Planted - Estab
EG 100 yr (770 cfs) - BSLN4
WS 100 yr (770 cfs) - Estab 2
WS 100 yr (770 cfs) - Planted - Estab
WS 100 yr (770 cfs) - BSLN4
Crit 100 yr (770 cfs) - BSLN4
Crit 100 yr (770 cfs) - Planted - Estab
Crit 100 yr (770 cfs) - Estab 2
Ground
Bank Sta


GronwallLane Plan: 1) BSLN4 3/4/2021 2) Planted - Establ 3/4/2021 3) Estab 2 3/4/2021
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Elevation (ft)
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EG 100 yr (770 cfs) - Planted - Estab
EG 100 yr (770 cfs) - BSLN4
WS 100 yr (770 cfs) - Estab 2
WS 100 yr (770 cfs) - Planted - Estab
WS 100 yr (770 cfs) - BSLN4
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Crit 100 yr (770 cfs) - Estab 2
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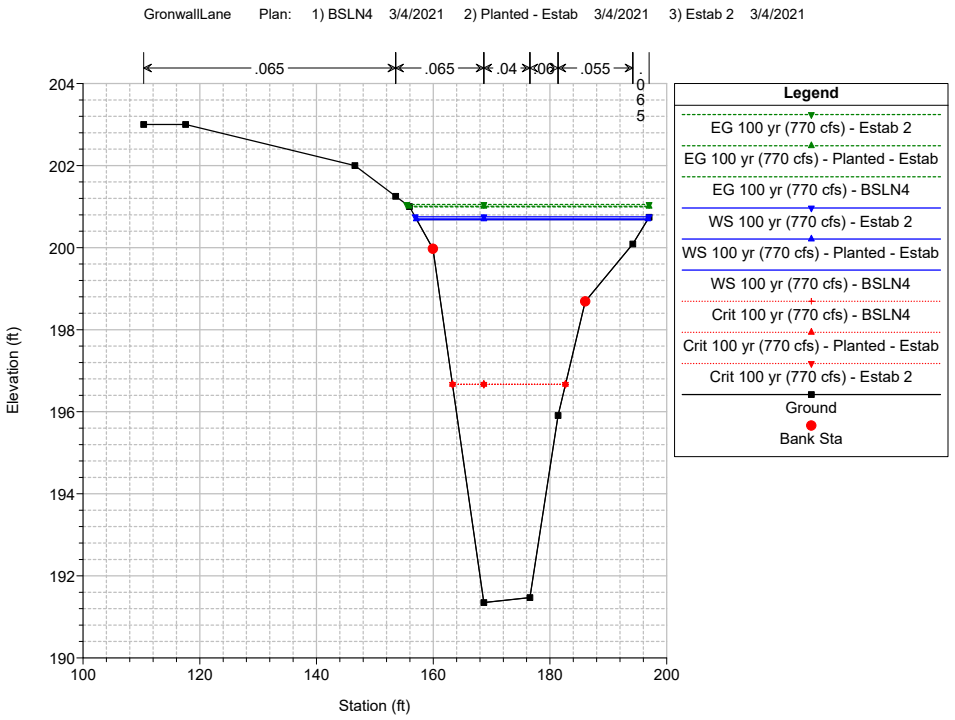
GronwallLane Plan: 1) BSLN4 3/4/2021 2) Planted - Establ 3/4/2021 3) Estab 2 3/4/2021
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EG 100 yr (770 cfs) - BSLN4
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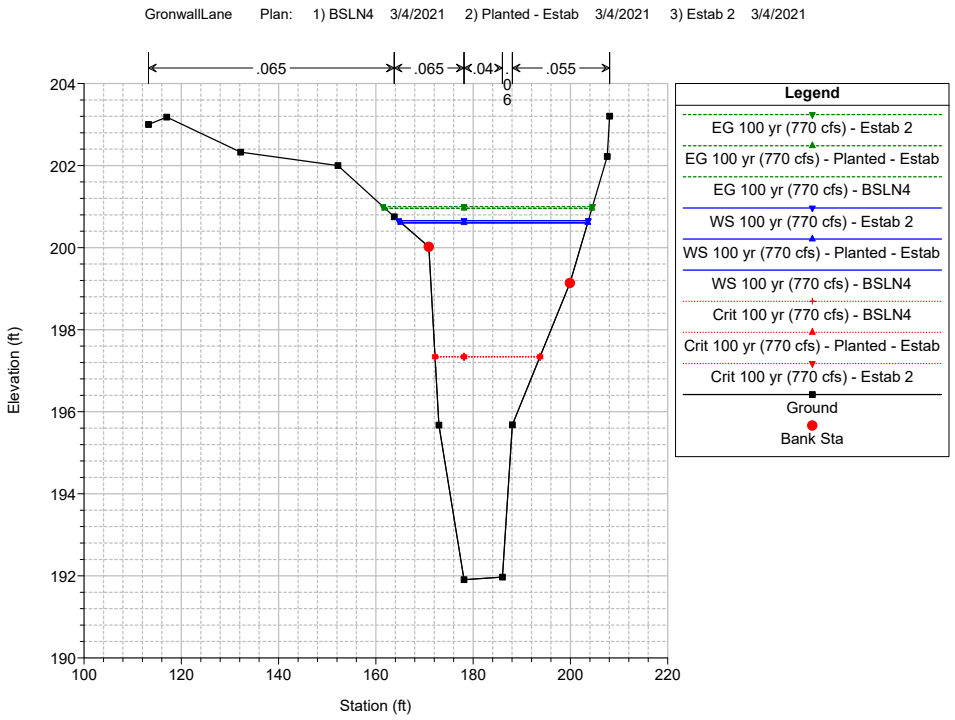
GronwallLane Plan: 1) BSLN4 3/4/2021 2) Planted - Establ 3/4/2021 3) Estab 2 3/4/2021
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Crit 100 yr (770 cfs) - Estab 2
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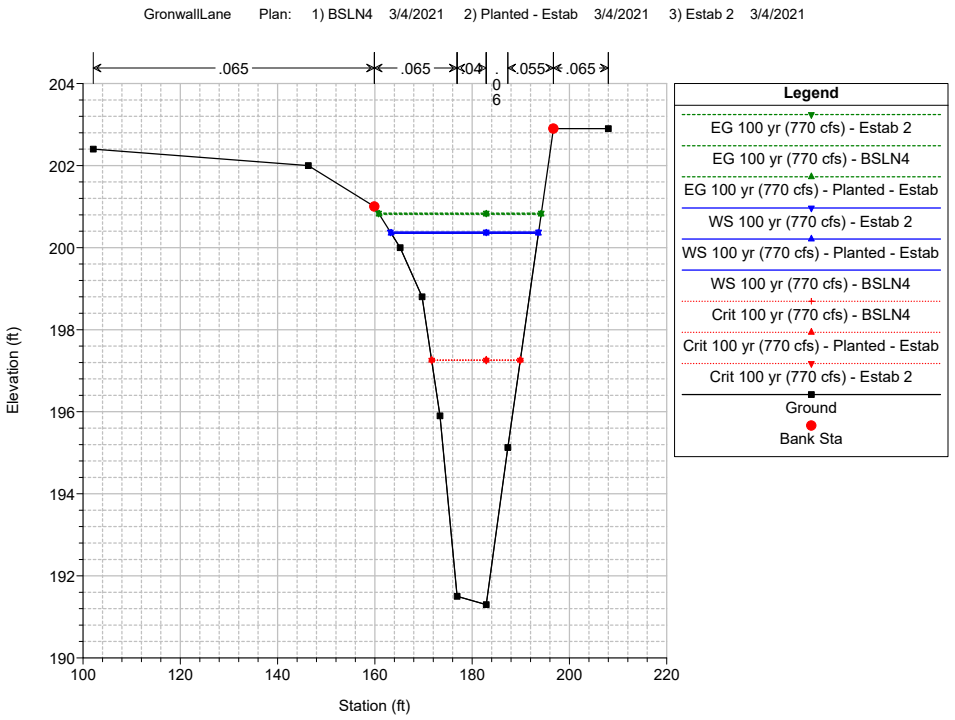
Bank Sta


GronwallLane Plan: 1) BSLN4 3/4/2021 2) Planted - Establ 3/4/2021 3) Estab 2 3/4/2021
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Elevation (ft)
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EG 100 yr (770 cfs) - Planted - Estab
WS 100 yr (770 cfs) - Estab 2
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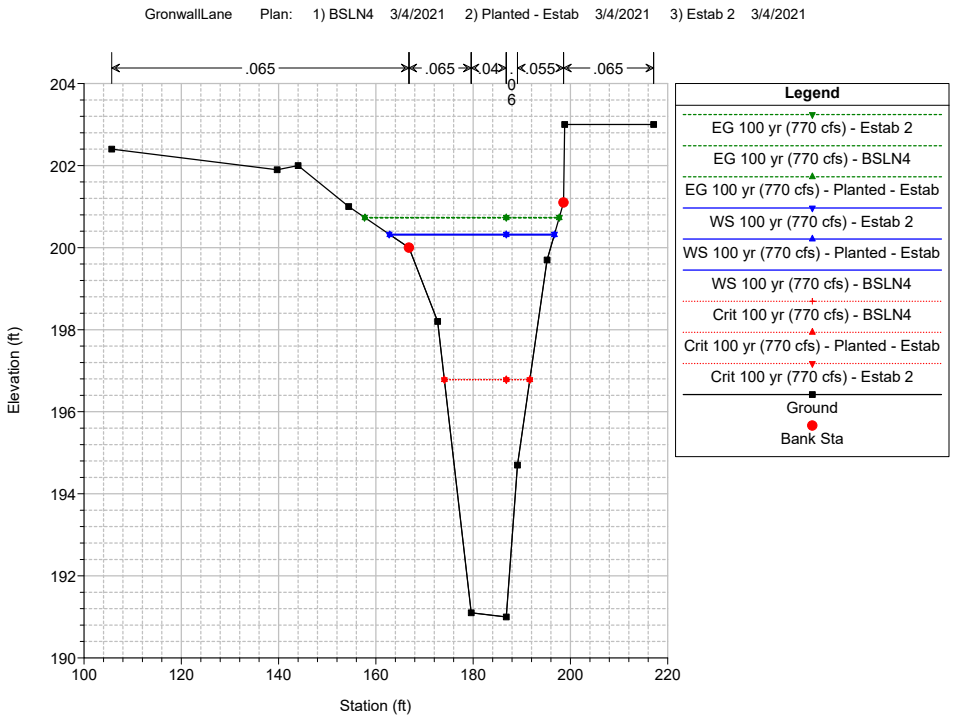
Crit 100 yr (770 cfs) - Estab 2
Ground
Bank Sta


GronwallLane Plan: 1) BSLN4 3/4/2021 2) Planted - Estab 3/4/2021 3) Estab 2 3/4/2021
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Elevation (ft)
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EG 100 yr (770 cfs) - Planted - Estab
WS 100 yr (770 cfs) - Estab 2
WS 100 yr (770 cfs) - Planted - Estab
WS 100 yr (770 cfs) - BSLN4
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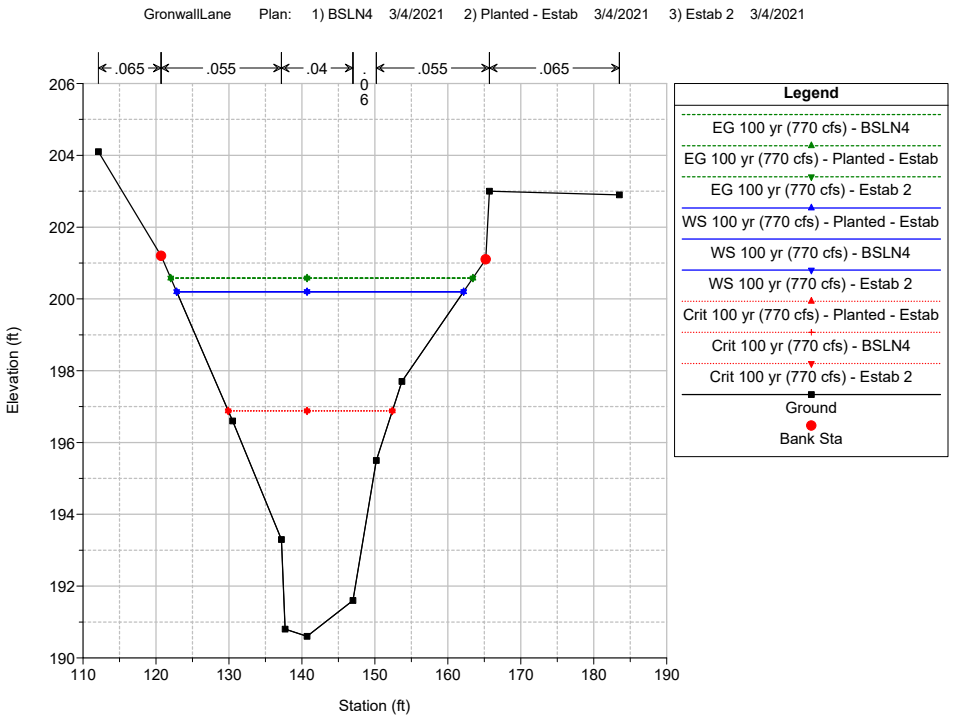
Crit 100 yr (770 cfs) - Planted - Estab
Crit 100 yr (770 cfs) - Estab 2
Ground
Bank Sta


GronwallLane Plan: 1) BSLN4 3/4/2021 2) Planted - Estab 3/4/2021 3) Estab 2 3/4/2021
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Elevation (ft)
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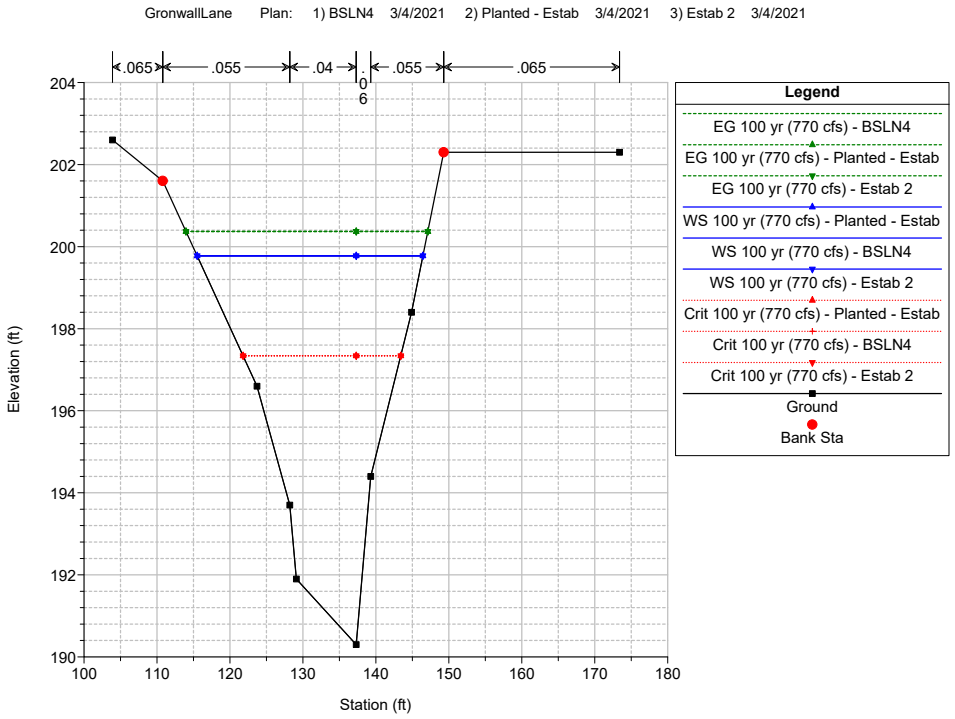
EG 100 yr (770 cfs) - Planted - Estab
EG 100 yr (770 cfs) - Estab 2
WS 100 yr (770 cfs) - Planted - Estab
WS 100 yr (770 cfs) - BSLN4
WS 100 yr (770 cfs) - Estab 2
Crit 100 yr (770 cfs) - Planted - Estab
Crit 100 yr (770 cfs) - BSLN4
Crit 100 yr (770 cfs) - Estab 2
Ground
Bank Sta


GronwallLane Plan: 1) BSLN4 3/4/2021 2) Planted - Estab 3/4/2021 3) Estab 2 3/4/2021
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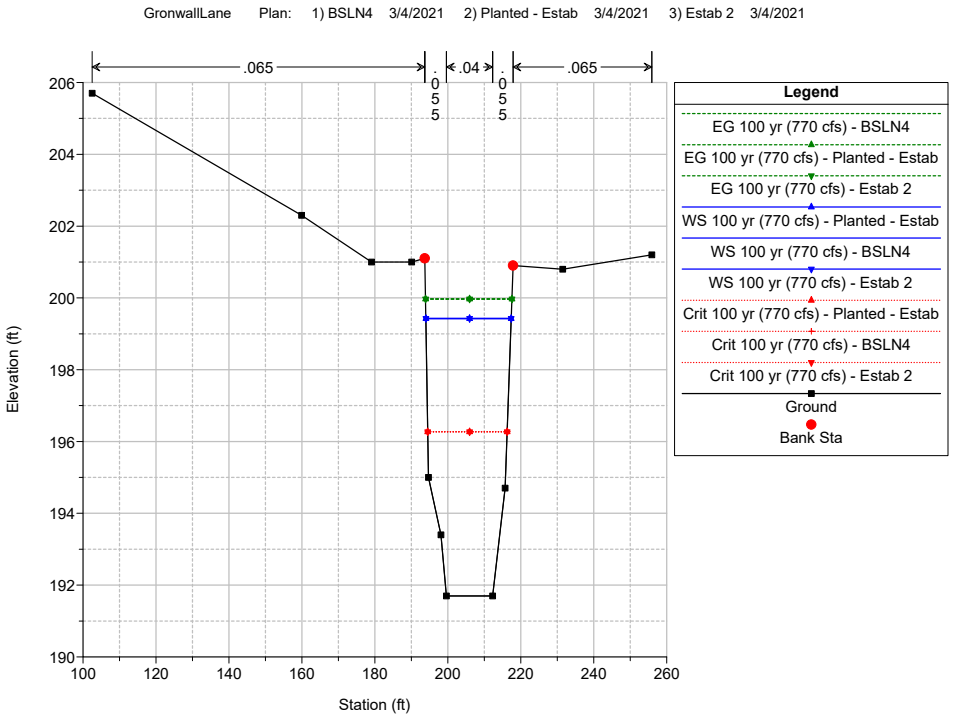
EG 100 yr (770 cfs) - Planted - Estab
EG 100 yr (770 cfs) - Estab 2
WS 100 yr (770 cfs) - Planted - Estab
WS 100 yr (770 cfs) - BSLN4
WS 100 yr (770 cfs) - Estab 2
Crit 100 yr (770 cfs) - Planted - Estab
Crit 100 yr (770 cfs) - BSLN4
Crit 100 yr (770 cfs) - Estab 2
Ground
Bank Sta


GronwallLane Plan: 1) BSLN4 3/4/2021 2) Planted - Estab 3/4/2021 3) Estab 2 3/4/2021
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EG 100 yr (770 cfs) - Estab 2
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WS 100 yr (770 cfs) - BSLN4
WS 100 yr (770 cfs) - Estab 2
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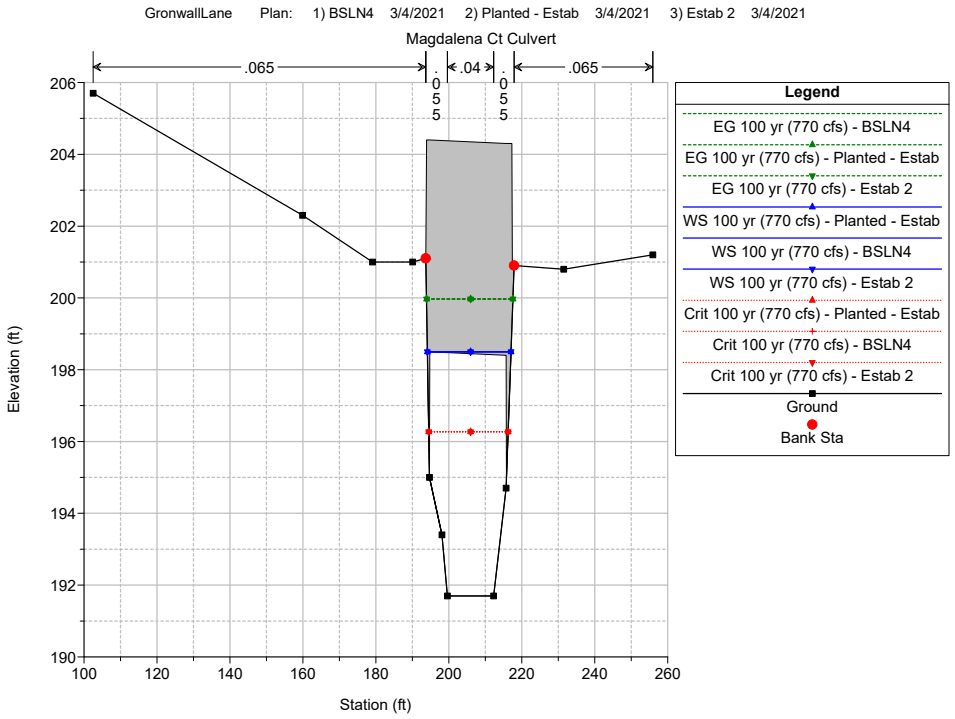
Crit 100 yr (770 cfs) - BSLN4
Crit 100 yr (770 cfs) - Estab 2
Ground
Bank Sta


GronwallLane Plan: 1) BSLN4 3/4/2021 2) Planted - Estab 3/4/2021 3) Estab 2 3/4/2021
Magdalena Ct Culvert
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Elevation (ft)
Station (ft)
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EG 100 yr (770 cfs) - Estab 2
WS 100 yr (770 cfs) - Planted - Estab
WS 100 yr (770 cfs) - BSLN4
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Crit 100 yr (770 cfs) - BSLN4
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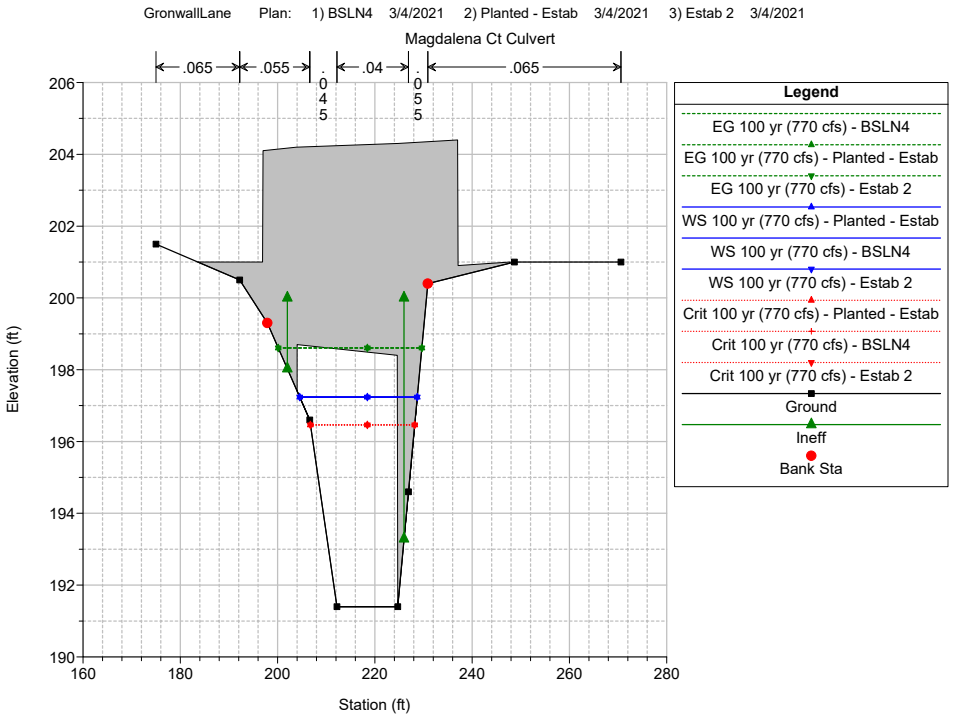
Bank Sta


GronwallLane Plan: 1) BSLN4 3/4/2021 2) Planted - Estab 3/4/2021 3) Estab 2 3/4/2021
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EG 100 yr (770 cfs) - Planted - Estab
EG 100 yr (770 cfs) - Estab 2
WS 100 yr (770 cfs) - Planted - Estab
WS 100 yr (770 cfs) - BSLN4
WS 100 yr (770 cfs) - Estab 2
Crit 100 yr (770 cfs) - Planted - Estab
Crit 100 yr (770 cfs) - BSLN4
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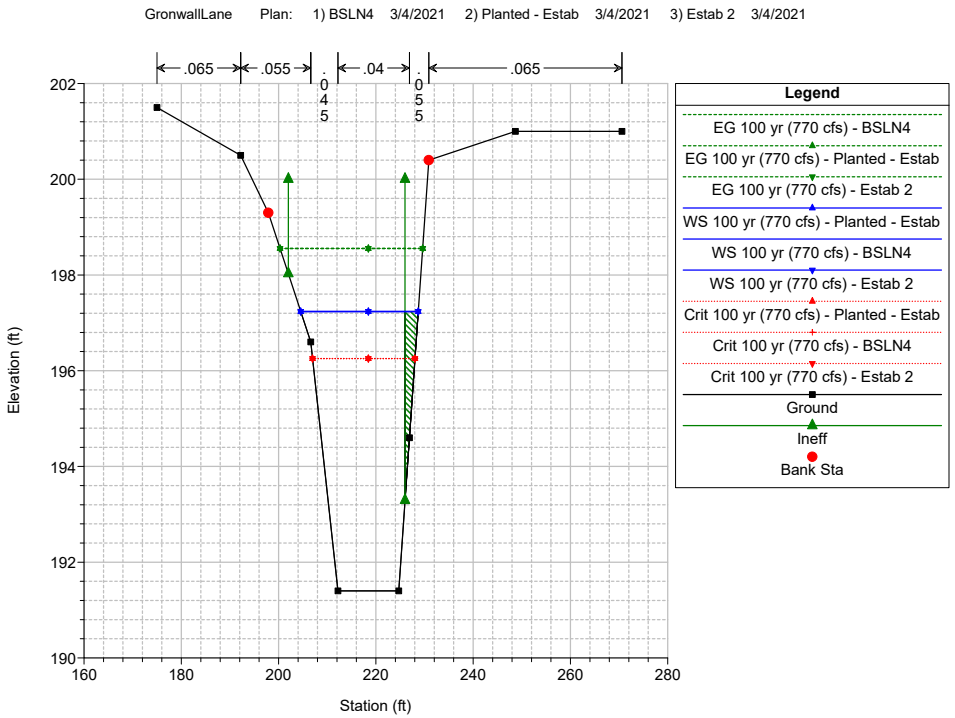
Bank Sta


GronwallLane Plan: 1) BSLN4 3/4/2021 2) Planted - Estab 3/4/2021 3) Estab 2 3/4/2021
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Elevation (ft)
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EG 100 yr (770 cfs) - Planted - Estab
EG 100 yr (770 cfs) - Estab 2
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WS 100 yr (770 cfs) - BSLN4
WS 100 yr (770 cfs) - Estab 2
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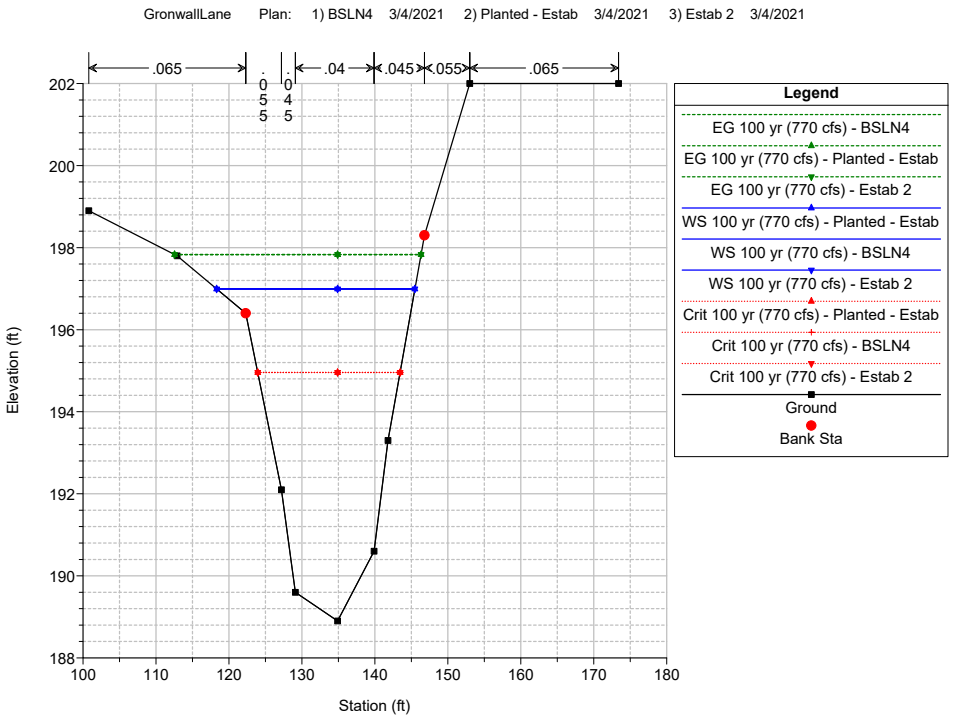
Crit 100 yr (770 cfs) - BSLN4
Crit 100 yr (770 cfs) - Estab 2
Ground
Ineff
Bank Sta


GronwallLane Plan: 1) BSLN4 3/4/2021 2) Planted - Estab 3/4/2021 3) Estab 2 3/4/2021
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Elevation (ft)
Station (ft)
Legend
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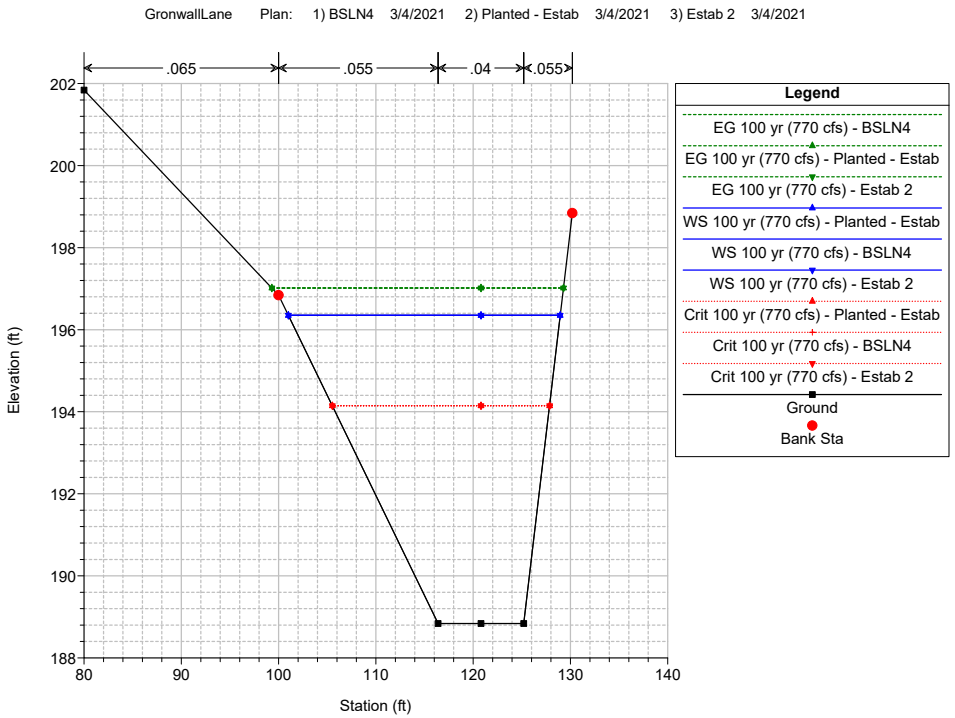
EG 100 yr (770 cfs) - Planted - Estab
EG 100 yr (770 cfs) - Estab 2
WS 100 yr (770 cfs) - Planted - Estab
WS 100 yr (770 cfs) - BSLN4
WS 100 yr (770 cfs) - Estab 2
Crit 100 yr (770 cfs) - Planted - Estab
Crit 100 yr (770 cfs) - BSLN4
Crit 100 yr (770 cfs) - Estab 2
Ground
Bank Sta


GronwallLane Plan: 1) BSLN4 3/4/2021 2) Planted - Estab 3/4/2021 3) Estab 2 3/4/2021
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.055
202
200
198
196
194
192
190
188
Elevation (ft)
80
90
100
110
120
130
140
Station (ft)
Legend
EG 100 yr (770 cfs) - BSLN4
EG 100 yr (770 cfs) - Planted - Estab
EG 100 yr (770 cfs) - Estab 2
WS 100 yr (770 cfs) - Planted - Estab
WS 100 yr (770 cfs) - BSLN4
WS 100 yr (770 cfs) - Estab 2
Crit 100 yr (770 cfs) - Planted - Estab
Crit 100 yr (770 cfs) - BSLN4
Crit 100 yr (770 cfs) - Estab 2
Ground
Bank Sta

HEC-RAS River: Hale Creek Reach: Gronwall Profile: 100 yr (770 cfs)

| Reach | River Sta | Profile | Plan | E.G. Elev | W.S. Elev | Vel Head | Frctn Loss | C & E Loss | Q Left | Q Channel | Q Right | Top Width |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | (ft) | (ft) | (ft) | (ft) | (ft) | (cfs) | (cfs) | (cfs) | (ft) |
| Gronwall | 1593 | 100 yr (770 cfs) | BSLN4 | 204.39 | 204.10 | 0.30 | 0.06 | 0.02 | | 770.00 | | 26.55 |
| Gronwall | 1593 | 100 yr (770 cfs) | Planted - Estab | 204.38 | 204.08 | 0.30 | 0.06 | 0.02 | | 770.00 | | 26.55 |
| Gronwall | 1593 | 100 yr (770 cfs) | Estab 2 | 204.39 | 204.10 | 0.30 | 0.06 | 0.02 | | 770.00 | | 26.55 |
| | | | | | | | | | | | | |
| Gronwall | 1573 | 100 yr (770 cfs) | BSLN4 | 204.31 | 203.80 | 0.51 | | | 23.91 | 735.71 | 10.38 | 100.00 |
| Gronwall | 1573 | 100 yr (770 cfs) | Planted - Estab | 204.30 | 203.78 | 0.52 | | | 22.46 | 738.07 | 9.47 | 100.00 |
| Gronwall | 1573 | 100 yr (770 cfs) | Estab 2 | 204.31 | 203.80 | 0.51 | | | 23.84 | 735.82 | 10.34 | 100.00 |
| | | | | | | | | | | | | |
| Gronwall | 1568 | | | Culvert | | | | | | | | |
| | | | | | | | | | | | | |
| Gronwall | 1459 | 100 yr (770 cfs) | BSLN4 | 201.63 | 200.36 | 1.26 | 0.03 | 0.04 | | 770.00 | | 16.34 |
| Gronwall | 1459 | 100 yr (770 cfs) | Planted - Estab | 201.64 | 200.39 | 1.25 | 0.03 | 0.04 | | 770.00 | | 16.37 |
| Gronwall | 1459 | 100 yr (770 cfs) | Estab 2 | 201.68 | 200.46 | 1.22 | 0.03 | 0.04 | | 770.00 | | 16.45 |
| | | | | | | | | | | | | |
| Gronwall | 1443 | 100 yr (770 cfs) | BSLN4 | 201.55 | 200.37 | 1.18 | 0.03 | 0.01 | 0.06 | 769.94 | | 19.79 |
| Gronwall | 1443 | 100 yr (770 cfs) | Planted - Estab | 201.57 | 200.40 | 1.16 | 0.03 | 0.01 | 0.08 | 769.92 | | 20.04 |
| Gronwall | 1443 | 100 yr (770 cfs) | Estab 2 | 201.60 | 200.47 | 1.13 | 0.03 | 0.01 | 0.16 | 769.84 | | 20.67 |
| | | | | | | | | | | | | |
| Gronwall | 1429 | 100 yr (770 cfs) | BSLN4 | 201.52 | 200.31 | 1.21 | 0.02 | 0.41 | 0.02 | 769.98 | | 19.18 |
| Gronwall | 1429 | 100 yr (770 cfs) | Planted - Estab | 201.53 | 200.34 | 1.19 | 0.02 | 0.40 | 0.03 | 769.97 | | 19.48 |
| Gronwall | 1429 | 100 yr (770 cfs) | Estab 2 | 201.57 | 200.41 | 1.16 | 0.02 | 0.39 | 0.09 | 769.91 | | 20.14 |
| | | | | | | | | | | | | |
| Gronwall | 1422 | 100 yr (770 cfs) | BSLN4 | 201.09 | 200.70 | 0.39 | 0.02 | 0.03 | | 770.00 | | 31.81 |
| Gronwall | 1422 | 100 yr (770 cfs) | Planted - Estab | 201.11 | 200.72 | 0.38 | 0.03 | 0.03 | | 770.00 | | 31.83 |
| Gronwall | 1422 | 100 yr (770 cfs) | Estab 2 | 201.16 | 200.78 | 0.37 | 0.03 | 0.03 | | 770.00 | | 31.88 |
| | | | | | | | | | | | | |
| Gronwall | 1415 | 100 yr (770 cfs) | BSLN4 | 201.03 | 200.71 | 0.32 | 0.03 | 0.01 | 0.63 | 752.05 | 17.32 | 39.82 |
| Gronwall | 1415 | 100 yr (770 cfs) | Planted - Estab | 201.05 | 200.73 | 0.32 | 0.03 | 0.00 | 0.60 | 750.23 | 19.17 | 40.03 |
| Gronwall | 1415 | 100 yr (770 cfs) | Estab 2 | 201.09 | 200.78 | 0.31 | 0.04 | 0.00 | 0.67 | 747.41 | 21.92 | 40.29 |
| | | | | | | | | | | | | |
| Gronwall | 1403 | 100 yr (770 cfs) | BSLN4 | 200.99 | 200.68 | 0.31 | 0.04 | 0.00 | 0.80 | 752.28 | 16.92 | 39.57 |
| Gronwall | 1403 | 100 yr (770 cfs) | Planted - Estab | 201.01 | 200.70 | 0.31 | 0.04 | 0.00 | 0.75 | 750.72 | 18.53 | 39.71 |
| Gronwall | 1403 | 100 yr (770 cfs) | Estab 2 | 201.05 | 200.75 | 0.30 | 0.05 | 0.00 | 0.80 | 748.22 | 20.97 | 40.08 |
| | | | | | | | | | | | | |
| Gronwall | 1390 | 100 yr (770 cfs) | BSLN4 | 200.95 | 200.60 | 0.35 | 0.12 | 0.01 | 1.40 | 765.37 | 3.23 | 38.34 |
| Gronwall | 1390 | 100 yr (770 cfs) | Planted - Estab | 200.96 | 200.61 | 0.35 | 0.13 | 0.01 | 1.27 | 765.25 | 3.49 | 38.46 |
| Gronwall | 1390 | 100 yr (770 cfs) | Estab 2 | 201.00 | 200.66 | 0.34 | 0.15 | 0.01 | 1.36 | 764.69 | 3.95 | 39.00 |
| | | | | | | | | | | | | |
| Gronwall | 1363 | 100 yr (770 cfs) | BSLN4 | 200.82 | 200.36 | 0.46 | 0.08 | 0.02 | | 770.00 | | 30.32 |
| Gronwall | 1363 | 100 yr (770 cfs) | Planted - Estab | 200.82 | 200.36 | 0.46 | 0.08 | 0.02 | | 770.00 | | 30.32 |
| Gronwall | 1363 | 100 yr (770 cfs) | Estab 2 | 200.84 | 200.38 | 0.46 | 0.09 | 0.01 | | 770.00 | | 30.49 |
| | | | | | | | | | | | | |
| Gronwall | 1350 | 100 yr (770 cfs) | BSLN4 | 200.73 | 200.32 | 0.41 | 0.14 | 0.01 | 0.30 | 769.70 | | 33.82 |

HEC-RAS River: Hale Creek Reach: Gronwall Profile: 100 yr (770 cfs) (Continued)

| Reach | River Sta | Profile | Plan | E.G. Elev | W.S. Elev | Vel Head | Frctn Loss | C & E Loss | Q Left | Q Channel | Q Right | Top Width |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | (ft) | (ft) | (ft) | (ft) | (ft) | (cfs) | (cfs) | (cfs) | (ft) |
| Gronwall | 1350 | 100 yr (770 cfs) | Planted - Estab | 200.73 | 200.32 | 0.41 | 0.14 | 0.01 | 0.30 | 769.70 | | 33.82 |
| Gronwall | 1350 | 100 yr (770 cfs) | Estab 2 | 200.74 | 200.33 | 0.41 | 0.15 | 0.01 | 0.36 | 769.64 | | 33.99 |
| | | | | | | | | | | | | |
| Gronwall | 1322 | 100 yr (770 cfs) | BSLN4 | 200.58 | 200.20 | 0.38 | 0.19 | 0.02 | | 903.00 | | 39.35 |
| Gronwall | 1322 | 100 yr (770 cfs) | Planted - Estab | 200.58 | 200.20 | 0.38 | 0.19 | 0.02 | | 903.00 | | 39.35 |
| Gronwall | 1322 | 100 yr (770 cfs) | Estab 2 | 200.58 | 200.20 | 0.38 | 0.19 | 0.02 | | 903.00 | | 39.35 |
| | | | | | | | | | | | | |
| Gronwall | 1290 | 100 yr (770 cfs) | BSLN4 | 200.37 | 199.78 | 0.59 | 0.38 | 0.02 | | 903.00 | | 30.94 |
| Gronwall | 1290 | 100 yr (770 cfs) | Planted - Estab | 200.37 | 199.78 | 0.59 | 0.38 | 0.02 | | 903.00 | | 30.94 |
| Gronwall | 1290 | 100 yr (770 cfs) | Estab 2 | 200.37 | 199.78 | 0.59 | 0.38 | 0.02 | | 903.00 | | 30.94 |
| | | | | | | | | | | | | |
| Gronwall | 1227 | 100 yr (770 cfs) | BSLN4 | 199.97 | 199.43 | 0.54 | | | | 903.00 | | 23.40 |
| Gronwall | 1227 | 100 yr (770 cfs) | Planted - Estab | 199.97 | 199.43 | 0.54 | | | | 903.00 | | 23.40 |
| Gronwall | 1227 | 100 yr (770 cfs) | Estab 2 | 199.97 | 199.43 | 0.54 | | | | 903.00 | | 23.40 |
| | | | | | | | | | | | | |
| Gronwall | 1210 | | | Bridge | | | | | | | | |
| | | | | | | | | | | | | |
| Gronwall | 1194 | 100 yr (770 cfs) | BSLN4 | 198.55 | 197.24 | 1.32 | 0.48 | 0.24 | | 903.00 | | 24.17 |
| Gronwall | 1194 | 100 yr (770 cfs) | Planted - Estab | 198.55 | 197.24 | 1.32 | 0.48 | 0.24 | | 903.00 | | 24.17 |
| Gronwall | 1194 | 100 yr (770 cfs) | Estab 2 | 198.55 | 197.24 | 1.32 | 0.48 | 0.24 | | 903.00 | | 24.17 |
| | | | | | | | | | | | | |
| Gronwall | 1140.66 | 100 yr (770 cfs) | BSLN4 | 197.83 | 196.99 | 0.84 | 0.77 | 0.05 | 1.03 | 901.97 | | 27.17 |
| Gronwall | 1140.66 | 100 yr (770 cfs) | Planted - Estab | 197.83 | 196.99 | 0.84 | 0.77 | 0.05 | 1.03 | 901.97 | | 27.17 |
| Gronwall | 1140.66 | 100 yr (770 cfs) | Estab 2 | 197.83 | 196.99 | 0.84 | 0.77 | 0.05 | 1.03 | 901.97 | | 27.17 |
| | | | | | | | | | | | | |
| Gronwall | 1042 | 100 yr (770 cfs) | BSLN4 | 197.01 | 196.35 | 0.67 | | | | 903.00 | | 27.95 |
| Gronwall | 1042 | 100 yr (770 cfs) | Planted - Estab | 197.01 | 196.35 | 0.67 | | | | 903.00 | | 27.95 |
| Gronwall | 1042 | 100 yr (770 cfs) | Estab 2 | 197.01 | 196.35 | 0.67 | | | | 903.00 | | 27.95 |

HEC-RAS River: Hale Creek Reach: Gronwall Profile: 100 yr (770 cfs)

| Reach | River Sta | Profile | Plan | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| Gronwall | 1593 | 100 yr (770 cfs) | BSLN4 | 770.00 | 194.37 | 204.10 | 199.55 | 204.39 | 0.002657 | 4.38 | 175.73 | 26.55 | 0.30 |
| Gronwall | 1593 | 100 yr (770 cfs) | Planted - Estab | 770.00 | 194.37 | 204.08 | 199.55 | 204.38 | 0.002675 | 4.39 | 175.31 | 26.55 | 0.30 |
| Gronwall | 1593 | 100 yr (770 cfs) | Estab 2 | 770.00 | 194.37 | 204.10 | 199.55 | 204.39 | 0.002657 | 4.38 | 175.71 | 26.55 | 0.30 |
| | | | | | | | | | | | | | |
| Gronwall | 1573 | 100 yr (770 cfs) | BSLN4 | 770.00 | 194.23 | 203.80 | 199.83 | 204.31 | 0.003749 | 5.84 | 162.47 | 100.00 | 0.40 |
| Gronwall | 1573 | 100 yr (770 cfs) | Planted - Estab | 770.00 | 194.23 | 203.78 | 199.83 | 204.30 | 0.003819 | 5.88 | 160.03 | 100.00 | 0.40 |
| Gronwall | 1573 | 100 yr (770 cfs) | Estab 2 | 770.00 | 194.23 | 203.80 | 199.83 | 204.31 | 0.003752 | 5.84 | 162.36 | 100.00 | 0.40 |
| | | | | | | | | | | | | | |
| Gronwall | 1568 | | | Culvert | | | | | | | | | |
| | | | | | | | | | | | | | |
| Gronwall | 1459 | 100 yr (770 cfs) | BSLN4 | 770.00 | 193.26 | 200.36 | 199.04 | 201.63 | 0.002239 | 9.02 | 85.38 | 16.34 | 0.70 |
| Gronwall | 1459 | 100 yr (770 cfs) | Planted - Estab | 770.00 | 193.26 | 200.39 | 199.04 | 201.64 | 0.002209 | 8.97 | 85.81 | 16.37 | 0.69 |
| Gronwall | 1459 | 100 yr (770 cfs) | Estab 2 | 770.00 | 193.26 | 200.46 | 199.04 | 201.68 | 0.002135 | 8.86 | 86.92 | 16.45 | 0.68 |
| | | | | | | | | | | | | | |
| Gronwall | 1443 | 100 yr (770 cfs) | BSLN4 | 770.00 | 192.95 | 200.37 | 199.02 | 201.55 | 0.002038 | 8.70 | 88.69 | 19.79 | 0.68 |
| Gronwall | 1443 | 100 yr (770 cfs) | Planted - Estab | 770.00 | 192.95 | 200.40 | 199.02 | 201.57 | 0.002006 | 8.66 | 89.22 | 20.04 | 0.68 |
| Gronwall | 1443 | 100 yr (770 cfs) | Estab 2 | 770.00 | 192.95 | 200.47 | 199.02 | 201.60 | 0.001927 | 8.54 | 90.61 | 20.67 | 0.67 |
| | | | | | | | | | | | | | |
| Gronwall | 1429 | 100 yr (770 cfs) | BSLN4 | 770.00 | 192.95 | 200.31 | 199.02 | 201.52 | 0.002119 | 8.82 | 87.42 | 19.18 | 0.70 |
| Gronwall | 1429 | 100 yr (770 cfs) | Planted - Estab | 770.00 | 192.95 | 200.34 | 199.02 | 201.53 | 0.002079 | 8.76 | 88.03 | 19.48 | 0.69 |
| Gronwall | 1429 | 100 yr (770 cfs) | Estab 2 | 770.00 | 192.95 | 200.41 | 199.02 | 201.57 | 0.001993 | 8.64 | 89.44 | 20.14 | 0.68 |
| | | | | | | | | | | | | | |
| Gronwall | 1422 | 100 yr (770 cfs) | BSLN4 | 770.00 | 190.73 | 200.70 | 197.50 | 201.09 | 0.004165 | 4.99 | 154.32 | 31.81 | 0.40 |
| Gronwall | 1422 | 100 yr (770 cfs) | Planted - Estab | 770.00 | 190.73 | 200.72 | 197.50 | 201.11 | 0.004763 | 4.96 | 155.12 | 31.83 | 0.40 |
| Gronwall | 1422 | 100 yr (770 cfs) | Estab 2 | 770.00 | 190.73 | 200.78 | 197.50 | 201.16 | 0.005325 | 4.90 | 156.99 | 31.88 | 0.39 |
| | | | | | | | | | | | | | |
| Gronwall | 1415 | 100 yr (770 cfs) | BSLN4 | 770.00 | 191.35 | 200.71 | 196.79 | 201.03 | 0.002553 | 4.60 | 175.87 | 39.82 | 0.32 |
| Gronwall | 1415 | 100 yr (770 cfs) | Planted - Estab | 770.00 | 191.35 | 200.73 | 196.79 | 201.05 | 0.002949 | 4.57 | 176.75 | 40.03 | 0.32 |
| Gronwall | 1415 | 100 yr (770 cfs) | Estab 2 | 770.00 | 191.35 | 200.78 | 196.79 | 201.09 | 0.003325 | 4.51 | 178.97 | 40.29 | 0.31 |
| | | | | | | | | | | | | | |
| Gronwall | 1403 | 100 yr (770 cfs) | BSLN4 | 770.00 | 191.35 | 200.68 | 196.67 | 200.99 | 0.002459 | 4.52 | 178.71 | 39.57 | 0.32 |
| Gronwall | 1403 | 100 yr (770 cfs) | Planted - Estab | 770.00 | 191.35 | 200.70 | 196.67 | 201.01 | 0.002818 | 4.50 | 179.39 | 39.71 | 0.31 |
| Gronwall | 1403 | 100 yr (770 cfs) | Estab 2 | 770.00 | 191.35 | 200.75 | 196.67 | 201.05 | 0.003157 | 4.45 | 181.40 | 40.08 | 0.31 |
| | | | | | | | | | | | | | |
| Gronwall | 1390 | 100 yr (770 cfs) | BSLN4 | 770.00 | 191.91 | 200.60 | 197.34 | 200.95 | 0.003351 | 4.76 | 165.28 | 38.34 | 0.36 |
| Gronwall | 1390 | 100 yr (770 cfs) | Planted - Estab | 770.00 | 191.91 | 200.61 | 197.34 | 200.96 | 0.003763 | 4.75 | 165.66 | 38.46 | 0.35 |
| Gronwall | 1390 | 100 yr (770 cfs) | Estab 2 | 770.00 | 191.91 | 200.66 | 197.34 | 201.00 | 0.004135 | 4.71 | 167.38 | 39.00 | 0.35 |
| | | | | | | | | | | | | | |
| Gronwall | 1363 | 100 yr (770 cfs) | BSLN4 | 770.00 | 191.30 | 200.36 | 197.26 | 200.82 | 0.006503 | 5.46 | 140.92 | 30.32 | 0.45 |
| Gronwall | 1363 | 100 yr (770 cfs) | Planted - Estab | 770.00 | 191.30 | 200.36 | 197.26 | 200.82 | 0.006503 | 5.46 | 140.92 | 30.32 | 0.45 |
| Gronwall | 1363 | 100 yr (770 cfs) | Estab 2 | 770.00 | 191.30 | 200.38 | 197.26 | 200.84 | 0.007616 | 5.43 | 141.72 | 30.49 | 0.44 |
| | | | | | | | | | | | | | |
| Gronwall | 1350 | 100 yr (770 cfs) | BSLN4 | 770.00 | 191.00 | 200.32 | 196.78 | 200.73 | 0.005224 | 5.14 | 150.27 | 33.82 | 0.41 |
| Gronwall | 1350 | 100 yr (770 cfs) | Planted - Estab | 770.00 | 191.00 | 200.32 | 196.78 | 200.73 | 0.005224 | 5.14 | 150.27 | 33.82 | 0.41 |
| Gronwall | 1350 | 100 yr (770 cfs) | Estab 2 | 770.00 | 191.00 | 200.33 | 196.78 | 200.74 | 0.006114 | 5.13 | 150.64 | 33.99 | 0.40 |

HEC-RAS River: Hale Creek Reach: Gronwall Profile: 100 yr (770 cfs) (Continued)

| Reach | River Sta | Profile | Plan | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | |
| | | | | | | | | | | | | | |
| Gronwall | 1322 | 100 yr (770 cfs) | BSLN4 | 903.00 | 190.60 | 200.20 | 196.88 | 200.58 | 0.004656 | 4.92 | 183.48 | 39.35 | 0.40 |
| Gronwall | 1322 | 100 yr (770 cfs) | Planted - Estab | 903.00 | 190.60 | 200.20 | 196.88 | 200.58 | 0.004656 | 4.92 | 183.48 | 39.35 | 0.40 |
| Gronwall | 1322 | 100 yr (770 cfs) | Estab 2 | 903.00 | 190.60 | 200.20 | 196.88 | 200.58 | 0.004656 | 4.92 | 183.48 | 39.35 | 0.40 |
| | | | | | | | | | | | | | |
| Gronwall | 1290 | 100 yr (770 cfs) | BSLN4 | 903.00 | 190.30 | 199.78 | 197.34 | 200.37 | 0.007711 | 6.18 | 146.06 | 30.94 | 0.50 |
| Gronwall | 1290 | 100 yr (770 cfs) | Planted - Estab | 903.00 | 190.30 | 199.78 | 197.34 | 200.37 | 0.007711 | 6.18 | 146.06 | 30.94 | 0.50 |
| Gronwall | 1290 | 100 yr (770 cfs) | Estab 2 | 903.00 | 190.30 | 199.78 | 197.34 | 200.37 | 0.007711 | 6.18 | 146.06 | 30.94 | 0.50 |
| | | | | | | | | | | | | | |
| Gronwall | 1227 | 100 yr (770 cfs) | BSLN4 | 903.00 | 191.70 | 199.43 | 196.27 | 199.97 | 0.004945 | 5.90 | 152.99 | 23.40 | 0.41 |
| Gronwall | 1227 | 100 yr (770 cfs) | Planted - Estab | 903.00 | 191.70 | 199.43 | 196.27 | 199.97 | 0.004945 | 5.90 | 152.99 | 23.40 | 0.41 |
| Gronwall | 1227 | 100 yr (770 cfs) | Estab 2 | 903.00 | 191.70 | 199.43 | 196.27 | 199.97 | 0.004945 | 5.90 | 152.99 | 23.40 | 0.41 |
| | | | | | | | | | | | | | |
| Gronwall | 1210 | | | Bridge | | | | | | | | | |
| | | | | | | | | | | | | | |
| Gronwall | 1194 | 100 yr (770 cfs) | BSLN4 | 903.00 | 191.40 | 197.24 | 196.25 | 198.55 | 0.011194 | 9.20 | 98.12 | 24.17 | 0.76 |
| Gronwall | 1194 | 100 yr (770 cfs) | Planted - Estab | 903.00 | 191.40 | 197.24 | 196.25 | 198.55 | 0.011194 | 9.20 | 98.12 | 24.17 | 0.76 |
| Gronwall | 1194 | 100 yr (770 cfs) | Estab 2 | 903.00 | 191.40 | 197.24 | 196.25 | 198.55 | 0.011194 | 9.20 | 98.12 | 24.17 | 0.76 |
| | | | | | | | | | | | | | |
| Gronwall | 1140.66 | 100 yr (770 cfs) | BSLN4 | 903.00 | 188.90 | 196.99 | 194.96 | 197.83 | 0.007523 | 7.36 | 123.81 | 27.17 | 0.56 |
| Gronwall | 1140.66 | 100 yr (770 cfs) | Planted - Estab | 903.00 | 188.90 | 196.99 | 194.96 | 197.83 | 0.007523 | 7.36 | 123.81 | 27.17 | 0.56 |
| Gronwall | 1140.66 | 100 yr (770 cfs) | Estab 2 | 903.00 | 188.90 | 196.99 | 194.96 | 197.83 | 0.007523 | 7.36 | 123.81 | 27.17 | 0.56 |
| | | | | | | | | | | | | | |
| Gronwall | 1042 | 100 yr (770 cfs) | BSLN4 | 903.00 | 188.84 | 196.35 | 194.15 | 197.01 | 0.008011 | 6.55 | 137.96 | 27.95 | 0.52 |
| Gronwall | 1042 | 100 yr (770 cfs) | Planted - Estab | 903.00 | 188.84 | 196.35 | 194.15 | 197.01 | 0.008011 | 6.55 | 137.96 | 27.95 | 0.52 |
| Gronwall | 1042 | 100 yr (770 cfs) | Estab 2 | 903.00 | 188.84 | 196.35 | 194.15 | 197.01 | 0.008011 | 6.55 | 137.96 | 27.95 | 0.52 |

HEC-RAS River: Hale Creek Reach: Gronwall

| Reach | River Sta | Profile | Plan | Q Total | W.S. Elev | Vel Chnl | Shear Chan |
|---|---|---|---|---|---|---|---|
| | | | | (cfs) | (ft) | (ft/s) | (lb/sq ft) |
| Gronwall | 1593 | 10 yr (334 cfs) | BSLN4 | 334.00 | 200.86 | 3.45 | 0.55 |
| Gronwall | 1593 | 10 yr (334 cfs) | Planted - Estab | 334.00 | 200.86 | 3.45 | 0.55 |
| Gronwall | 1593 | 10 yr (334 cfs) | Estab 2 | 334.00 | 200.86 | 3.45 | 0.55 |
| Gronwall | 1593 | 50 yr (705 cfs) | BSLN4 | 705.00 | 203.95 | 4.10 | 0.73 |
| Gronwall | 1593 | 50 yr (705 cfs) | Planted - Estab | 705.00 | 203.95 | 4.10 | 0.73 |
| Gronwall | 1593 | 50 yr (705 cfs) | Estab 2 | 705.00 | 203.95 | 4.10 | 0.73 |
| Gronwall | 1593 | 100 yr (770 cfs) | BSLN4 | 770.00 | 204.10 | 4.38 | 0.82 |
| Gronwall | 1593 | 100 yr (770 cfs) | Planted - Estab | 770.00 | 204.08 | 4.39 | 0.83 |
| Gronwall | 1593 | 100 yr (770 cfs) | Estab 2 | 770.00 | 204.10 | 4.38 | 0.82 |
| | | | | | | | |
| Gronwall | 1573 | 10 yr (334 cfs) | BSLN4 | 334.00 | 200.61 | 4.80 | 0.75 |
| Gronwall | 1573 | 10 yr (334 cfs) | Planted - Estab | 334.00 | 200.61 | 4.80 | 0.75 |
| Gronwall | 1573 | 10 yr (334 cfs) | Estab 2 | 334.00 | 200.61 | 4.80 | 0.75 |
| Gronwall | 1573 | 50 yr (705 cfs) | BSLN4 | 705.00 | 203.67 | 5.55 | 1.00 |
| Gronwall | 1573 | 50 yr (705 cfs) | Planted - Estab | 705.00 | 203.67 | 5.55 | 1.00 |
| Gronwall | 1573 | 50 yr (705 cfs) | Estab 2 | 705.00 | 203.67 | 5.55 | 1.00 |
| Gronwall | 1573 | 100 yr (770 cfs) | BSLN4 | 770.00 | 203.80 | 5.84 | 1.10 |
| Gronwall | 1573 | 100 yr (770 cfs) | Planted - Estab | 770.00 | 203.78 | 5.88 | 1.12 |
| Gronwall | 1573 | 100 yr (770 cfs) | Estab 2 | 770.00 | 203.80 | 5.84 | 1.10 |
| | | | | | | | |
| Gronwall | 1568 | | | Culvert | | | |
| | | | | | | | |
| Gronwall | 1459 | 10 yr (334 cfs) | BSLN4 | 334.00 | 196.01 | 13.06 | 1.28 |
| Gronwall | 1459 | 10 yr (334 cfs) | Planted - Estab | 334.00 | 196.01 | 13.06 | 1.28 |
| Gronwall | 1459 | 10 yr (334 cfs) | Estab 2 | 334.00 | 196.01 | 13.06 | 1.28 |
| Gronwall | 1459 | 50 yr (705 cfs) | BSLN4 | 705.00 | 200.12 | 8.65 | 0.46 |
| Gronwall | 1459 | 50 yr (705 cfs) | Planted - Estab | 705.00 | 200.15 | 8.61 | 0.45 |
| Gronwall | 1459 | 50 yr (705 cfs) | Estab 2 | 705.00 | 200.21 | 8.50 | 0.44 |
| Gronwall | 1459 | 100 yr (770 cfs) | BSLN4 | 770.00 | 200.36 | 9.02 | 0.49 |
| Gronwall | 1459 | 100 yr (770 cfs) | Planted - Estab | 770.00 | 200.39 | 8.97 | 0.49 |
| Gronwall | 1459 | 100 yr (770 cfs) | Estab 2 | 770.00 | 200.46 | 8.86 | 0.47 |
| | | | | | | | |
| Gronwall | 1443 | 10 yr (334 cfs) | BSLN4 | 334.00 | 197.38 | 7.86 | 0.42 |
| Gronwall | 1443 | 10 yr (334 cfs) | Planted - Estab | 334.00 | 197.39 | 7.83 | 0.42 |
| Gronwall | 1443 | 10 yr (334 cfs) | Estab 2 | 334.00 | 197.43 | 7.74 | 0.41 |
| Gronwall | 1443 | 50 yr (705 cfs) | BSLN4 | 705.00 | 200.13 | 8.38 | 0.43 |
| Gronwall | 1443 | 50 yr (705 cfs) | Planted - Estab | 705.00 | 200.16 | 8.33 | 0.42 |
| Gronwall | 1443 | 50 yr (705 cfs) | Estab 2 | 705.00 | 200.22 | 8.22 | 0.41 |
| Gronwall | 1443 | 100 yr (770 cfs) | BSLN4 | 770.00 | 200.37 | 8.70 | 0.45 |
| Gronwall | 1443 | 100 yr (770 cfs) | Planted - Estab | 770.00 | 200.40 | 8.66 | 0.45 |
| Gronwall | 1443 | 100 yr (770 cfs) | Estab 2 | 770.00 | 200.47 | 8.54 | 0.44 |
| | | | | | | | |
| Gronwall | 1429 | 10 yr (334 cfs) | BSLN4 | 334.00 | 197.15 | 8.45 | 0.49 |
| Gronwall | 1429 | 10 yr (334 cfs) | Planted - Estab | 334.00 | 197.20 | 8.33 | 0.48 |
| Gronwall | 1429 | 10 yr (334 cfs) | Estab 2 | 334.00 | 197.28 | 8.11 | 0.45 |
| Gronwall | 1429 | 50 yr (705 cfs) | BSLN4 | 705.00 | 200.07 | 8.48 | 0.44 |
| Gronwall | 1429 | 50 yr (705 cfs) | Planted - Estab | 705.00 | 200.10 | 8.42 | 0.43 |
| Gronwall | 1429 | 50 yr (705 cfs) | Estab 2 | 705.00 | 200.17 | 8.31 | 0.42 |
| Gronwall | 1429 | 100 yr (770 cfs) | BSLN4 | 770.00 | 200.31 | 8.82 | 0.47 |

HEC-RAS River: Hale Creek Reach: Gronwall (Continued)

| Reach | River Sta | Profile | Plan | Q Total | W.S. Elev | Vel Chnl | Shear Chan |
|---|---|---|---|---|---|---|---|
| | | | | (cfs) | (ft) | (ft/s) | (lb/sq ft) |
| Gronwall | 1429 | 100 yr (770 cfs) | Planted - Estab | 770.00 | 200.34 | 8.76 | 0.46 |
| Gronwall | 1429 | 100 yr (770 cfs) | Estab 2 | 770.00 | 200.41 | 8.64 | 0.45 |
| | | | | | | | |
| Gronwall | 1422 | 10 yr (334 cfs) | BSLN4 | 334.00 | 197.50 | 4.72 | 1.02 |
| Gronwall | 1422 | 10 yr (334 cfs) | Planted - Estab | 334.00 | 197.53 | 4.68 | 1.18 |
| Gronwall | 1422 | 10 yr (334 cfs) | Estab 2 | 334.00 | 197.60 | 4.60 | 1.33 |
| Gronwall | 1422 | 50 yr (705 cfs) | BSLN4 | 705.00 | 200.43 | 4.84 | 0.94 |
| Gronwall | 1422 | 50 yr (705 cfs) | Planted - Estab | 705.00 | 200.45 | 4.81 | 1.08 |
| Gronwall | 1422 | 50 yr (705 cfs) | Estab 2 | 705.00 | 200.51 | 4.76 | 1.22 |
| Gronwall | 1422 | 100 yr (770 cfs) | BSLN4 | 770.00 | 200.70 | 4.99 | 0.99 |
| Gronwall | 1422 | 100 yr (770 cfs) | Planted - Estab | 770.00 | 200.72 | 4.96 | 1.13 |
| Gronwall | 1422 | 100 yr (770 cfs) | Estab 2 | 770.00 | 200.78 | 4.90 | 1.28 |
| | | | | | | | |
| Gronwall | 1415 | 10 yr (334 cfs) | BSLN4 | 334.00 | 197.53 | 3.89 | 0.68 |
| Gronwall | 1415 | 10 yr (334 cfs) | Planted - Estab | 334.00 | 197.55 | 3.87 | 0.78 |
| Gronwall | 1415 | 10 yr (334 cfs) | Estab 2 | 334.00 | 197.61 | 3.81 | 0.87 |
| Gronwall | 1415 | 50 yr (705 cfs) | BSLN4 | 705.00 | 200.43 | 4.43 | 0.77 |
| Gronwall | 1415 | 50 yr (705 cfs) | Planted - Estab | 705.00 | 200.46 | 4.41 | 0.90 |
| Gronwall | 1415 | 50 yr (705 cfs) | Estab 2 | 705.00 | 200.51 | 4.36 | 1.02 |
| Gronwall | 1415 | 100 yr (770 cfs) | BSLN4 | 770.00 | 200.71 | 4.60 | 0.82 |
| Gronwall | 1415 | 100 yr (770 cfs) | Planted - Estab | 770.00 | 200.73 | 4.57 | 0.95 |
| Gronwall | 1415 | 100 yr (770 cfs) | Estab 2 | 770.00 | 200.78 | 4.51 | 1.08 |
| | | | | | | | |
| Gronwall | 1403 | 10 yr (334 cfs) | BSLN4 | 334.00 | 197.49 | 3.82 | 0.66 |
| Gronwall | 1403 | 10 yr (334 cfs) | Planted - Estab | 334.00 | 197.51 | 3.80 | 0.74 |
| Gronwall | 1403 | 10 yr (334 cfs) | Estab 2 | 334.00 | 197.56 | 3.75 | 0.82 |
| Gronwall | 1403 | 50 yr (705 cfs) | BSLN4 | 705.00 | 200.41 | 4.35 | 0.75 |
| Gronwall | 1403 | 50 yr (705 cfs) | Planted - Estab | 705.00 | 200.43 | 4.34 | 0.86 |
| Gronwall | 1403 | 50 yr (705 cfs) | Estab 2 | 705.00 | 200.47 | 4.29 | 0.97 |
| Gronwall | 1403 | 100 yr (770 cfs) | BSLN4 | 770.00 | 200.68 | 4.52 | 0.80 |
| Gronwall | 1403 | 100 yr (770 cfs) | Planted - Estab | 770.00 | 200.70 | 4.50 | 0.91 |
| Gronwall | 1403 | 100 yr (770 cfs) | Estab 2 | 770.00 | 200.75 | 4.45 | 1.03 |
| | | | | | | | |
| Gronwall | 1390 | 10 yr (334 cfs) | BSLN4 | 334.00 | 197.33 | 4.55 | 0.98 |
| Gronwall | 1390 | 10 yr (334 cfs) | Planted - Estab | 334.00 | 197.35 | 4.53 | 1.10 |
| Gronwall | 1390 | 10 yr (334 cfs) | Estab 2 | 334.00 | 197.40 | 4.47 | 1.21 |
| Gronwall | 1390 | 50 yr (705 cfs) | BSLN4 | 705.00 | 200.33 | 4.59 | 0.89 |
| Gronwall | 1390 | 50 yr (705 cfs) | Planted - Estab | 705.00 | 200.34 | 4.58 | 1.01 |
| Gronwall | 1390 | 50 yr (705 cfs) | Estab 2 | 705.00 | 200.39 | 4.54 | 1.11 |
| Gronwall | 1390 | 100 yr (770 cfs) | BSLN4 | 770.00 | 200.60 | 4.76 | 0.94 |
| Gronwall | 1390 | 100 yr (770 cfs) | Planted - Estab | 770.00 | 200.61 | 4.75 | 1.06 |
| Gronwall | 1390 | 100 yr (770 cfs) | Estab 2 | 770.00 | 200.66 | 4.71 | 1.18 |
| | | | | | | | |
| Gronwall | 1363 | 10 yr (334 cfs) | BSLN4 | 334.00 | 197.08 | 5.04 | 1.39 |
| Gronwall | 1363 | 10 yr (334 cfs) | Planted - Estab | 334.00 | 197.08 | 5.04 | 1.39 |
| Gronwall | 1363 | 10 yr (334 cfs) | Estab 2 | 334.00 | 197.10 | 5.01 | 1.56 |
| Gronwall | 1363 | 50 yr (705 cfs) | BSLN4 | 705.00 | 200.09 | 5.29 | 1.45 |
| Gronwall | 1363 | 50 yr (705 cfs) | Planted - Estab | 705.00 | 200.09 | 5.29 | 1.45 |
| Gronwall | 1363 | 50 yr (705 cfs) | Estab 2 | 705.00 | 200.12 | 5.26 | 1.69 |

HEC-RAS River: Hale Creek Reach: Gronwall (Continued)

| Reach | River Sta | Profile | Plan | Q Total | W.S. Elev | Vel Chnl | Shear Chan |
|---|---|---|---|---|---|---|---|
| | | | | (cfs) | (ft) | (ft/s) | (lb/sq ft) |
| Gronwall | 1363 | 100 yr (770 cfs) | BSLN4 | 770.00 | 200.36 | 5.46 | 1.55 |
| Gronwall | 1363 | 100 yr (770 cfs) | Planted - Estab | 770.00 | 200.36 | 5.46 | 1.55 |
| Gronwall | 1363 | 100 yr (770 cfs) | Estab 2 | 770.00 | 200.38 | 5.43 | 1.82 |
| | | | | | | | |
| Gronwall | 1350 | 10 yr (334 cfs) | BSLN4 | 334.00 | 197.05 | 4.55 | 1.07 |
| Gronwall | 1350 | 10 yr (334 cfs) | Planted - Estab | 334.00 | 197.05 | 4.55 | 1.07 |
| Gronwall | 1350 | 10 yr (334 cfs) | Estab 2 | 334.00 | 197.06 | 4.54 | 1.22 |
| Gronwall | 1350 | 50 yr (705 cfs) | BSLN4 | 705.00 | 200.06 | 4.96 | 1.24 |
| Gronwall | 1350 | 50 yr (705 cfs) | Planted - Estab | 705.00 | 200.06 | 4.96 | 1.24 |
| Gronwall | 1350 | 50 yr (705 cfs) | Estab 2 | 705.00 | 200.07 | 4.95 | 1.45 |
| Gronwall | 1350 | 100 yr (770 cfs) | BSLN4 | 770.00 | 200.32 | 5.14 | 1.31 |
| Gronwall | 1350 | 100 yr (770 cfs) | Planted - Estab | 770.00 | 200.32 | 5.14 | 1.31 |
| Gronwall | 1350 | 100 yr (770 cfs) | Estab 2 | 770.00 | 200.33 | 5.13 | 1.54 |
| | | | | | | | |
| Gronwall | 1322 | 10 yr (334 cfs) | BSLN4 | 392.00 | 196.85 | 4.79 | 1.12 |
| Gronwall | 1322 | 10 yr (334 cfs) | Planted - Estab | 392.00 | 196.85 | 4.79 | 1.12 |
| Gronwall | 1322 | 10 yr (334 cfs) | Estab 2 | 392.00 | 196.85 | 4.79 | 1.12 |
| Gronwall | 1322 | 50 yr (705 cfs) | BSLN4 | 827.00 | 199.95 | 4.76 | 1.09 |
| Gronwall | 1322 | 50 yr (705 cfs) | Planted - Estab | 827.00 | 199.95 | 4.76 | 1.09 |
| Gronwall | 1322 | 50 yr (705 cfs) | Estab 2 | 827.00 | 199.95 | 4.76 | 1.09 |
| Gronwall | 1322 | 100 yr (770 cfs) | BSLN4 | 903.00 | 200.20 | 4.92 | 1.16 |
| Gronwall | 1322 | 100 yr (770 cfs) | Planted - Estab | 903.00 | 200.20 | 4.92 | 1.16 |
| Gronwall | 1322 | 100 yr (770 cfs) | Estab 2 | 903.00 | 200.20 | 4.92 | 1.16 |
| | | | | | | | |
| Gronwall | 1290 | 10 yr (334 cfs) | BSLN4 | 392.00 | 196.25 | 6.46 | 2.10 |
| Gronwall | 1290 | 10 yr (334 cfs) | Planted - Estab | 392.00 | 196.25 | 6.46 | 2.10 |
| Gronwall | 1290 | 10 yr (334 cfs) | Estab 2 | 392.00 | 196.25 | 6.46 | 2.10 |
| Gronwall | 1290 | 50 yr (705 cfs) | BSLN4 | 827.00 | 199.55 | 5.94 | 1.71 |
| Gronwall | 1290 | 50 yr (705 cfs) | Planted - Estab | 827.00 | 199.55 | 5.94 | 1.71 |
| Gronwall | 1290 | 50 yr (705 cfs) | Estab 2 | 827.00 | 199.55 | 5.94 | 1.71 |
| Gronwall | 1290 | 100 yr (770 cfs) | BSLN4 | 903.00 | 199.78 | 6.18 | 1.85 |
| Gronwall | 1290 | 100 yr (770 cfs) | Planted - Estab | 903.00 | 199.78 | 6.18 | 1.85 |
| Gronwall | 1290 | 100 yr (770 cfs) | Estab 2 | 903.00 | 199.78 | 6.18 | 1.85 |
| | | | | | | | |
| Gronwall | 1227 | 10 yr (334 cfs) | BSLN4 | 392.00 | 195.73 | 5.60 | 1.43 |
| Gronwall | 1227 | 10 yr (334 cfs) | Planted - Estab | 392.00 | 195.73 | 5.60 | 1.43 |
| Gronwall | 1227 | 10 yr (334 cfs) | Estab 2 | 392.00 | 195.73 | 5.60 | 1.43 |
| Gronwall | 1227 | 50 yr (705 cfs) | BSLN4 | 827.00 | 199.24 | 5.56 | 1.28 |
| Gronwall | 1227 | 50 yr (705 cfs) | Planted - Estab | 827.00 | 199.24 | 5.56 | 1.28 |
| Gronwall | 1227 | 50 yr (705 cfs) | Estab 2 | 827.00 | 199.24 | 5.56 | 1.28 |
| Gronwall | 1227 | 100 yr (770 cfs) | BSLN4 | 903.00 | 199.43 | 5.90 | 1.44 |
| Gronwall | 1227 | 100 yr (770 cfs) | Planted - Estab | 903.00 | 199.43 | 5.90 | 1.44 |
| Gronwall | 1227 | 100 yr (770 cfs) | Estab 2 | 903.00 | 199.43 | 5.90 | 1.44 |
| | | | | | | | |
| Gronwall | 1210 | | | Bridge | | | |
| | | | | | | | |
| Gronwall | 1194 | 10 yr (334 cfs) | BSLN4 | 392.00 | 194.66 | 7.93 | 2.22 |
| Gronwall | 1194 | 10 yr (334 cfs) | Planted - Estab | 392.00 | 194.66 | 7.93 | 2.22 |
| Gronwall | 1194 | 10 yr (334 cfs) | Estab 2 | 392.00 | 194.66 | 7.93 | 2.22 |

HEC-RAS River: Hale Creek Reach: Gronwall (Continued)

| Reach | River Sta | Profile | Plan | Q Total | W.S. Elev | Vel Chnl | Shear Chan |
|---|---|---|---|---|---|---|---|
| | | | | (cfs) | (ft) | (ft/s) | (lb/sq ft) |
| Gronwall | 1194 | 50 yr (705 cfs) | BSLN4 | 827.00 | 196.92 | 9.03 | 2.64 |
| Gronwall | 1194 | 50 yr (705 cfs) | Planted - Estab | 827.00 | 196.92 | 9.03 | 2.64 |
| Gronwall | 1194 | 50 yr (705 cfs) | Estab 2 | 827.00 | 196.92 | 9.03 | 2.64 |
| Gronwall | 1194 | 100 yr (770 cfs) | BSLN4 | 903.00 | 197.24 | 9.20 | 2.79 |
| Gronwall | 1194 | 100 yr (770 cfs) | Planted - Estab | 903.00 | 197.24 | 9.20 | 2.79 |
| Gronwall | 1194 | 100 yr (770 cfs) | Estab 2 | 903.00 | 197.24 | 9.20 | 2.79 |
| | | | | | | | |
| Gronwall | 1140.66 | 10 yr (334 cfs) | BSLN4 | 392.00 | 194.38 | 5.78 | 1.28 |
| Gronwall | 1140.66 | 10 yr (334 cfs) | Planted - Estab | 392.00 | 194.38 | 5.78 | 1.28 |
| Gronwall | 1140.66 | 10 yr (334 cfs) | Estab 2 | 392.00 | 194.38 | 5.78 | 1.28 |
| Gronwall | 1140.66 | 50 yr (705 cfs) | BSLN4 | 827.00 | 196.68 | 7.16 | 1.89 |
| Gronwall | 1140.66 | 50 yr (705 cfs) | Planted - Estab | 827.00 | 196.68 | 7.16 | 1.89 |
| Gronwall | 1140.66 | 50 yr (705 cfs) | Estab 2 | 827.00 | 196.68 | 7.16 | 1.89 |
| Gronwall | 1140.66 | 100 yr (770 cfs) | BSLN4 | 903.00 | 196.99 | 7.36 | 1.97 |
| Gronwall | 1140.66 | 100 yr (770 cfs) | Planted - Estab | 903.00 | 196.99 | 7.36 | 1.97 |
| Gronwall | 1140.66 | 100 yr (770 cfs) | Estab 2 | 903.00 | 196.99 | 7.36 | 1.97 |
| | | | | | | | |
| Gronwall | 1042 | 10 yr (334 cfs) | BSLN4 | 392.00 | 193.70 | 5.38 | 1.44 |
| Gronwall | 1042 | 10 yr (334 cfs) | Planted - Estab | 392.00 | 193.70 | 5.38 | 1.44 |
| Gronwall | 1042 | 10 yr (334 cfs) | Estab 2 | 392.00 | 193.70 | 5.38 | 1.44 |
| Gronwall | 1042 | 50 yr (705 cfs) | BSLN4 | 827.00 | 196.02 | 6.41 | 1.94 |
| Gronwall | 1042 | 50 yr (705 cfs) | Planted - Estab | 827.00 | 196.02 | 6.41 | 1.94 |
| Gronwall | 1042 | 50 yr (705 cfs) | Estab 2 | 827.00 | 196.02 | 6.41 | 1.94 |
| Gronwall | 1042 | 100 yr (770 cfs) | BSLN4 | 903.00 | 196.35 | 6.55 | 2.01 |
| Gronwall | 1042 | 100 yr (770 cfs) | Planted - Estab | 903.00 | 196.35 | 6.55 | 2.01 |
| Gronwall | 1042 | 100 yr (770 cfs) | Estab 2 | 903.00 | 196.35 | 6.55 | 2.01 |

HEC-RAS River: Hale Creek Reach: Gronwall

| Reach | River Sta | Profile | Plan | Q Total | W.S. Elev | Vel Chnl | Shear Chan |
|---|---|---|---|---|---|---|---|
| | | | | (cfs) | (ft) | (ft/s) | (lb/sq ft) |
| Gronwall | 1593 | 10 yr (334 cfs) | BSLN4 | 334.00 | 200.86 | 3.45 | 0.55 |
| Gronwall | 1593 | 10 yr (334 cfs) | Planted - Estab | 334.00 | 200.86 | 3.45 | 0.55 |
| Gronwall | 1593 | 10 yr (334 cfs) | Estab 2 | 334.00 | 200.86 | 3.45 | 0.55 |
| Gronwall | 1593 | 50 yr (705 cfs) | BSLN4 | 705.00 | 203.95 | 4.10 | 0.73 |
| Gronwall | 1593 | 50 yr (705 cfs) | Planted - Estab | 705.00 | 203.95 | 4.10 | 0.73 |
| Gronwall | 1593 | 50 yr (705 cfs) | Estab 2 | 705.00 | 203.95 | 4.10 | 0.73 |
| Gronwall | 1593 | 100 yr (770 cfs) | BSLN4 | 770.00 | 204.10 | 4.38 | 0.82 |
| Gronwall | 1593 | 100 yr (770 cfs) | Planted - Estab | 770.00 | 204.08 | 4.39 | 0.83 |
| Gronwall | 1593 | 100 yr (770 cfs) | Estab 2 | 770.00 | 204.10 | 4.38 | 0.82 |
| | | | | | | | |
| Gronwall | 1573 | 10 yr (334 cfs) | BSLN4 | 334.00 | 200.61 | 4.80 | 0.75 |
| Gronwall | 1573 | 10 yr (334 cfs) | Planted - Estab | 334.00 | 200.61 | 4.80 | 0.75 |
| Gronwall | 1573 | 10 yr (334 cfs) | Estab 2 | 334.00 | 200.61 | 4.80 | 0.75 |
| Gronwall | 1573 | 50 yr (705 cfs) | BSLN4 | 705.00 | 203.67 | 5.55 | 1.00 |
| Gronwall | 1573 | 50 yr (705 cfs) | Planted - Estab | 705.00 | 203.67 | 5.55 | 1.00 |
| Gronwall | 1573 | 50 yr (705 cfs) | Estab 2 | 705.00 | 203.67 | 5.55 | 1.00 |
| Gronwall | 1573 | 100 yr (770 cfs) | BSLN4 | 770.00 | 203.80 | 5.84 | 1.10 |
| Gronwall | 1573 | 100 yr (770 cfs) | Planted - Estab | 770.00 | 203.78 | 5.88 | 1.12 |
| Gronwall | 1573 | 100 yr (770 cfs) | Estab 2 | 770.00 | 203.80 | 5.84 | 1.10 |
| | | | | | | | |
| Gronwall | 1568 | | | Culvert | | | |
| | | | | | | | |
| Gronwall | 1459 | 10 yr (334 cfs) | BSLN4 | 334.00 | 196.01 | 13.06 | 1.28 |
| Gronwall | 1459 | 10 yr (334 cfs) | Planted - Estab | 334.00 | 196.01 | 13.06 | 1.28 |
| Gronwall | 1459 | 10 yr (334 cfs) | Estab 2 | 334.00 | 196.01 | 13.06 | 1.28 |
| Gronwall | 1459 | 50 yr (705 cfs) | BSLN4 | 705.00 | 200.12 | 8.65 | 0.46 |
| Gronwall | 1459 | 50 yr (705 cfs) | Planted - Estab | 705.00 | 200.15 | 8.61 | 0.45 |
| Gronwall | 1459 | 50 yr (705 cfs) | Estab 2 | 705.00 | 200.21 | 8.50 | 0.44 |
| Gronwall | 1459 | 100 yr (770 cfs) | BSLN4 | 770.00 | 200.36 | 9.02 | 0.49 |
| Gronwall | 1459 | 100 yr (770 cfs) | Planted - Estab | 770.00 | 200.39 | 8.97 | 0.49 |
| Gronwall | 1459 | 100 yr (770 cfs) | Estab 2 | 770.00 | 200.46 | 8.86 | 0.47 |
| | | | | | | | |
| Gronwall | 1443 | 10 yr (334 cfs) | BSLN4 | 334.00 | 197.38 | 7.86 | 0.42 |
| Gronwall | 1443 | 10 yr (334 cfs) | Planted - Estab | 334.00 | 197.39 | 7.83 | 0.42 |
| Gronwall | 1443 | 10 yr (334 cfs) | Estab 2 | 334.00 | 197.43 | 7.74 | 0.41 |
| Gronwall | 1443 | 50 yr (705 cfs) | BSLN4 | 705.00 | 200.13 | 8.38 | 0.43 |
| Gronwall | 1443 | 50 yr (705 cfs) | Planted - Estab | 705.00 | 200.16 | 8.33 | 0.42 |
| Gronwall | 1443 | 50 yr (705 cfs) | Estab 2 | 705.00 | 200.22 | 8.22 | 0.41 |
| Gronwall | 1443 | 100 yr (770 cfs) | BSLN4 | 770.00 | 200.37 | 8.70 | 0.45 |
| Gronwall | 1443 | 100 yr (770 cfs) | Planted - Estab | 770.00 | 200.40 | 8.66 | 0.45 |
| Gronwall | 1443 | 100 yr (770 cfs) | Estab 2 | 770.00 | 200.47 | 8.54 | 0.44 |
| | | | | | | | |
| Gronwall | 1429 | 10 yr (334 cfs) | BSLN4 | 334.00 | 197.15 | 8.45 | 0.49 |
| Gronwall | 1429 | 10 yr (334 cfs) | Planted - Estab | 334.00 | 197.20 | 8.33 | 0.48 |
| Gronwall | 1429 | 10 yr (334 cfs) | Estab 2 | 334.00 | 197.28 | 8.11 | 0.45 |
| Gronwall | 1429 | 50 yr (705 cfs) | BSLN4 | 705.00 | 200.07 | 8.48 | 0.44 |
| Gronwall | 1429 | 50 yr (705 cfs) | Planted - Estab | 705.00 | 200.10 | 8.42 | 0.43 |
| Gronwall | 1429 | 50 yr (705 cfs) | Estab 2 | 705.00 | 200.17 | 8.31 | 0.42 |
| Gronwall | 1429 | 100 yr (770 cfs) | BSLN4 | 770.00 | 200.31 | 8.82 | 0.47 |

HEC-RAS River: Hale Creek Reach: Gronwall (Continued)

| Reach | River Sta | Profile | Plan | Q Total | W.S. Elev | Vel Chnl | Shear Chan |
|---|---|---|---|---|---|---|---|
| | | | | (cfs) | (ft) | (ft/s) | (lb/sq ft) |
| Gronwall | 1429 | 100 yr (770 cfs) | Planted - Estab | 770.00 | 200.34 | 8.76 | 0.46 |
| Gronwall | 1429 | 100 yr (770 cfs) | Estab 2 | 770.00 | 200.41 | 8.64 | 0.45 |
| | | | | | | | |
| Gronwall | 1422 | 10 yr (334 cfs) | BSLN4 | 334.00 | 197.50 | 4.72 | 1.02 |
| Gronwall | 1422 | 10 yr (334 cfs) | Planted - Estab | 334.00 | 197.53 | 4.68 | 1.18 |
| Gronwall | 1422 | 10 yr (334 cfs) | Estab 2 | 334.00 | 197.60 | 4.60 | 1.33 |
| Gronwall | 1422 | 50 yr (705 cfs) | BSLN4 | 705.00 | 200.43 | 4.84 | 0.94 |
| Gronwall | 1422 | 50 yr (705 cfs) | Planted - Estab | 705.00 | 200.45 | 4.81 | 1.08 |
| Gronwall | 1422 | 50 yr (705 cfs) | Estab 2 | 705.00 | 200.51 | 4.76 | 1.22 |
| Gronwall | 1422 | 100 yr (770 cfs) | BSLN4 | 770.00 | 200.70 | 4.99 | 0.99 |
| Gronwall | 1422 | 100 yr (770 cfs) | Planted - Estab | 770.00 | 200.72 | 4.96 | 1.13 |
| Gronwall | 1422 | 100 yr (770 cfs) | Estab 2 | 770.00 | 200.78 | 4.90 | 1.28 |
| | | | | | | | |
| Gronwall | 1415 | 10 yr (334 cfs) | BSLN4 | 334.00 | 197.53 | 3.89 | 0.68 |
| Gronwall | 1415 | 10 yr (334 cfs) | Planted - Estab | 334.00 | 197.55 | 3.87 | 0.78 |
| Gronwall | 1415 | 10 yr (334 cfs) | Estab 2 | 334.00 | 197.61 | 3.81 | 0.87 |
| Gronwall | 1415 | 50 yr (705 cfs) | BSLN4 | 705.00 | 200.43 | 4.43 | 0.77 |
| Gronwall | 1415 | 50 yr (705 cfs) | Planted - Estab | 705.00 | 200.46 | 4.41 | 0.90 |
| Gronwall | 1415 | 50 yr (705 cfs) | Estab 2 | 705.00 | 200.51 | 4.36 | 1.02 |
| Gronwall | 1415 | 100 yr (770 cfs) | BSLN4 | 770.00 | 200.71 | 4.60 | 0.82 |
| Gronwall | 1415 | 100 yr (770 cfs) | Planted - Estab | 770.00 | 200.73 | 4.57 | 0.95 |
| Gronwall | 1415 | 100 yr (770 cfs) | Estab 2 | 770.00 | 200.78 | 4.51 | 1.08 |
| | | | | | | | |
| Gronwall | 1403 | 10 yr (334 cfs) | BSLN4 | 334.00 | 197.49 | 3.82 | 0.66 |
| Gronwall | 1403 | 10 yr (334 cfs) | Planted - Estab | 334.00 | 197.51 | 3.80 | 0.74 |
| Gronwall | 1403 | 10 yr (334 cfs) | Estab 2 | 334.00 | 197.56 | 3.75 | 0.82 |
| Gronwall | 1403 | 50 yr (705 cfs) | BSLN4 | 705.00 | 200.41 | 4.35 | 0.75 |
| Gronwall | 1403 | 50 yr (705 cfs) | Planted - Estab | 705.00 | 200.43 | 4.34 | 0.86 |
| Gronwall | 1403 | 50 yr (705 cfs) | Estab 2 | 705.00 | 200.47 | 4.29 | 0.97 |
| Gronwall | 1403 | 100 yr (770 cfs) | BSLN4 | 770.00 | 200.68 | 4.52 | 0.80 |
| Gronwall | 1403 | 100 yr (770 cfs) | Planted - Estab | 770.00 | 200.70 | 4.50 | 0.91 |
| Gronwall | 1403 | 100 yr (770 cfs) | Estab 2 | 770.00 | 200.75 | 4.45 | 1.03 |
| | | | | | | | |
| Gronwall | 1390 | 10 yr (334 cfs) | BSLN4 | 334.00 | 197.33 | 4.55 | 0.98 |
| Gronwall | 1390 | 10 yr (334 cfs) | Planted - Estab | 334.00 | 197.35 | 4.53 | 1.10 |
| Gronwall | 1390 | 10 yr (334 cfs) | Estab 2 | 334.00 | 197.40 | 4.47 | 1.21 |
| Gronwall | 1390 | 50 yr (705 cfs) | BSLN4 | 705.00 | 200.33 | 4.59 | 0.89 |
| Gronwall | 1390 | 50 yr (705 cfs) | Planted - Estab | 705.00 | 200.34 | 4.58 | 1.01 |
| Gronwall | 1390 | 50 yr (705 cfs) | Estab 2 | 705.00 | 200.39 | 4.54 | 1.11 |
| Gronwall | 1390 | 100 yr (770 cfs) | BSLN4 | 770.00 | 200.60 | 4.76 | 0.94 |
| Gronwall | 1390 | 100 yr (770 cfs) | Planted - Estab | 770.00 | 200.61 | 4.75 | 1.06 |
| Gronwall | 1390 | 100 yr (770 cfs) | Estab 2 | 770.00 | 200.66 | 4.71 | 1.18 |
| | | | | | | | |
| Gronwall | 1363 | 10 yr (334 cfs) | BSLN4 | 334.00 | 197.08 | 5.04 | 1.39 |
| Gronwall | 1363 | 10 yr (334 cfs) | Planted - Estab | 334.00 | 197.08 | 5.04 | 1.39 |
| Gronwall | 1363 | 10 yr (334 cfs) | Estab 2 | 334.00 | 197.10 | 5.01 | 1.56 |
| Gronwall | 1363 | 50 yr (705 cfs) | BSLN4 | 705.00 | 200.09 | 5.29 | 1.45 |
| Gronwall | 1363 | 50 yr (705 cfs) | Planted - Estab | 705.00 | 200.09 | 5.29 | 1.45 |
| Gronwall | 1363 | 50 yr (705 cfs) | Estab 2 | 705.00 | 200.12 | 5.26 | 1.69 |

HEC-RAS River: Hale Creek Reach: Gronwall (Continued)

| Reach | River Sta | Profile | Plan | Q Total | W.S. Elev | Vel Chnl | Shear Chan |
|---|---|---|---|---|---|---|---|
| | | | | (cfs) | (ft) | (ft/s) | (lb/sq ft) |
| Gronwall | 1363 | 100 yr (770 cfs) | BSLN4 | 770.00 | 200.36 | 5.46 | 1.55 |
| Gronwall | 1363 | 100 yr (770 cfs) | Planted - Estab | 770.00 | 200.36 | 5.46 | 1.55 |
| Gronwall | 1363 | 100 yr (770 cfs) | Estab 2 | 770.00 | 200.38 | 5.43 | 1.82 |
| | | | | | | | |
| Gronwall | 1350 | 10 yr (334 cfs) | BSLN4 | 334.00 | 197.05 | 4.55 | 1.07 |
| Gronwall | 1350 | 10 yr (334 cfs) | Planted - Estab | 334.00 | 197.05 | 4.55 | 1.07 |
| Gronwall | 1350 | 10 yr (334 cfs) | Estab 2 | 334.00 | 197.06 | 4.54 | 1.22 |
| Gronwall | 1350 | 50 yr (705 cfs) | BSLN4 | 705.00 | 200.06 | 4.96 | 1.24 |
| Gronwall | 1350 | 50 yr (705 cfs) | Planted - Estab | 705.00 | 200.06 | 4.96 | 1.24 |
| Gronwall | 1350 | 50 yr (705 cfs) | Estab 2 | 705.00 | 200.07 | 4.95 | 1.45 |
| Gronwall | 1350 | 100 yr (770 cfs) | BSLN4 | 770.00 | 200.32 | 5.14 | 1.31 |
| Gronwall | 1350 | 100 yr (770 cfs) | Planted - Estab | 770.00 | 200.32 | 5.14 | 1.31 |
| Gronwall | 1350 | 100 yr (770 cfs) | Estab 2 | 770.00 | 200.33 | 5.13 | 1.54 |
| | | | | | | | |
| Gronwall | 1322 | 10 yr (334 cfs) | BSLN4 | 392.00 | 196.85 | 4.79 | 1.12 |
| Gronwall | 1322 | 10 yr (334 cfs) | Planted - Estab | 392.00 | 196.85 | 4.79 | 1.12 |
| Gronwall | 1322 | 10 yr (334 cfs) | Estab 2 | 392.00 | 196.85 | 4.79 | 1.12 |
| Gronwall | 1322 | 50 yr (705 cfs) | BSLN4 | 827.00 | 199.95 | 4.76 | 1.09 |
| Gronwall | 1322 | 50 yr (705 cfs) | Planted - Estab | 827.00 | 199.95 | 4.76 | 1.09 |
| Gronwall | 1322 | 50 yr (705 cfs) | Estab 2 | 827.00 | 199.95 | 4.76 | 1.09 |
| Gronwall | 1322 | 100 yr (770 cfs) | BSLN4 | 903.00 | 200.20 | 4.92 | 1.16 |
| Gronwall | 1322 | 100 yr (770 cfs) | Planted - Estab | 903.00 | 200.20 | 4.92 | 1.16 |
| Gronwall | 1322 | 100 yr (770 cfs) | Estab 2 | 903.00 | 200.20 | 4.92 | 1.16 |
| | | | | | | | |
| Gronwall | 1290 | 10 yr (334 cfs) | BSLN4 | 392.00 | 196.25 | 6.46 | 2.10 |
| Gronwall | 1290 | 10 yr (334 cfs) | Planted - Estab | 392.00 | 196.25 | 6.46 | 2.10 |
| Gronwall | 1290 | 10 yr (334 cfs) | Estab 2 | 392.00 | 196.25 | 6.46 | 2.10 |
| Gronwall | 1290 | 50 yr (705 cfs) | BSLN4 | 827.00 | 199.55 | 5.94 | 1.71 |
| Gronwall | 1290 | 50 yr (705 cfs) | Planted - Estab | 827.00 | 199.55 | 5.94 | 1.71 |
| Gronwall | 1290 | 50 yr (705 cfs) | Estab 2 | 827.00 | 199.55 | 5.94 | 1.71 |
| Gronwall | 1290 | 100 yr (770 cfs) | BSLN4 | 903.00 | 199.78 | 6.18 | 1.85 |
| Gronwall | 1290 | 100 yr (770 cfs) | Planted - Estab | 903.00 | 199.78 | 6.18 | 1.85 |
| Gronwall | 1290 | 100 yr (770 cfs) | Estab 2 | 903.00 | 199.78 | 6.18 | 1.85 |
| | | | | | | | |
| Gronwall | 1227 | 10 yr (334 cfs) | BSLN4 | 392.00 | 195.73 | 5.60 | 1.43 |
| Gronwall | 1227 | 10 yr (334 cfs) | Planted - Estab | 392.00 | 195.73 | 5.60 | 1.43 |
| Gronwall | 1227 | 10 yr (334 cfs) | Estab 2 | 392.00 | 195.73 | 5.60 | 1.43 |
| Gronwall | 1227 | 50 yr (705 cfs) | BSLN4 | 827.00 | 199.24 | 5.56 | 1.28 |
| Gronwall | 1227 | 50 yr (705 cfs) | Planted - Estab | 827.00 | 199.24 | 5.56 | 1.28 |
| Gronwall | 1227 | 50 yr (705 cfs) | Estab 2 | 827.00 | 199.24 | 5.56 | 1.28 |
| Gronwall | 1227 | 100 yr (770 cfs) | BSLN4 | 903.00 | 199.43 | 5.90 | 1.44 |
| Gronwall | 1227 | 100 yr (770 cfs) | Planted - Estab | 903.00 | 199.43 | 5.90 | 1.44 |
| Gronwall | 1227 | 100 yr (770 cfs) | Estab 2 | 903.00 | 199.43 | 5.90 | 1.44 |
| | | | | | | | |
| Gronwall | 1210 | | | Bridge | | | |
| | | | | | | | |
| Gronwall | 1194 | 10 yr (334 cfs) | BSLN4 | 392.00 | 194.66 | 7.93 | 2.22 |
| Gronwall | 1194 | 10 yr (334 cfs) | Planted - Estab | 392.00 | 194.66 | 7.93 | 2.22 |
| Gronwall | 1194 | 10 yr (334 cfs) | Estab 2 | 392.00 | 194.66 | 7.93 | 2.22 |

HEC-RAS River: Hale Creek Reach: Gronwall (Continued)

| Reach | River Sta | Profile | Plan | Q Total | W.S. Elev | Vel Chnl | Shear Chan |
|---|---|---|---|---|---|---|---|
| | | | | (cfs) | (ft) | (ft/s) | (lb/sq ft) |
| Gronwall | 1194 | 50 yr (705 cfs) | BSLN4 | 827.00 | 196.92 | 9.03 | 2.64 |
| Gronwall | 1194 | 50 yr (705 cfs) | Planted - Estab | 827.00 | 196.92 | 9.03 | 2.64 |
| Gronwall | 1194 | 50 yr (705 cfs) | Estab 2 | 827.00 | 196.92 | 9.03 | 2.64 |
| Gronwall | 1194 | 100 yr (770 cfs) | BSLN4 | 903.00 | 197.24 | 9.20 | 2.79 |
| Gronwall | 1194 | 100 yr (770 cfs) | Planted - Estab | 903.00 | 197.24 | 9.20 | 2.79 |
| Gronwall | 1194 | 100 yr (770 cfs) | Estab 2 | 903.00 | 197.24 | 9.20 | 2.79 |
| | | | | | | | |
| Gronwall | 1140.66 | 10 yr (334 cfs) | BSLN4 | 392.00 | 194.38 | 5.78 | 1.28 |
| Gronwall | 1140.66 | 10 yr (334 cfs) | Planted - Estab | 392.00 | 194.38 | 5.78 | 1.28 |
| Gronwall | 1140.66 | 10 yr (334 cfs) | Estab 2 | 392.00 | 194.38 | 5.78 | 1.28 |
| Gronwall | 1140.66 | 50 yr (705 cfs) | BSLN4 | 827.00 | 196.68 | 7.16 | 1.89 |
| Gronwall | 1140.66 | 50 yr (705 cfs) | Planted - Estab | 827.00 | 196.68 | 7.16 | 1.89 |
| Gronwall | 1140.66 | 50 yr (705 cfs) | Estab 2 | 827.00 | 196.68 | 7.16 | 1.89 |
| Gronwall | 1140.66 | 100 yr (770 cfs) | BSLN4 | 903.00 | 196.99 | 7.36 | 1.97 |
| Gronwall | 1140.66 | 100 yr (770 cfs) | Planted - Estab | 903.00 | 196.99 | 7.36 | 1.97 |
| Gronwall | 1140.66 | 100 yr (770 cfs) | Estab 2 | 903.00 | 196.99 | 7.36 | 1.97 |
| | | | | | | | |
| Gronwall | 1042 | 10 yr (334 cfs) | BSLN4 | 392.00 | 193.70 | 5.38 | 1.44 |
| Gronwall | 1042 | 10 yr (334 cfs) | Planted - Estab | 392.00 | 193.70 | 5.38 | 1.44 |
| Gronwall | 1042 | 10 yr (334 cfs) | Estab 2 | 392.00 | 193.70 | 5.38 | 1.44 |
| Gronwall | 1042 | 50 yr (705 cfs) | BSLN4 | 827.00 | 196.02 | 6.41 | 1.94 |
| Gronwall | 1042 | 50 yr (705 cfs) | Planted - Estab | 827.00 | 196.02 | 6.41 | 1.94 |
| Gronwall | 1042 | 50 yr (705 cfs) | Estab 2 | 827.00 | 196.02 | 6.41 | 1.94 |
| Gronwall | 1042 | 100 yr (770 cfs) | BSLN4 | 903.00 | 196.35 | 6.55 | 2.01 |
| Gronwall | 1042 | 100 yr (770 cfs) | Planted - Estab | 903.00 | 196.35 | 6.55 | 2.01 |
| Gronwall | 1042 | 100 yr (770 cfs) | Estab 2 | 903.00 | 196.35 | 6.55 | 2.01 |