Developing Quantitative Stream Maintenance Guidelines

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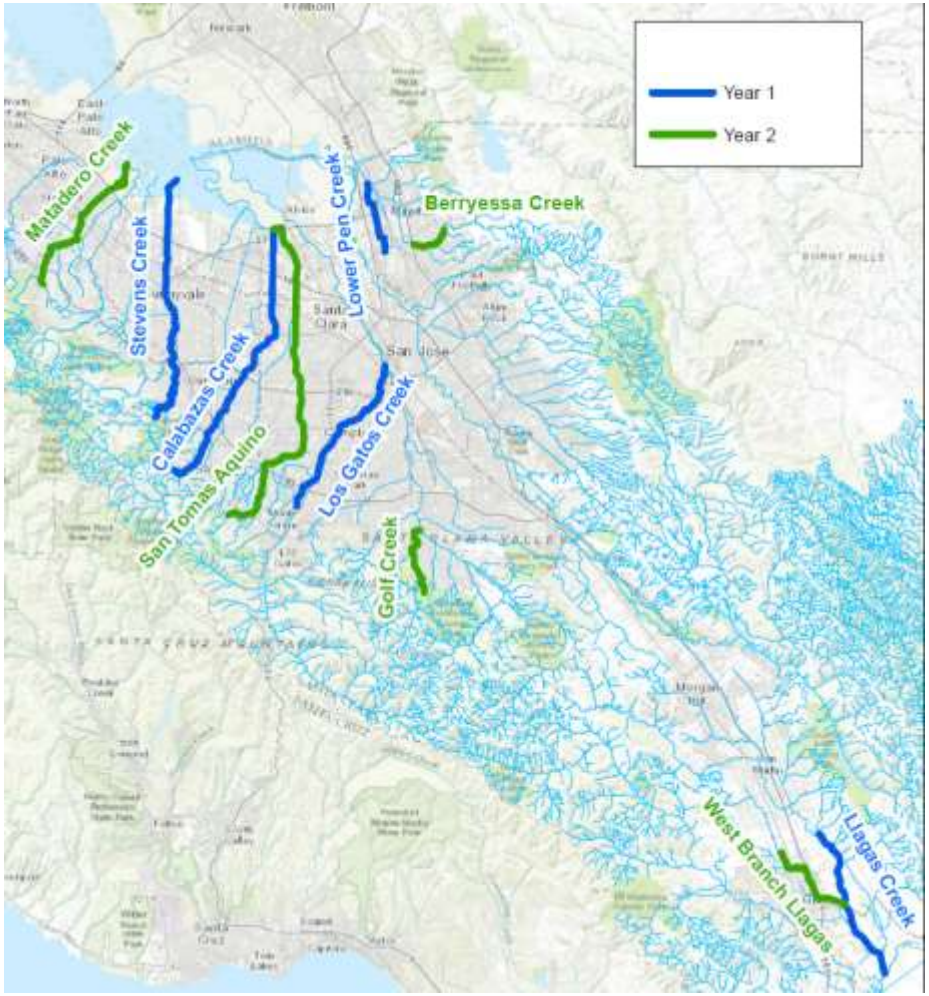
ESA

Maintenance Guidelines

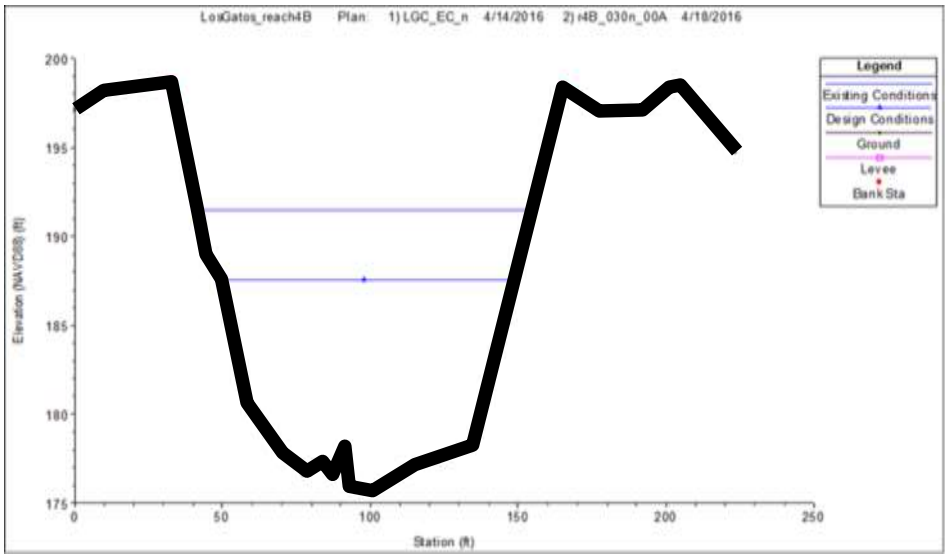


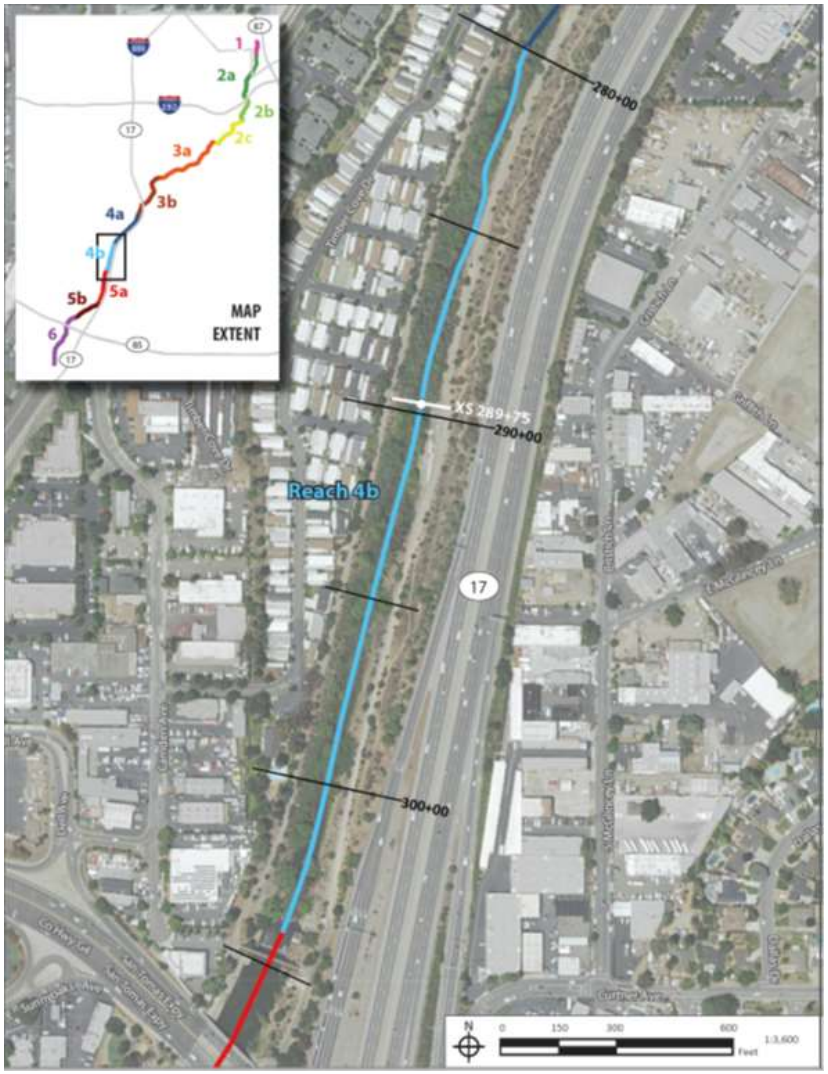
- Quantitative guidelines
- Routine maintenance
  - Vegetation Management
  - Sediment Removal
- Channel capacity
  - Level of Service flow
- 10 Santa Clara Valley Water District channels

Maintenance Guidelines

- Field work
  - Channel reconnaissance
  - Cross section surveys
- Hydraulic modeling
  - Existing conditions
  - Maintenance scenarios
- Maintenance Guidelines

Cross section survey

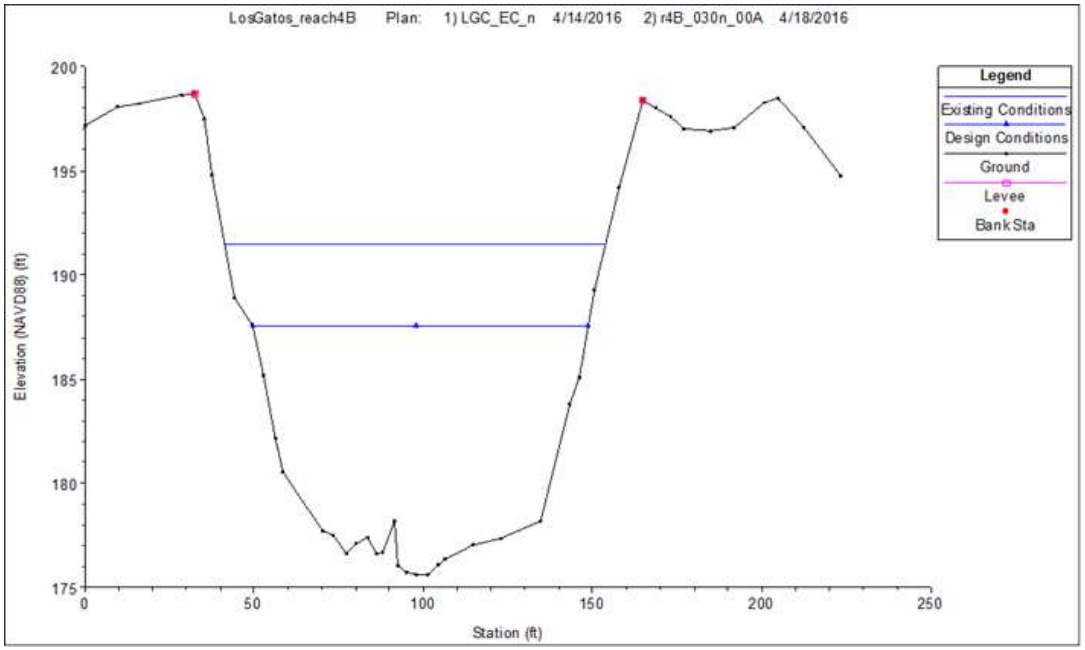




Hydraulic modeling

- Model inputs:
  - Flow rate (Level of Service flow)
    - Design flow rate for the channel, e.g. 100-year flow
  - Channel geometry
    - Surveyed cross sections
  - Hydraulic roughness
    - Estimated based on channel, vegetation conditions

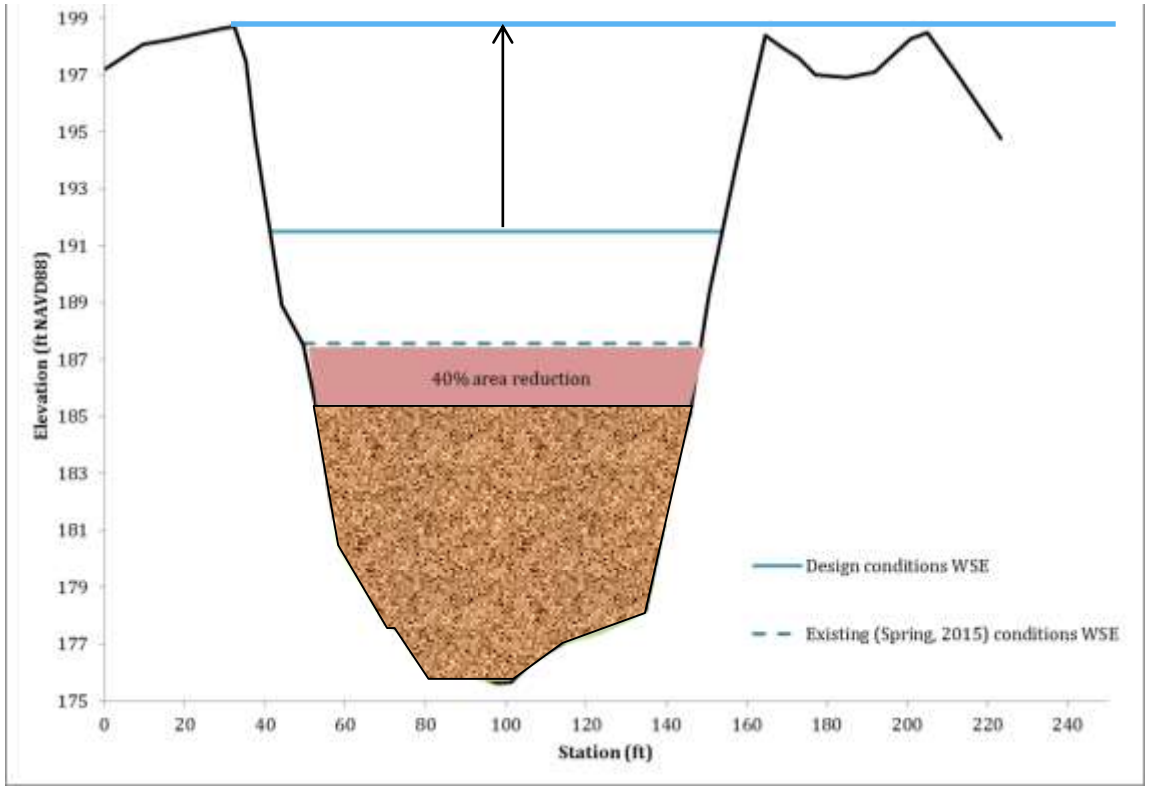
Hydraulic modeling



- Model output = water level
  - Existing Conditions
  - Maintenance Scenarios

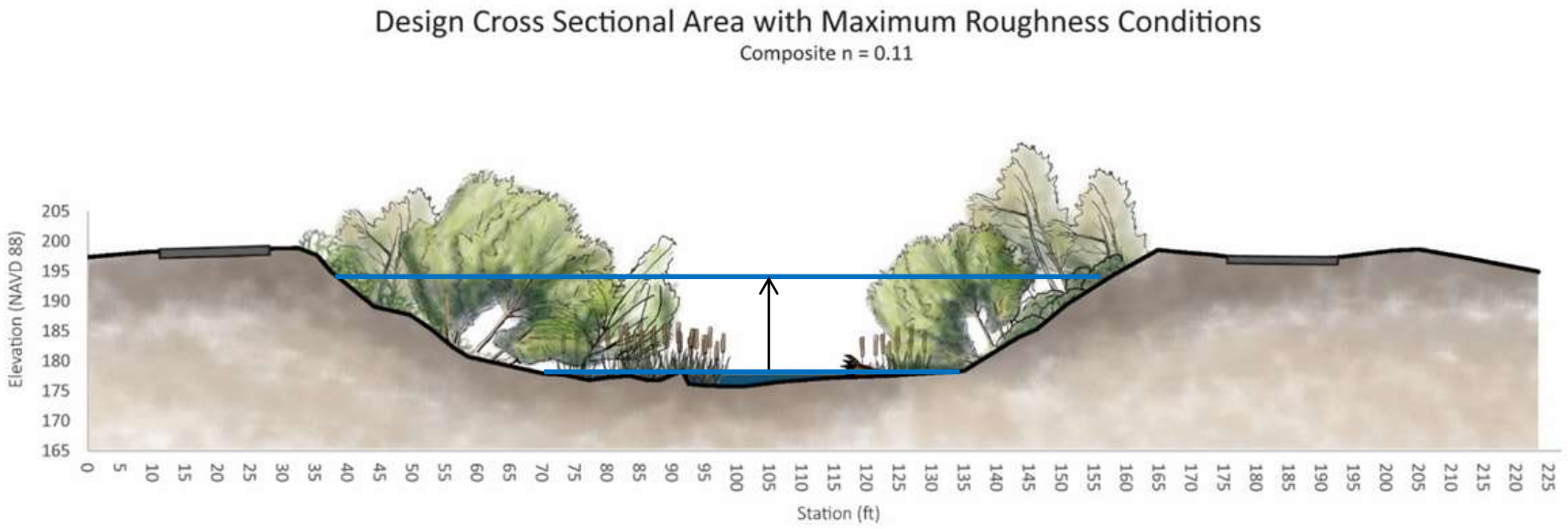
Maintenance scenarios

- Sedimentation
  - Reduces cross section area
  - Increases water level



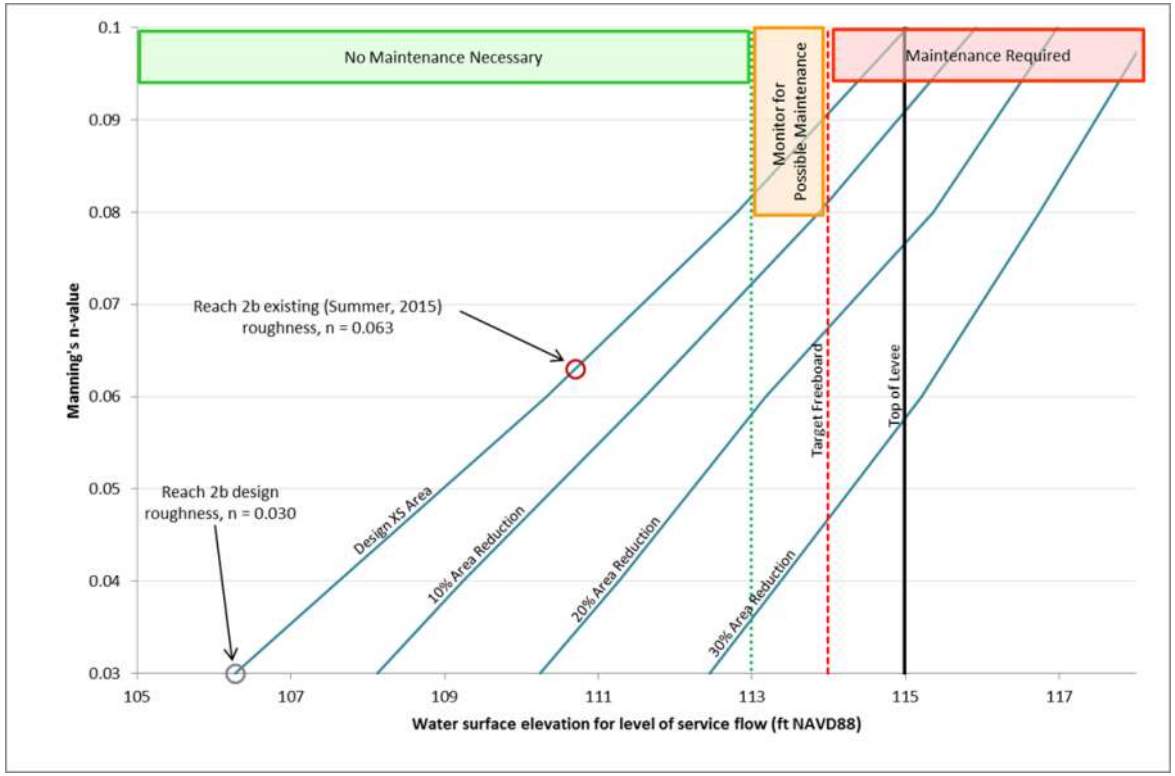
Maintenance Scenarios

- Vegetation
  - Increases hydraulic roughness
  - Increases water level

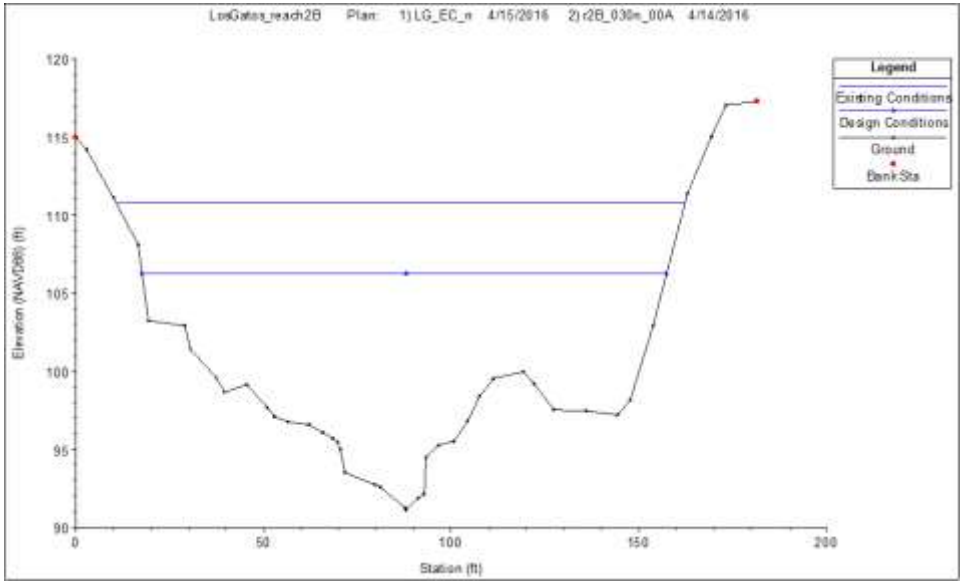


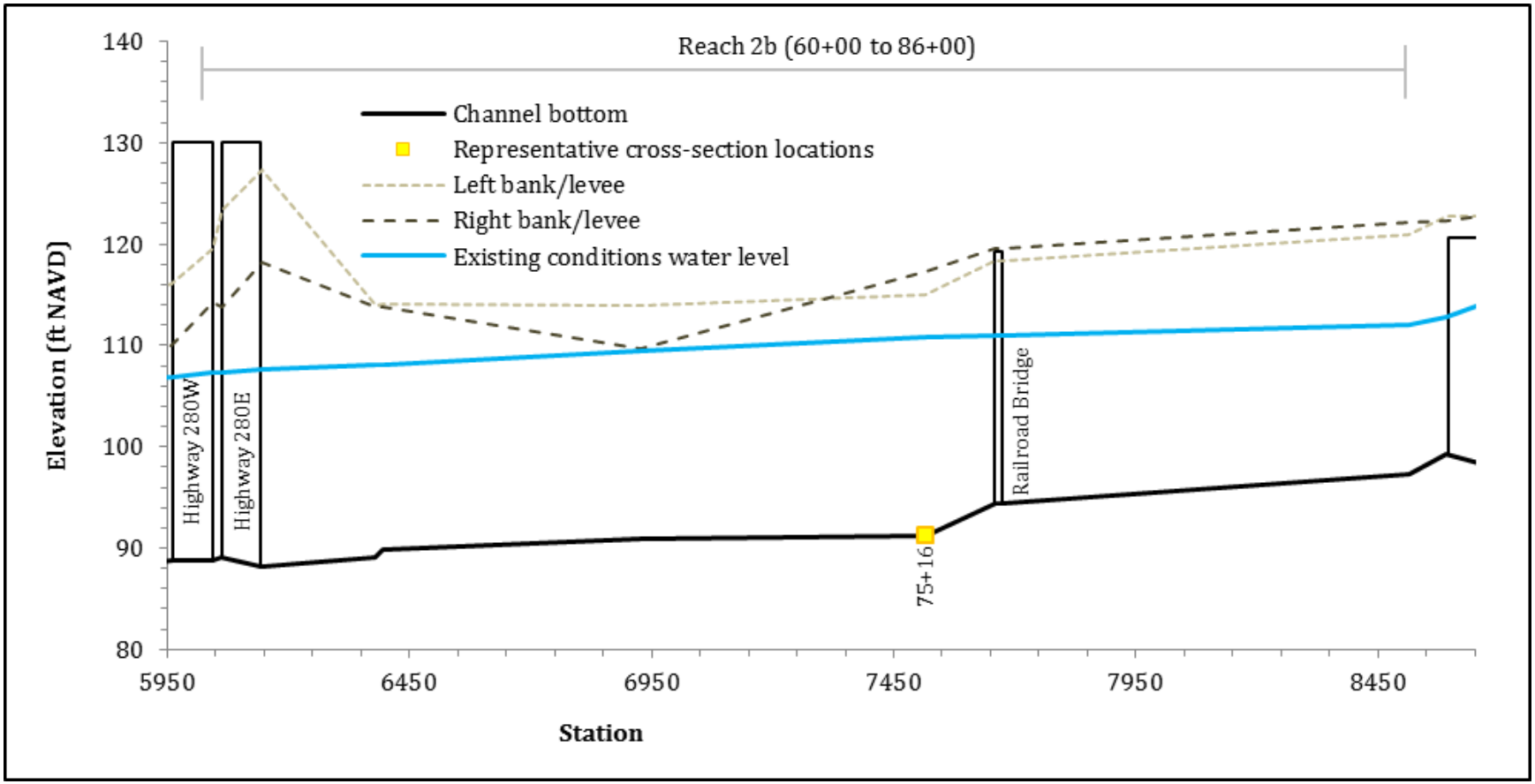
Maintenance Scenarios

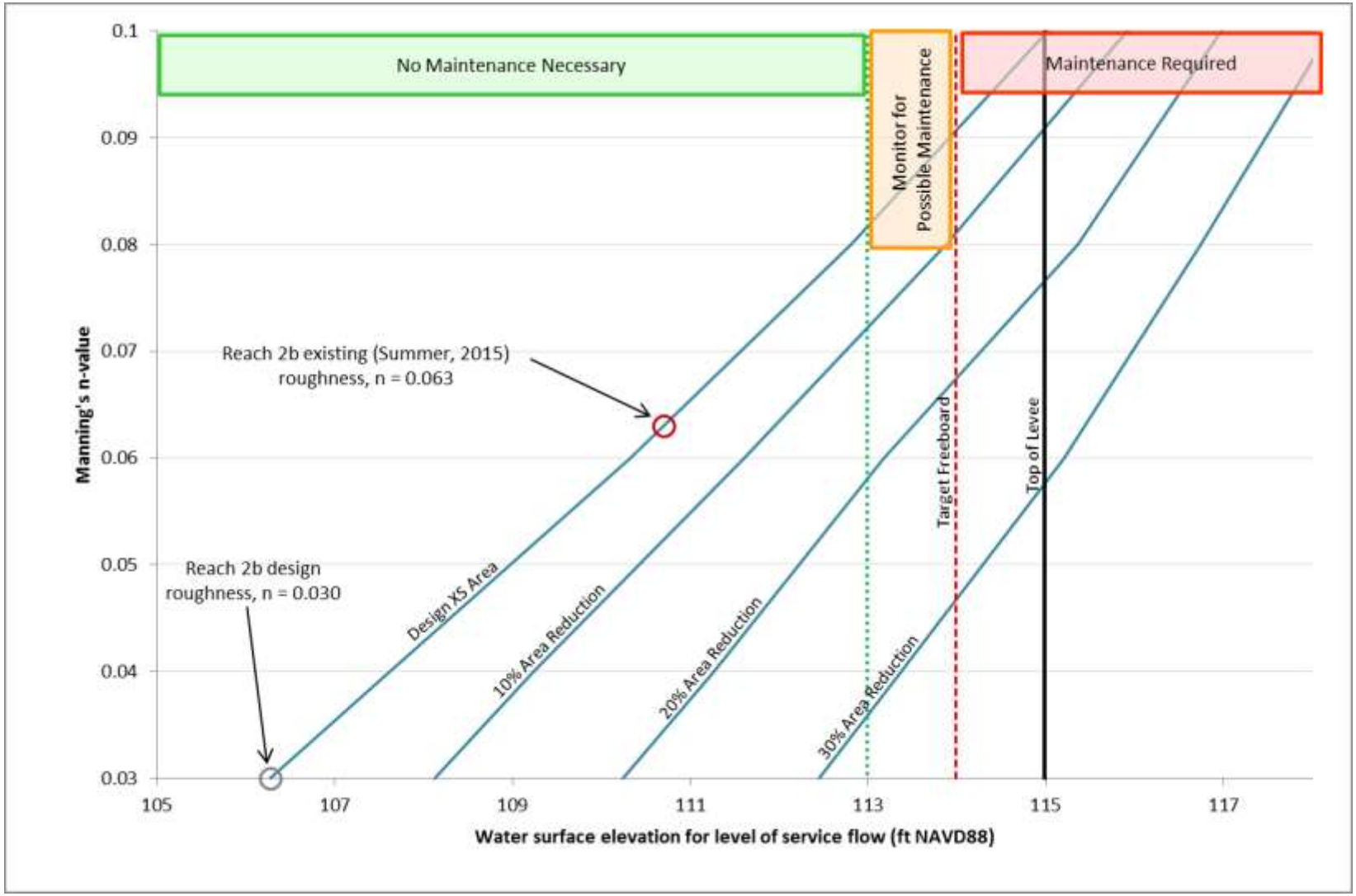
- Existing condition
- Range of sedimentation conditions
- Range of roughness conditions



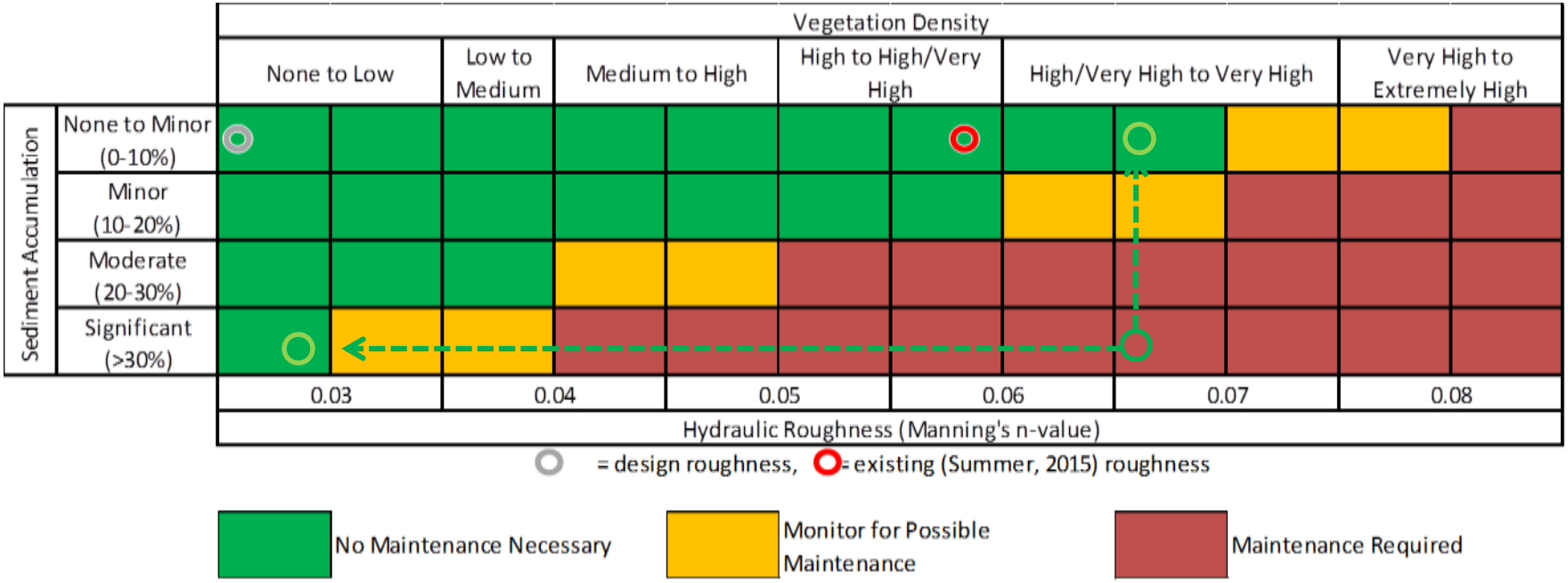
Maintenance Guidelines Example 1

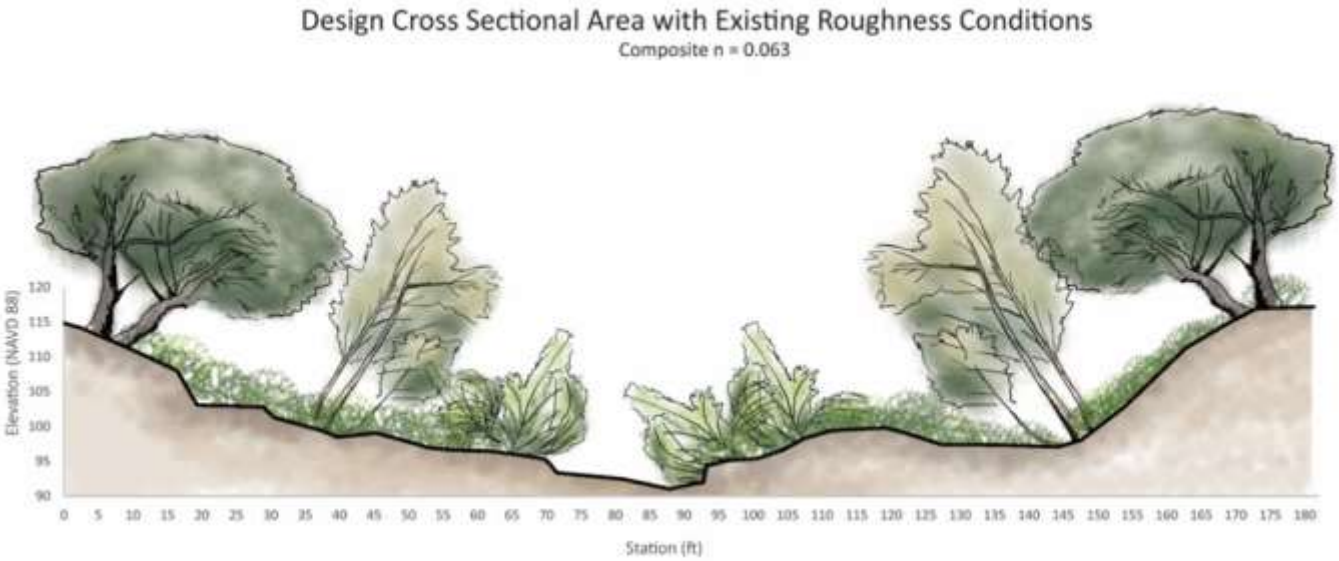


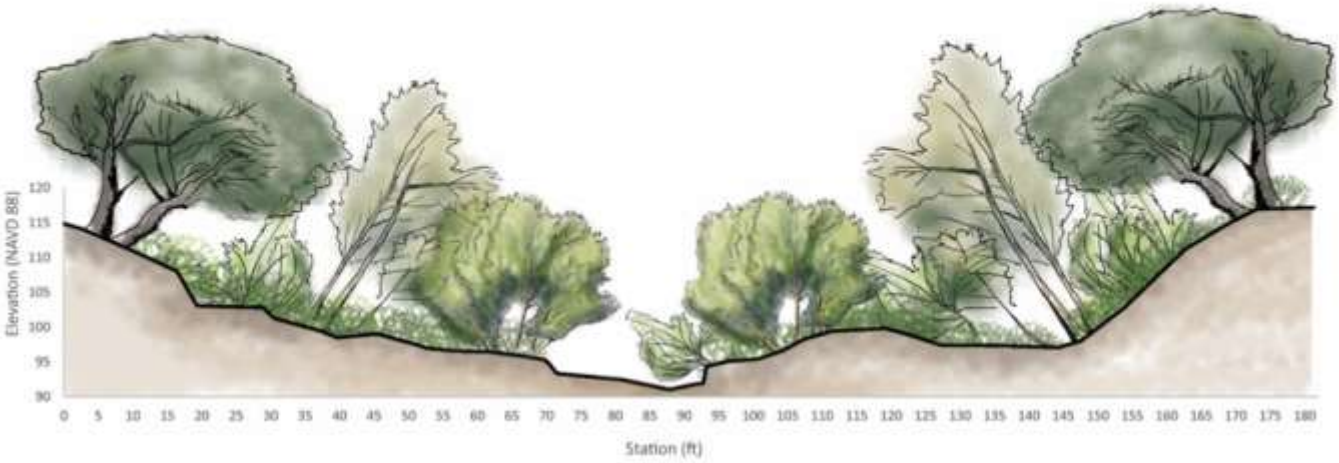

Reach 2b (60+00 to 86+00)
Channel bottom
Representative cross-section locations
Left bank/levee
Right bank/levee
Existing conditions water level
Highway 280W
Highway 280E
Railroad Bridge
75+16
Elevation (ft NAVD)
Station
140
130
120
110
100
90
80
5950
6450
6950
7450
7950
8450


No Maintenance Necessary
Monitor for Possible Maintenance
Maintenance Required
Reach 2b existing (Summer, 2015) roughness, n = 0.063
Reach 2b design roughness, n = 0.030
Design XS Area
10% Area Reduction
20% Area Reduction
30% Area Reduction
Target Freeboard
Top of Levee
Manning's n-value
Water surface elevation for level of service flow (ft NAVD88)
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
105
107
109
111
113
115
117

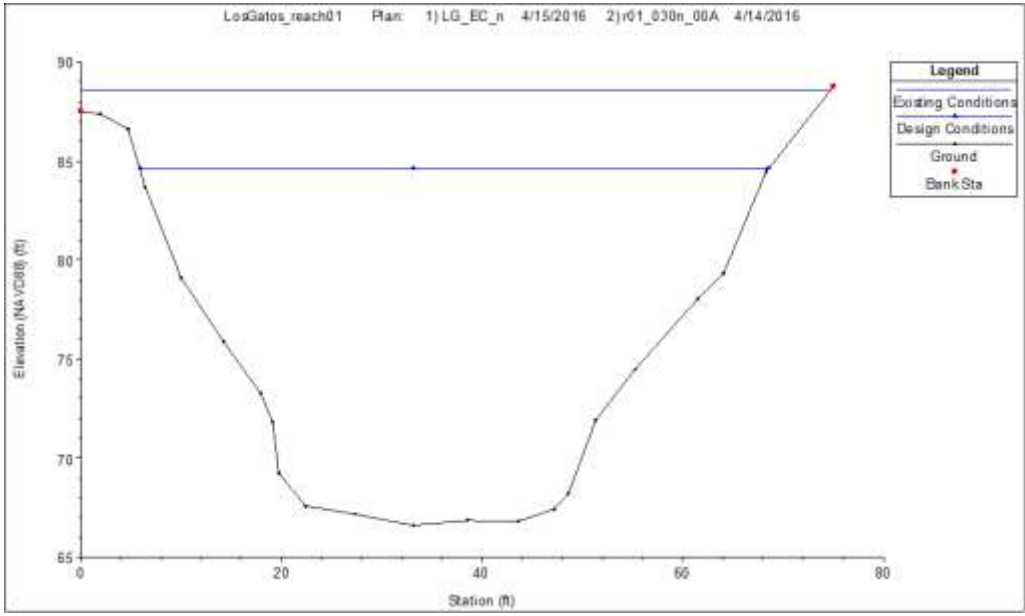
Maintenance Guidelines

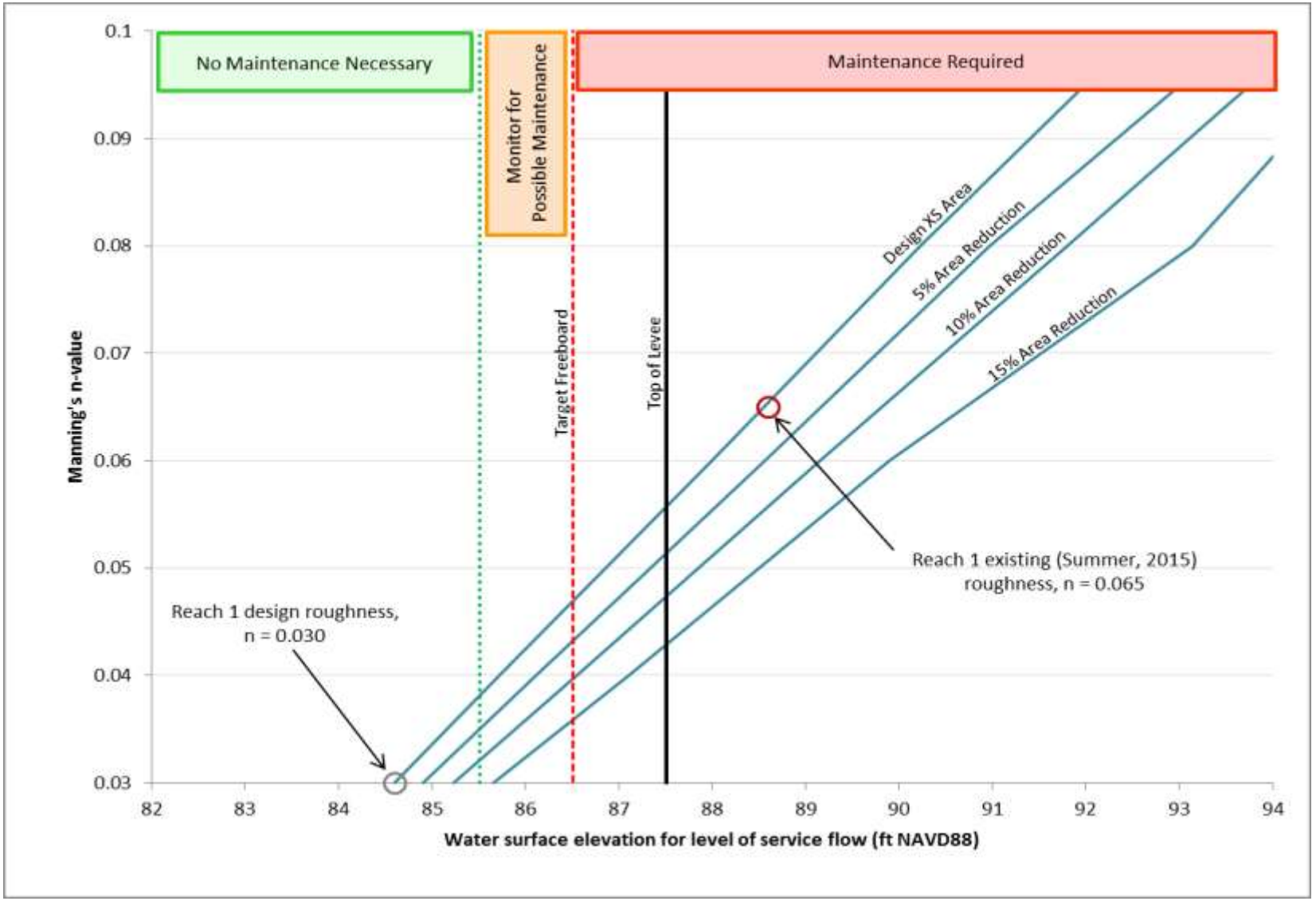


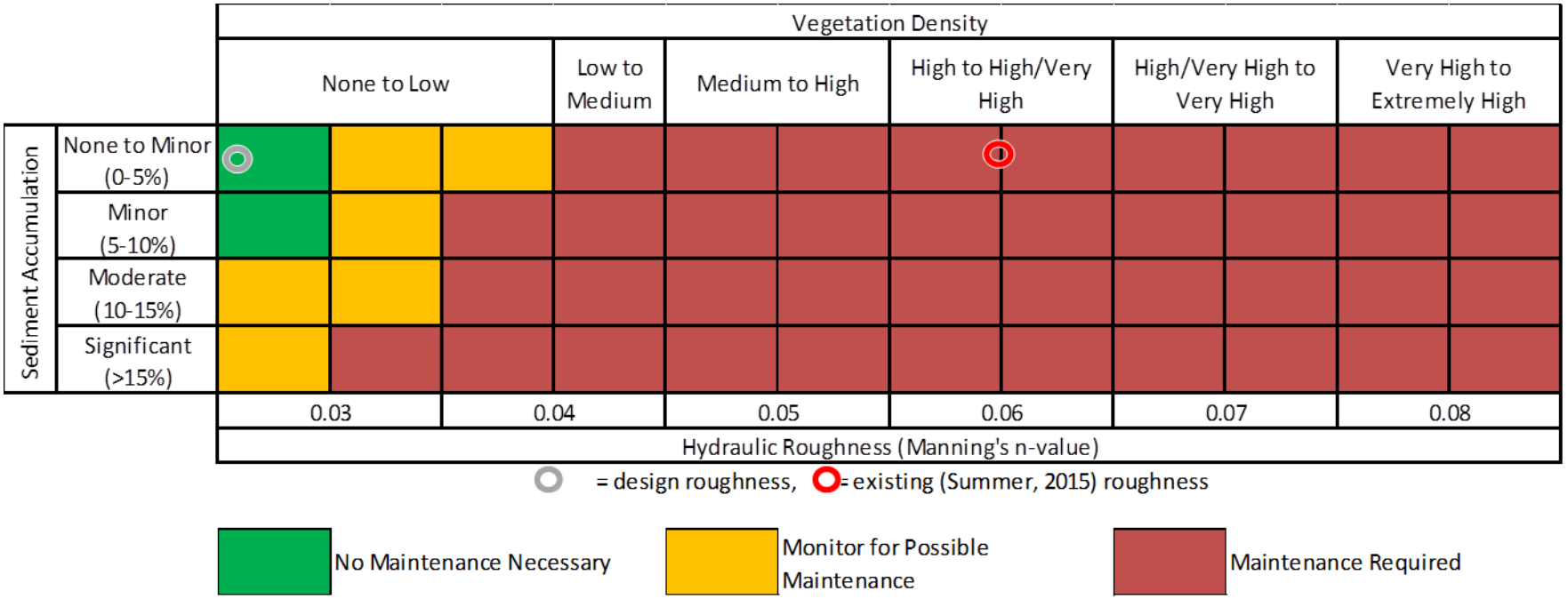

Design Cross Sectional Area with Existing Roughness Conditions
Composite n = 0.063
Elevation (NAVD 88)
120
115
110
105
100
95
90
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120 125 130 135 140 145 150 155 160 165 170 175 180
Station (ft)


Design Cross Sectional Area with Maximum Roughness Conditions
Composite n = 0.091
Elevation (NAVD 88)
120
115
110
105
100
95
90
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120 125 130 135 140 145 150 155 160 165 170 175 180
Station (ft)

Maintenance Guidelines - Example 2

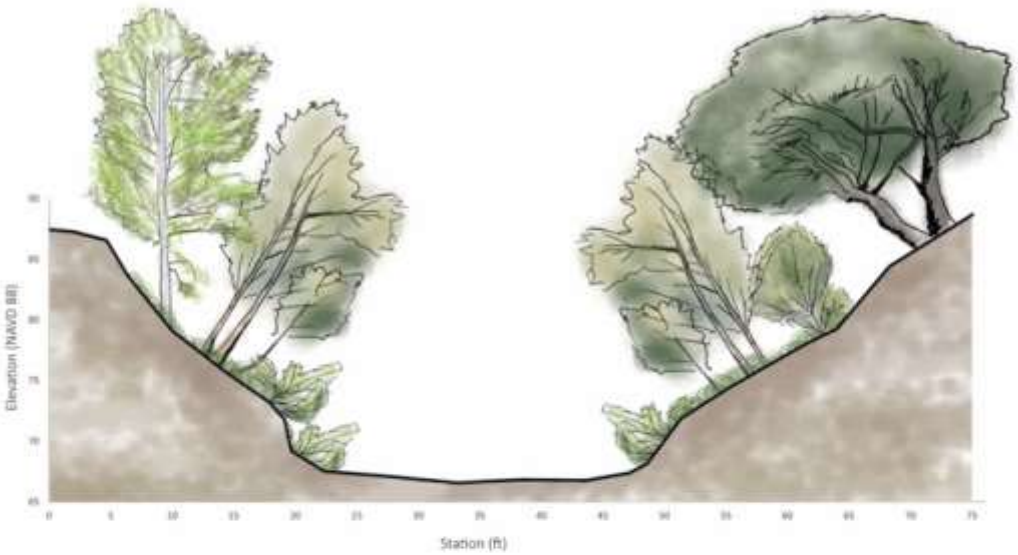



No Maintenance Necessary
Monitor for Possible Maintenance
Maintenance Required
Design XS Area
5% Area Reduction
10% Area Reduction
15% Area Reduction
Target Freeboard
Top of Levee
Reach 1 design roughness, n = 0.030
Reach 1 existing (Summer, 2015) roughness, n = 0.065
Manning's n-value
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
82
83
84
85
86
87
88
89
90
91
92
93
94
Water surface elevation for level of service flow (ft NAVD88)


Vegetation Density
None to Low
Low to Medium
Medium to High
High to High/Very High
High/Very High to Very High
Very High to Extremely High
Sediment Accumulation
None to Minor (0-5%)
Minor (5-10%)
Moderate (10-15%)
Significant (>15%)
0.03
0.04
0.05
0.06
0.07
0.08
Hydraulic Roughness (Manning's n-value)
= design roughness,
= existing (Summer, 2015) roughness
No Maintenance Necessary
Monitor for Possible Maintenance
Maintenance Required

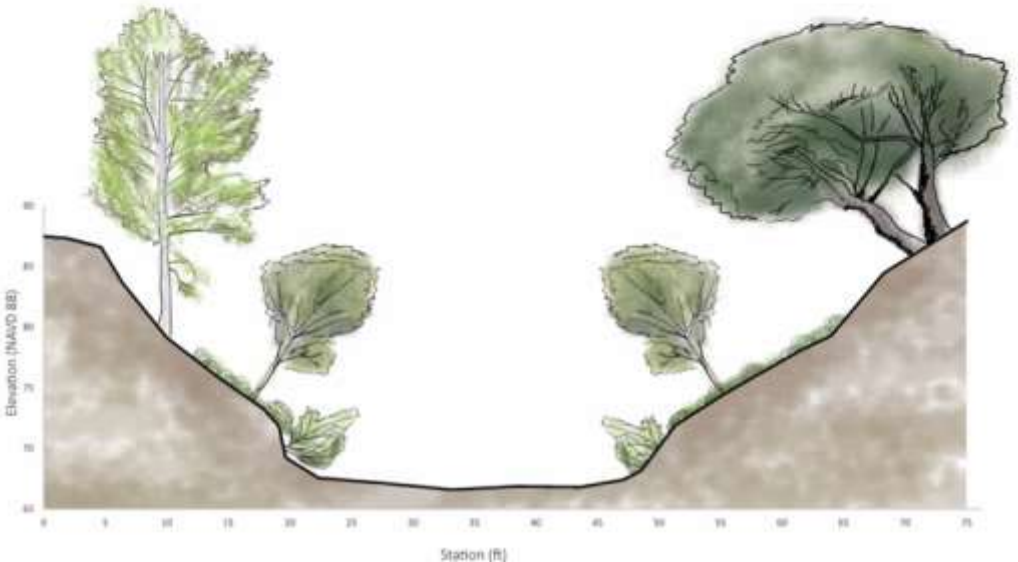
Design Cross Sectional Area with Existing Roughness Conditions

Composite n = 0.065

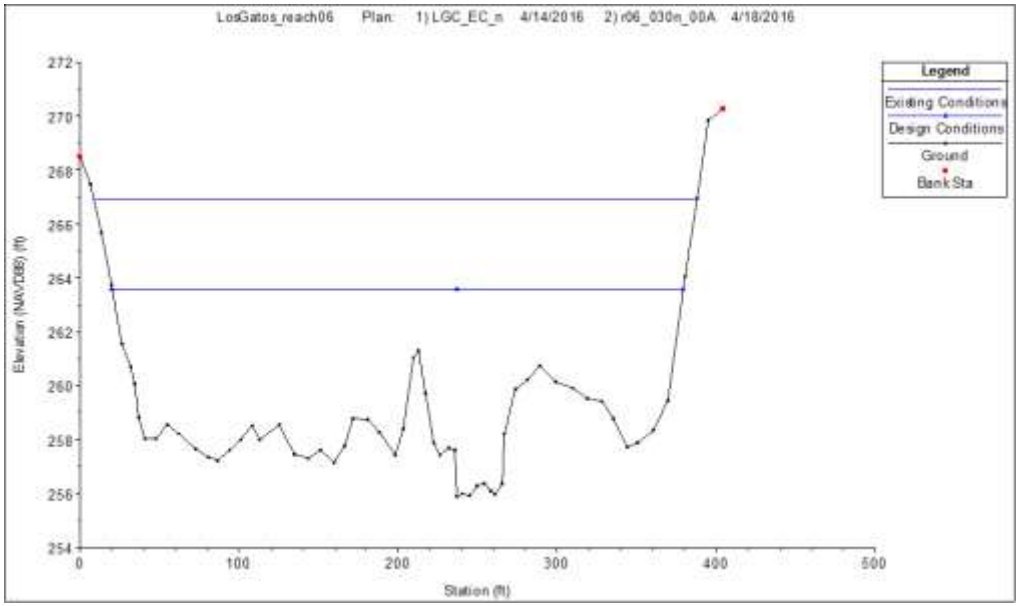


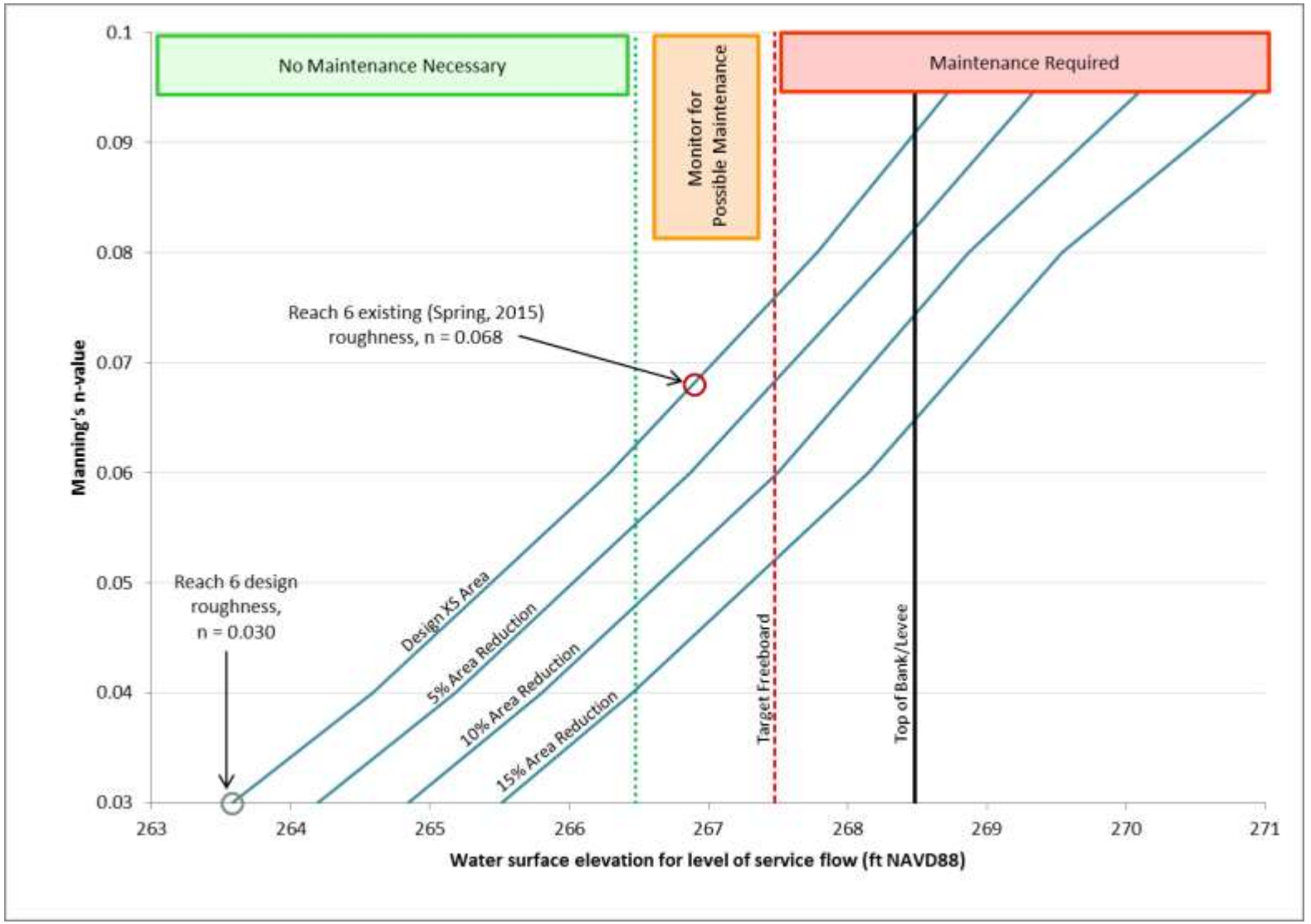
Design Cross Sectional Area with Maximum Roughness Conditions

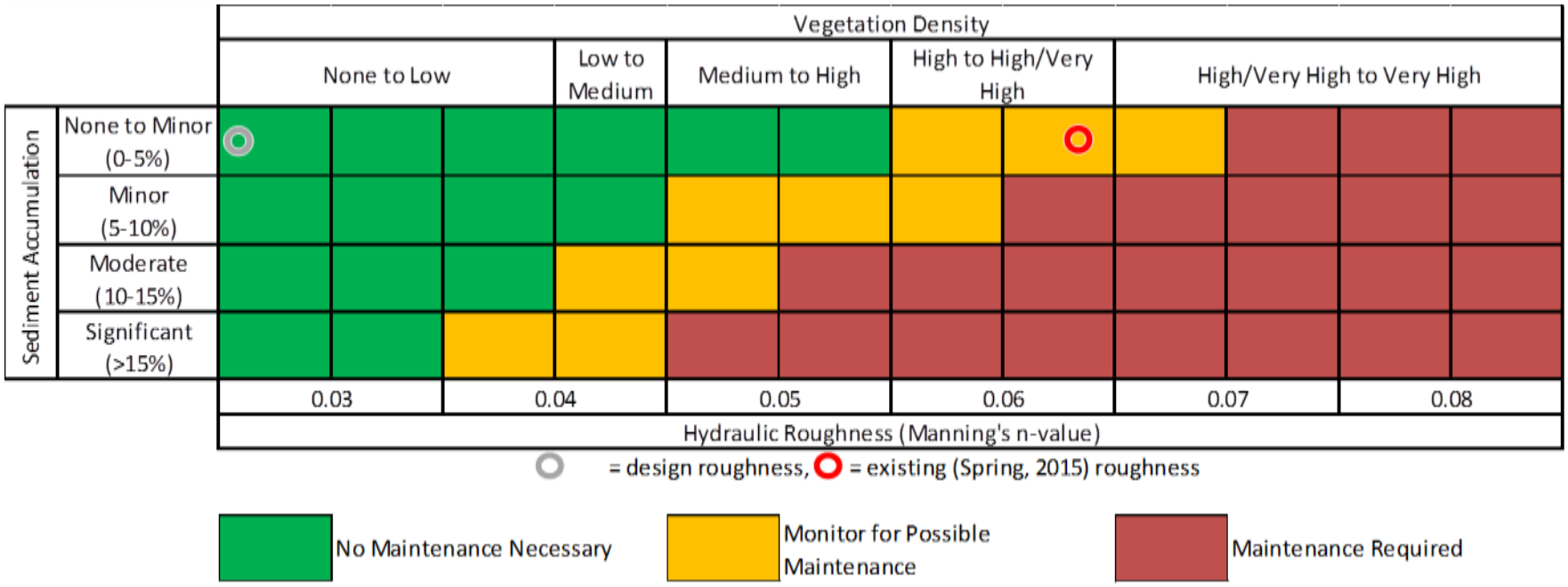
Composite n = 0.047

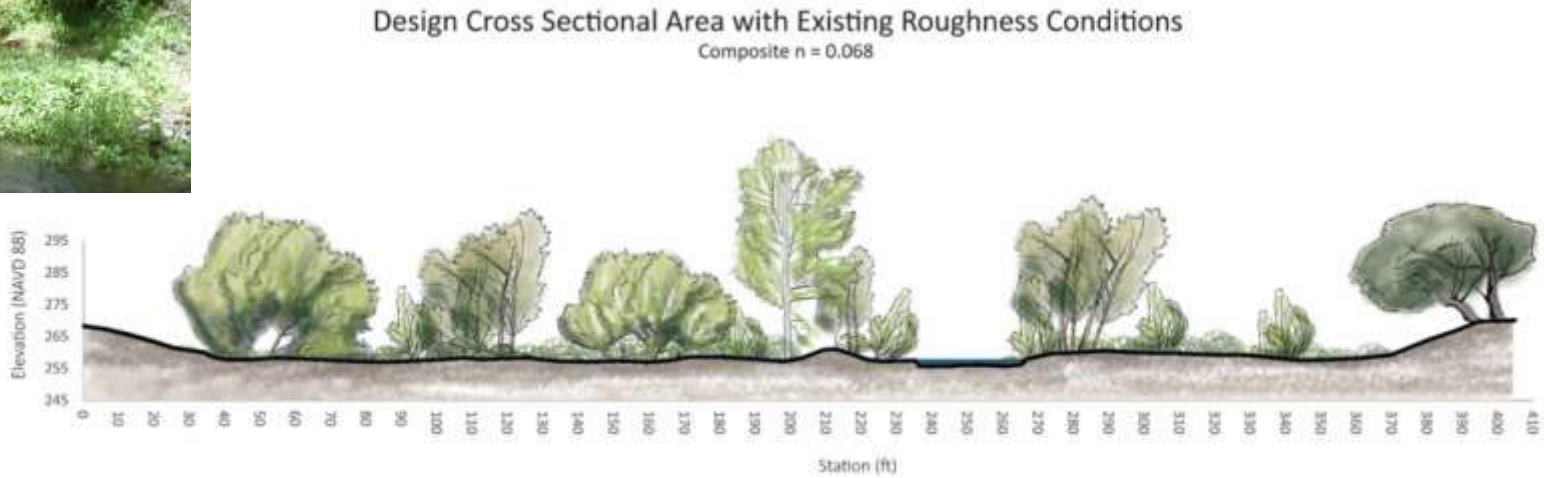


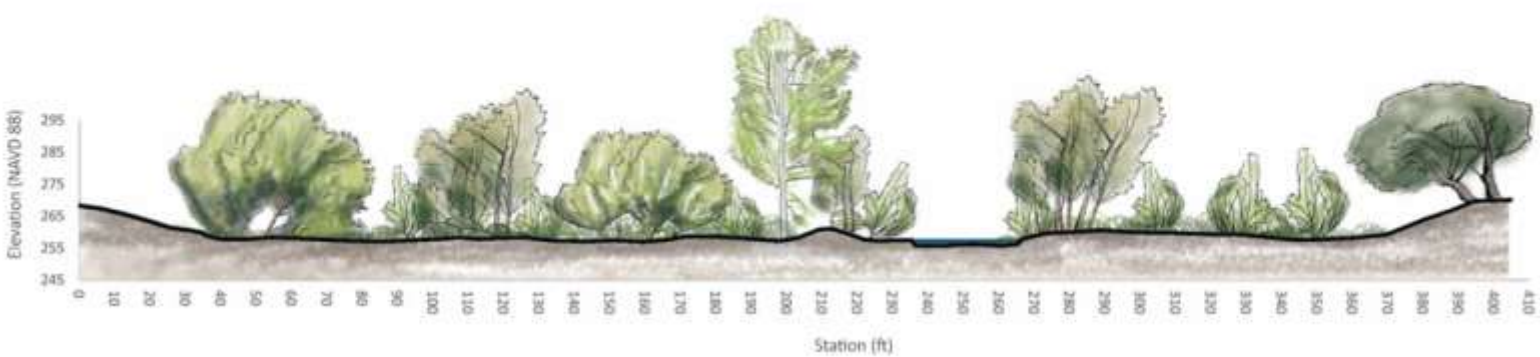
Maintenance Guidelines - Example 3



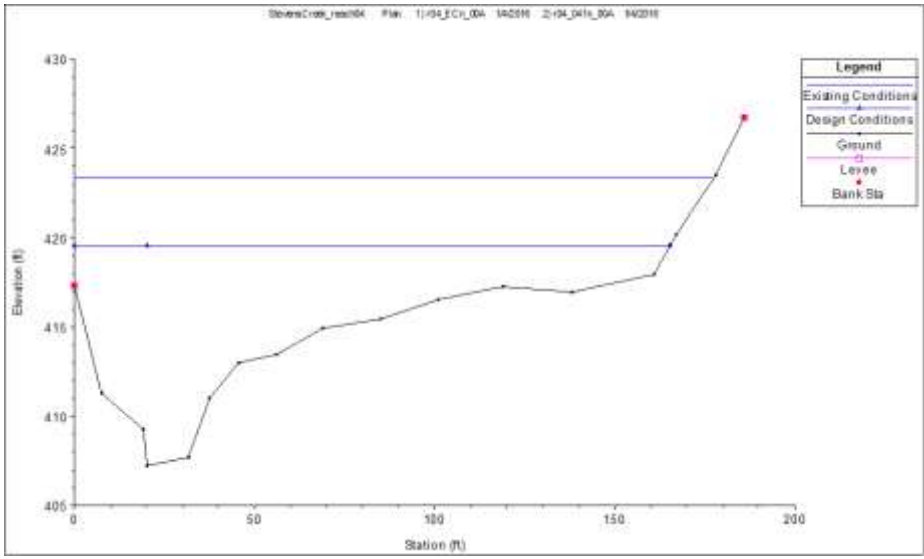

No Maintenance Necessary
Monitor for Possible Maintenance
Maintenance Required
Reach 6 existing (Spring, 2015) roughness, n = 0.068
Reach 6 design roughness, n = 0.030
Design XS Area
5% Area Reduction
10% Area Reduction
15% Area Reduction
Target Freeboard
Top of Bank/Levee
Manning's n-value
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
263
264
265
266
267
268
269
270
271
Water surface elevation for level of service flow (ft NAVD88)

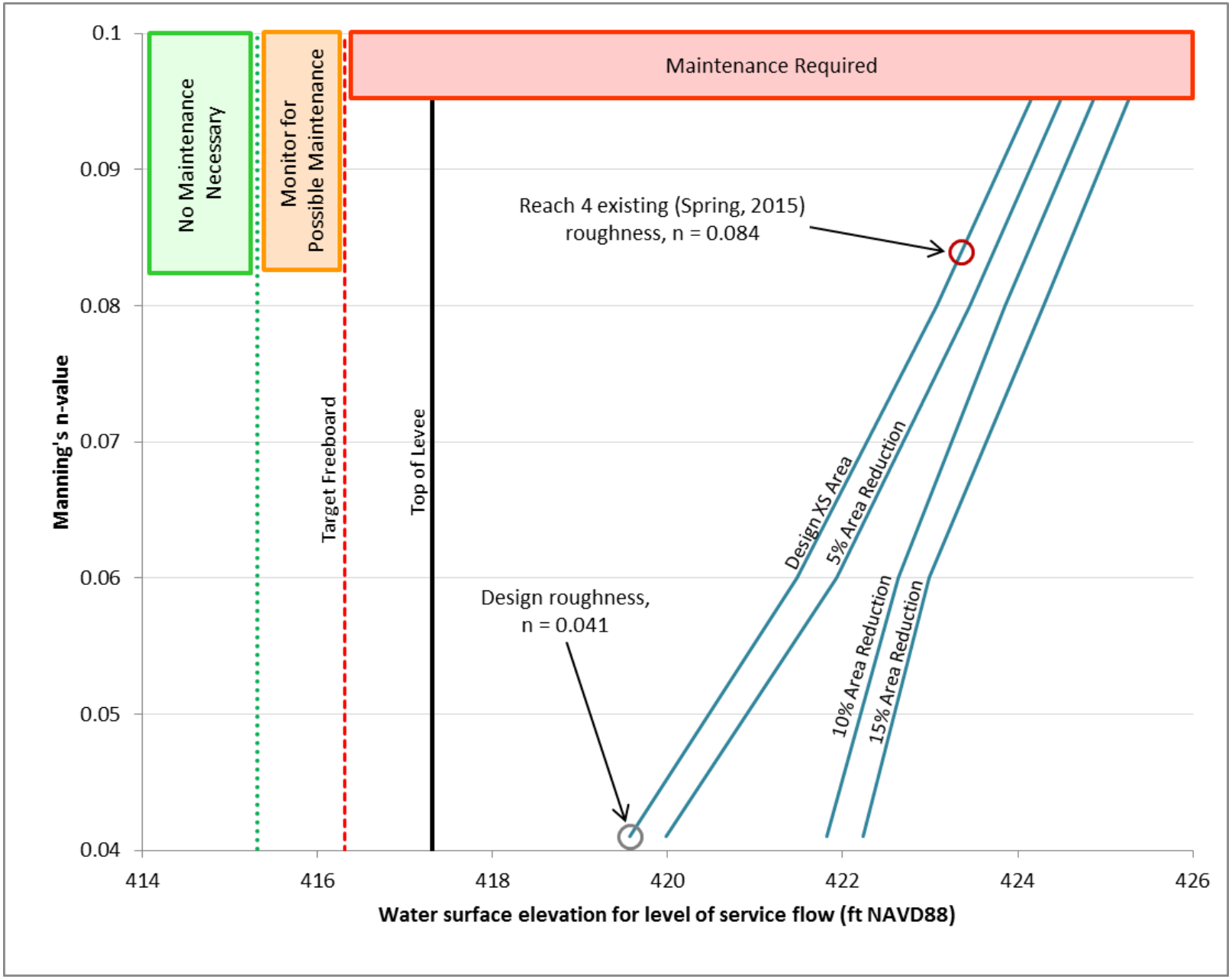

Vegetation Density
None to Low
Low to Medium
Medium to High
High to High/Very High
High/Very High to Very High
Sediment Accumulation
None to Minor (0-5%)
Minor (5-10%)
Moderate (10-15%)
Significant (>15%)
0.03
0.04
0.05
0.06
0.07
0.08
Hydraulic Roughness (Manning's n-value)
= design roughness, = existing (Spring, 2015) roughness
No Maintenance Necessary
Monitor for Possible Maintenance
Maintenance Required

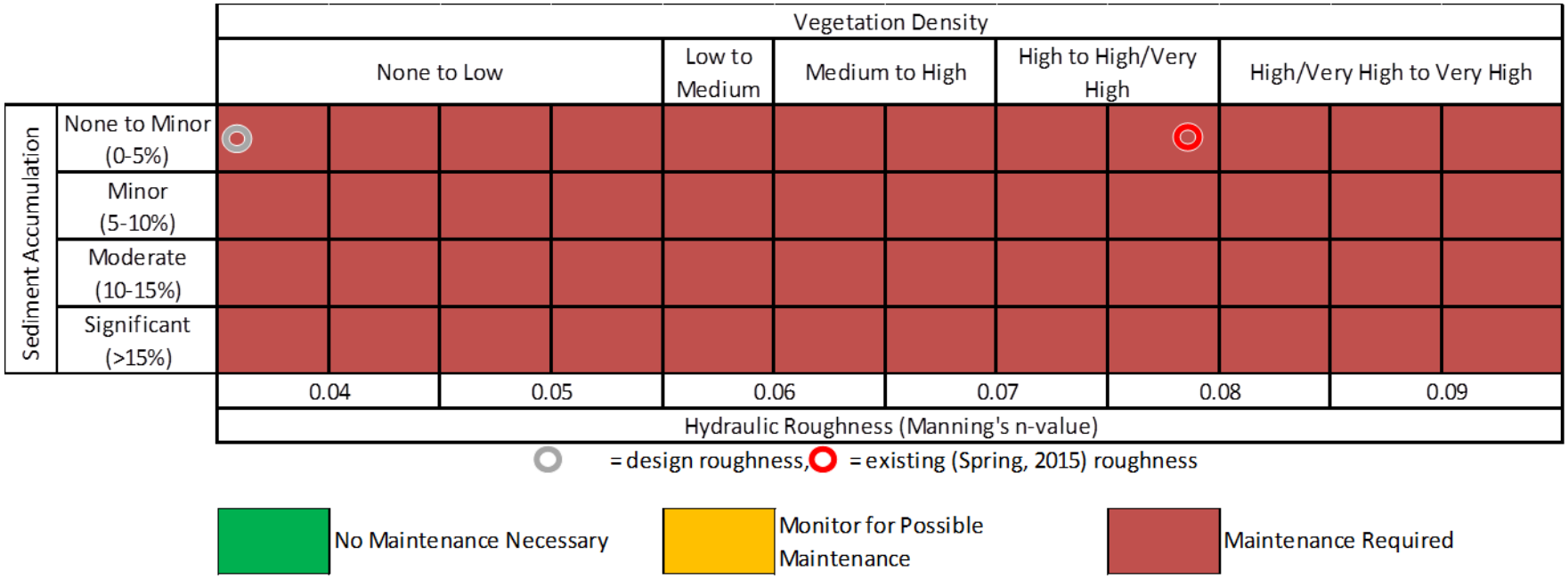

Design Cross Sectional Area with Existing Roughness Conditions
Composite n = 0.068
Elevation (NAVD 88)
295
285
275
265
255
245
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
210
220
230
240
250
260
270
280
290
300
310
320
330
340
350
360
370
380
390
400
410
Station (ft)


Design Cross Sectional Area with Maximum Roughness Conditions
Composite n = 0.076
Elevation (NAVD 88)
295
285
275
265
255
245
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
210
220
230
240
250
260
270
280
290
300
310
320
330
340
350
360
370
380
390
400
410
Station (ft)

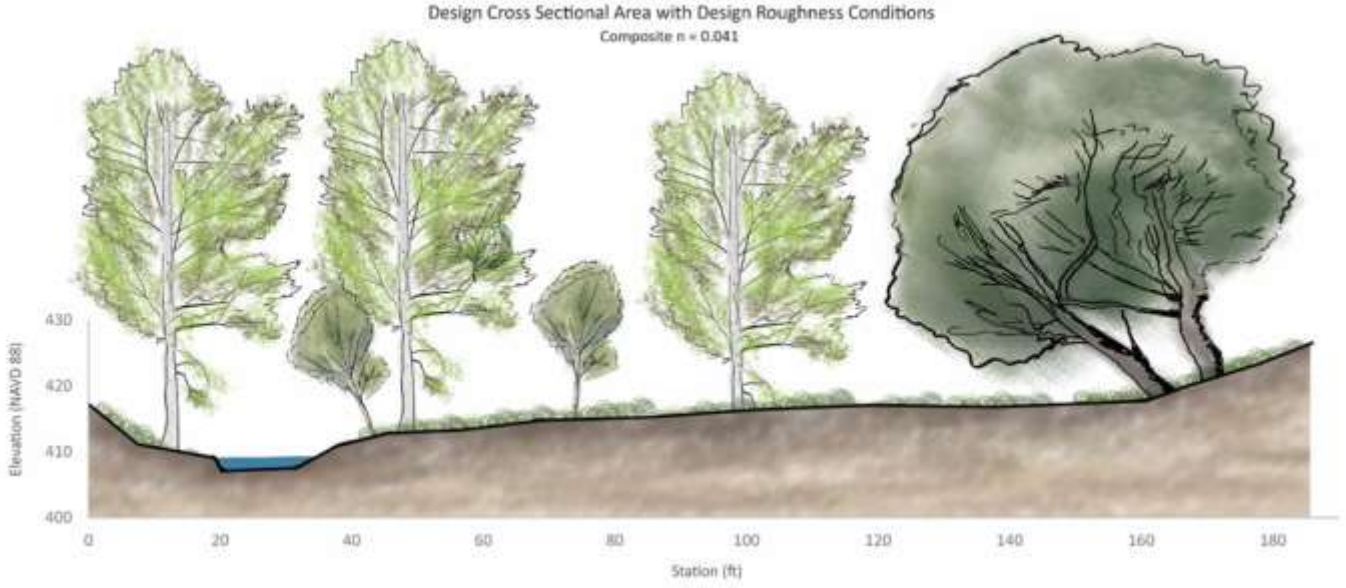
Maintenance Guidelines – Example 4




0.1
0.09
0.08
0.07
0.06
0.05
0.04
Manning's n-value
414
416
418
420
422
424
426
Water surface elevation for level of service flow (ft NAVD88)
No Maintenance Necessary
Monitor for Possible Maintenance
Maintenance Required
Target Freeboard
Top of Levee
Reach 4 existing (Spring, 2015) roughness, n = 0.084
Design roughness, n = 0.041
Design XS Area
5% Area Reduction
10% Area Reduction
15% Area Reduction


Vegetation Density
None to Low
Low to Medium
Medium to High
High to High/Very High
High/Very High to Very High
Sediment Accumulation
None to Minor (0-5%)
Minor (5-10%)
Moderate (10-15%)
Significant (>15%)
0.04
0.05
0.06
0.07
0.08
0.09
Hydraulic Roughness (Manning's n-value)
= design roughness, = existing (Spring, 2015) roughness
No Maintenance Necessary
Monitor for Possible Maintenance
Maintenance Required


Design Cross Sectional Area with Existing Roughness Conditions
Composite n = 0.084
430
420
410
400
0
20
40
60
80
100
120
140
160
180
Station (ft)


Design Cross Sectional Area with Design Roughness Conditions
Composite n = 0.041
Elevation (NAVD 88)
430
420
410
400
0
20
40
60
80
100
120
140
160
180
Station (ft)

Conclusion

- Quantitative guidelines to inform maintenance
- Specific to flood management/conveyance
- Other maintenance triggers may include:
  - Infrastructure/assets
  - Public safety
  - Access
  - Etc.