Flood Control District of Maricopa County

New River Channel
N-Value Determination

engineering and
environmental design

Draft Design Memorandum

Flood Control District of Maricopa County

New River Channel N-Value Determination

Prepared by:

J2 Engineering and Environmental Design

8222 South 48th Street, Suite 135

Phoenix, AZ

(602) 438-2221

April 13, 2004

J2 Project No 3033

Table of Contents

1 INTRODUCTION 1
1.1 Background 1
1.2 FCDMC Procedure 2
1.3 Determination of N_0 – Base n value 3
1.4 Determination of N_1 – Degree of Irregularity 3
1.5 Determination of N_2 – Effect of Obstruction 3
1.6 Determination of N_3 – Effect of Vegetation 3
1.7 Determination of n_4 – Variations in Channel Section 4
1.8 Determination of m_5 - meander 5
1.9 Manual Tables 1 and 2 5
1.10 N-Value Justification Process 8
2 N- VALUE SENSITIVITY ANALYSIS 8
REFERENCES 10

List of Tables

TABLE 1 ORIGINAL HYDRAULIC ANALYSIS N-VALUES 1
TABLE 2 UPDATED NEW RIVER HYDRAULIC ANALYSIS N- VALUES 2

Appendix

APPENDIX A: ..... EXCERPTS FROM FCDMC N-VALUE MANUAL (1991)
APPENDIX B: ..... N- VALUE CALCULATIONS
APPENDIX C: ..... HEC-RAS N- VALUE SENSITIVITY ANALYSIS

Computer CD

N-Value Spreadsheet (Example Section N Value Calculation.xls)

HEC-RAS Files (N-Sensitivity Analysis)

1 INTRODUCTION

J2 Engineering and Environmental Design, LLC (J2) was contracted to perform design and analysis for New River Channelization – Grand Avenue to Skunk Creek Including Paradise Shores segment. This work for the Flood Control District of Maricopa County (FCDMC) and the City of Peoria (COP) is under contract FCD 2003C001. As part of the 60% response process to FCDMC comments, a more thorough discussion of n-value analysis verification was undertaken. This memorandum is written to document the methodology for choosing n-value used in the hydraulic analysis.

1.1 Background

The HEC_RAS model of New River between Skunk Creek confluence and Grande Avenue, US60 was based on the Wood-Patel 1996 hydraulic model. This HEC-2 (1994) model used the following n values:

Table 1 Original Hydraulic Analysis N-Values

Cross Section Location	N
Overbannks	0.45
Main Channel	0.030

Some concern from the FCD was voiced relating to the seemingly low value of the main channel n value as run in the original HEC-2 model when correlated to the existing condition relatively high density of vegetation. Subsequent discussion with the FCD indicated that increasing the main channel roughness should be done to reflect realistic/current conditions. J2 used the following n-values for the updated hydraulic 60% analysis.

Table 2 Updated New River Hydraulic Analysis N- Values

Cross Section Location	N
Overbanks	0.45
Gabion Side Slopes w/ Sacrificial fill and some plants	0.035
Vegetated areas adjacent to low flow (within the main channel)	0.045
Low Flow Channel (clean and cobbles)	0.030

The following sections will briefly explain the rationale for these values taken within the framework of FCDMC accepted methodology.

1.2 FCDMC Procedure

N value determination is based upon the FCDMC's document titled *Estimated Manning's Roughness Coefficients for Stream Channels and Flood Plains in Maricopa County, Arizona.* This manual was prepared by the U.S. Geological Survey for the FCDMC. This document presents a methodology developed by B.W. Thomsen and H.W. Hjalmarson to estimate channel and floodplain roughness factors for major drainage ways in Maricopa County.

The procedure estimated Manning's n-value roughness factor based on an equation which adjusted a base n-value for such factors as channel condition (e.g. stable or sloughing), obstruction, and vegetation. J2 used the following equation for estimating Mannings n value is:

$$n = (n_0 + n_1 + n_2 + n_3 + n_4) * m_5$$

Where:

n_0 is the base n vale for straight uniform channels

n_1 channel condition adjustment – surface irregularities

n_2 effect of obstruction adjustment

n_3 Vegetation adjustment

n_4 Variation in channel adjustment

m_5 Degree of Meandering

The manual calculated n values for various cross sections based upon the first three adjustments for cross section characteristics (n_1, n_2 and n_3). However, Table 2 in the manual provides guidance on adjusting n for reach length characteristics such as channel variation (with respect to geometry), and channel sinuosity (i.e. meandering). J2 used the equation for n that accounted for all 5 parameters. A brief discussion of each component follows below.

1.3 Determination of N_0 – Base n value

Base n values for stable channels are given in the n-value manual in Table 1. The table bases the n value determination on channel material type and size of bed material. The New River channel bed consists primarily of smooth and rounded cobbles and small boulders. Average bed material size range is approximately 5-12 inches in diameter. Based upon site observation, and FCDMC methodology the base n value was estimated to be about 0.030.

1.4 Determination of N_1 – Degree of Irregularity

The degree of irregularity, n_1 refers to a channel's relative condition. An n_1 of 0 indicates the smoothest channel possible. The ratings for a channel's irregularity are smooth, minor, moderate and severe. The specific variations in the channel affecting this value are the condition of the channel side slopes - degree of jaggedness and tendency to slough and or erode. The greater the irregularity the higher n_1 will be. Table 2 in the manual indicated that n_1 ranges from 0 to 0.02.

Examination of New River reach indicates that the banks are generally slightly eroded and sloughed. The channel is generally smooth with respect to sharp irregularities along the reach. New River reach was considered to be generally smooth and an n_1 of 0 was applied for design purposes.

1.5 Determination of N_2 – Effect of Obstruction

N_2 is an adjustment for channel obstruction. Obstructions include debris deposits, stumps, isolated boulders and concrete debris etc. The effect of obstruction is categorized negligible, minor, appreciable and severe. The adjustment factor ranges between 0 to 0.06. The higher percent area blocked out by the obstructions the greater n_2 will be.

Although the existing and planned vegetative growth does obstruct flow, this effect is taken into account when estimating n_2. Actual obstruction due to debris such as stumps, boulders and concrete is relatively minor - approximately 5%. A minimal main channel n_2 was estimated at 0.001

1.6 Determination of N_3 – Effect of Vegetation

For this reach of New River, the adjustment for vegetation is the most difficult parameter to quantify. This is due to the high number of variables that vegetation characteristics imparts to channel roughness. Table 2 in the manual provides general guidance but determining this

adjustment value entails significant engineering judgment and coordination with FCDMC is critical to determining an acceptable value.

N_3 is rated as small, medium, large and very large. The adjustment factor for vegetation is a function of plant type (flexibility, geometry of canopy – that is if the trunk length to overall height is high), hydraulic radius and the flow depth to vegetation height ratio. Table 2 from the FCDMC n value manual gives guidance on the adjustment to be applied for different scenarios of plant type and flow depths.

For this reach of New River, the main channel plant types (trees) specified in the plant design for New River include:

- Cottonwood (Populus Fremonti) – 50' high by 30' wide at the top of canopy – 10'-15' trunks – trunk diameter of 12"-36"
- Gooding's Willow (Salix Gooddingii) – 25' high by 20' wide at the top of canopy – 5-10' – trunk diameter
- Sandbar Willow (Salix Exiqua) – 15' high by 6' wide at the top of canopy – 4'-10' trunks

These tree types were considered (for estimation of the roughness in the main channel) the critical plant types. Shrubs and low vegetation will generally have a negligible affect due to the high SPF and 100-year flow depths. This type of material would in general fold over and or be washed away during large storm events. The effect on roughness due to these plant types is more applicable when modeling smaller events. The main contributors to n_3 in the main channel were the 3 tree types mentioned above.

The source for general dimension characteristics of the trees was drawn from the Mountain States Nursery website – http://www.mswn.com).

According to Table 2, the vegetation adjustment n_3 is s primarily a function of flow depth to height of vegetation. However, other factors of the vegetation character impact the adjustment factor and must be considered. Examples are trunk length, obstruction area and flexibility. Consideration of these factors influences the rating chosen for n_3.

Where the trunk height indicated that flow would only "see" the less obstructive trunk (not canopy and trunk combined), the severity of the rating was reduced. The thickness and rigidity of the tree species also factored into n_3 determination. As the vegetation increased in thickness and more rigid the vegetation, the n_3 rating, increased.

1.7 Determination of n_4 – Variations in Channel Section

The adjustment variable n4 represents the adjustment for channel variation in shape of cross section change along the reach length. The ratings are gradual, alternating (occasionally) and alternating (frequently).

For this reach of New River, it was felt that the channel section change was gradual. Therefore the n_4 was 0.

1.8 Determination of m_5 - meander

The factor m_5 is applied to account for meander of the channel reach. Ratings for meander m5, are minor, appreciable and severe. Table 2 gives descriptions of the degrees of meander and the appropriate factor to use. For this reach of New River, meander was not considered significant and a rating of minor was used. M_5 was estimated to be 1.0.

1.9 Manual Tables 1 and 2

For convenience the tables shown in the FCDMC n-value manual are shown below.

Figure 1: ***N-Value Manual - Table 1***

Table 1.--*Base values of Manning's n for stable channels*

[Modified from Aldridge and Garrett, 1973, table 1]

Channel material	Size of bed material		Base *n* values	
	Millimeters	Inches	Benson and Dalrymple (1967)[1]	Chow (1959)[2]
Concrete.....	-------	--------	0.012-0.018	0.011
Rock cut.....	-------	--------	----------	.025
Firm soil.....	-------	--------	.025- .032	.020
Coarse sand.....	1-2	--------	.026- .035	-----
Fine gravel.....	-------	--------	----------	.024
Gravel.....	2-64	0.08-2.5	028- .035	-----
Coarse gravel.....	-------	--------	----------	.028
Cobble.....	64-256	2.5-10.0	.030- .050	-----
Boulder.....	>256	>10.0	.040- .070	-----

[1]Straight uniform channel.
[2]Smoothest channel attainable in indicated material.

Figure 2: N-Value Manual - Table 2

Table 2.--*Adjustment factors for the determination of overall Manning's n values*

[Modified from Chow, 1959]

Channel conditions	Manning's n adjustment[1]	Example
Degree of irregularity:		
Smooth	0.000	Smoothest channel attainable in given bed material.
Minor	.001- .005	Channels with slightly eroded or scoured side slopes.
Moderate	.006- .010	Channels with moderately sloughed or eroded side slopes.
Severe	.011- .020	Channels with badly sloughed banks; unshaped, jagged, and irregular surfaces of channels in rock.
Effects of obstruction[2]:		
Negligible	.000- .004	A few scattered obstructions, which include debris deposits, stumps, exposed roots, logs, piers, or isolated boulders, that occupy less than 5 percent of the cross-sectional area.
Minor	.005- .015	Obstructions occupy 5 to 15 percent of the cross-sectional area and the spacing between obstructions is such that the sphere of influence around one obstruction does not extend to the sphere of influence around another obstruction. Smaller adjustments are used for curved smooth-surfaced objects than are used for sharp-edged angular objects.
Appreciable	.020- .030	Obstructions occupy from 15 to 50 percent of the cross-sectional area or the space between obstructions is small enough to cause the effects of several obstructions to be additive, thereby blocking an equivalent part of a cross section.
Severe	.040- .060	Obstructions occupy more than 50 percent of the cross-sectional area or the space between obstructions is small enough to cause turbulence across most of the cross section.
Vegetation:		
Small	.002- .010	Dense growths of flexible turf grass, such as Bermuda, or weeds where the average depth of flow is at least two times the height of the vegetation; supple tree seedlings such as willow, cottonwood, arrow weed, or saltcedar where the average depth of flow is at least three times the height of the vegetation.
Medium	.010- .025	Grass or weeds where the average depth of flow is from one to two times the height of the vegetation; moderately dense stemmy grass, weeds, or tree seedlings where the average depth of flow is from two to three times the height of the vegetation; moderately dense brush, similar to 1- to 2-year-old saltcedar in the dormant season, along the banks and no significant vegetation along the channel bottoms where the hydraulic radius exceeds 2 feet.
Large	.025- .050	Turf grass or weeds where the average depth to flow is about equal to the height of vegetation; small trees intergrown with some weeds and brush where the hydraulic radius exceeds 2 feet.

See footnotes at end of table.

8

Table 2.--*Adjustment factors for the determination of overall Manning's n values*--Continued

Channel conditions	Manning's n adjustment[1]	Example
Vegetation—Continued:		
Very large	.050- .100	Turf grass or weeds where the average depth of flow is less than half the height of vegetation; small bushy trees intergrown with weeds along side slopes of dense cattails growing along channel bottom; trees intergrown with weeds and brush.
Variations in channel cross section:		
Gradual	.000	Size and shape of cross sections change gradually.
Alternating	.001- .005	Large and small cross sections alternate occasionally, or the main flow occasionally shifts from side to side owing to changes in cross-sectional shape.
Alternating	.010- .015	Large and small cross sections alternate frequently, or the main flow frequently shifts from side to side owing to changes in cross-sectional shape.
Degree of meadering[3]:		
Minor	1.00	Ratio of the meander length to the straight length of the channel reach is 1.0 to 1.2.
Appreciable	1.15	Ratio of the meader length to the straight length of channel is 1.2 to 1.5.
Severe	1.30	Ratio of the meander length to the straight length of channel is greater than 1.5.

[1]Adjustments for degree of irregularity, variations in cross section, effect of obstructions, and vegetation are added to the base n value (table 1) before multiplying by the adjustment for meander.

[2]Conditions considered in other steps must not be reevaluated or duplicated in this section.

[3]Adjustment values apply to flow confined in the channel and do not apply where downvalley flow crosses meanders. The adjustment is a multiplier.

For floodflows in sand channels with moveable beds, roughness mainly is a function of the size of the bed material as shown in the following table (Benson and Dalrymple, 1967, p. 22).

Median grain size, in millimeters	Manning's *n*	Median grain size, in millimeters	Manning's *n*
0.2	0.012	0.6	.023
.3	.017	.8	.025
.4	.020	1.0	.026
.5	.022		

1.10 N-Value Justification Process

This document provides example analysis for 4 cross section locations for n-value verification/justification purposes. The 4 sections were chosen because they represented typical planting schemes and hydraulic conditions (e.g. limited versus extra conveyance) for surrounding cross sections. The cross sections chosen for analysis were:

- 358.25
- 388.50
- 424.17
- 441.6

Calculations verifying n-values used and cross section schematics are included as Appendix B of this document. In general the basic n-value assumptions used at the 60% stage hydraulic analysis were validated. However, there are some locations in the 1% slope down to the low flow channel (in the channel invert) that may be require removal some cottonwoods. Their inclusion may raise the n value higher than the permissible design n- value (generally 0.035). The determination of a final plant design and balancing with the hydraulics of the project – e.g. permissible roughness - is a subjective and often times iterative process and may be subject to some change based on FCDMC recommendations.

"Existing" n-values are based on the Wood-Patel model and indicate values that are abnormally low for the existing conditions at some locations. Where the existing n-values exceed the proposed values, the existing vegetation will be thinned out and/or replaced to match the proposed n-value.

Calculations and schematics showing this analysis are contained in Appendix B.

2 N- VALUE SENSITIVITY ANALYSIS

An HEC-RAS analysis was performed to determine the sensitivity of the flow depths to variations in n value. The proposed geometry (60% to 90%) was used as the basis for the HEC-RAS cross sections. N was varied only in the main channel. The left and right overbanks were left at 0.045. The main channel n value was varied between 0.030 (the original study values) and 0.055.

The analysis was run to answer 2 fundamental questions relating to this project.

1. For a given n-value increase, what is the relative rise in flow depth?
2. What is the difference between the design n-value and the maximum? What growth margin is there?

(More discussion on results will be included fro the final version of this memorandum)

Preliminary hydraulic runs are included on the CD and in Appendix C.

REFERENCES

Flood Control District of Maricopa County, *Estimated Manning's Roughness Coefficients for Stream Channels and Floodplains in Maricopa County*. Prepared by US Geological Survey by B.W. Thomsen and H.W. Hjalmarson. April 1991.

Flood Control District of Maricopa County, *Drainage Design Manual for Maricopa County Volume I - Hydrology*. January 1995.

Flood Control District of Maricopa County, *Drainage Design Manual for Maricopa County Volume II – Hydraulics*, January 28, 1996.

APPENDIX

Appendix A: Excerpts from FCDMC N-Value Manual (1991)

Estimated Manning's Roughness Coefficients for Stream Channels and Flood Plains in Maricopa County, Arizona

Prepared by the
U.S. GEOLOGICAL SURVEY
Water Resources Division

Prepared for
Flood Control District
of Maricopa County

and, for convenience in the absence of a more suitable method, the coefficient is assumed to be unity (Chow, 1959). A detailed study of the velocity-head coefficient, alpha, in natural channels showed a significant correlation between alpha and channel roughness for channels without overbank flow. Variation in the horizontal distribution of velocity had a greater effect on the value of alpha than variation in the vertical. Computed values of alpha at 894 sites in a variety of settings ranged from 1.03 to 4.70, and the median value for trapezoidal channels was 1.40 (Hulsing and others, 1966). In the computation of water-surface profiles in open channels, the value of alpha is assumed to be 1.0 if the section is not subdivided (Davidian, 1984). In subdivided channel cross sections, the value of alpha is computed as

$$\alpha = \frac{\Sigma(k_i^3/a_i^2)}{K_T^3/A_T^2}, \tag{6}$$

where

k_i = conveyance of individual subsections,

a_i = area of individual subsections,

K_T = conveyance of entire cross section, and

A_T = area of entire cross section.

Channel n Values

The Manning roughness coefficient, *n*, is a measure of the flow resistance or relative roughness of a channel or overflow area. The flow resistance is affected by many factors including bed material, cross-section irregularities, depth of flow, vegetation, channel alignment, channel shape, obstructions, suspended material, and bedload. In general, all factors that cause turbulence and retard flow tend to increase the roughness coefficient (Jarrett, 1984). Channel roughness also is directly related to channel slope (Riggs, 1976; Jarrett, 1984). The relation of roughness to slope results partly from the interrelation between channel slope and bed-material particle size. For similar bed material, however, channels with low gradients have lower roughness coefficients than channels with high gradients (Jarrett, 1984). The direct relation between channel roughness and channel slope is not evident in low-gradient channels where high roughness coefficients result from vegetation. Roughness coefficients as great as 0.20 have been verified for channels with low gradients and dense vegetation (Arcement and Schneider, 1984). For vegetation that will bend under the force of flowing water, the relation between roughness and gradient can be inversely related. Steep slopes cause greater velocities that bend and flatten vegetation if depths of flow are sufficient, resulting in lower *n* values. Because of the relation between channel slope and size of bed material, the effect of slope on *n* values is considered in the selection of base *n* values.

A common method of selecting the roughness coefficient, *n*, is to first select a base value of *n* for the bed material (table 1). The base values of *n* are for a straight uniform channel of a given bed material. Cross-section irregularities, channel alignment, obstructions, vegetation, and other factors that increase roughness are accounted for by adding increments of roughness to the base value of *n*. Ranges of adjustments for the factors that may add to channel roughness are shown in table 2.

Many alluvial channels in Maricopa County have bed material that moves during floodflow. In addition to the changing channel geometry of these channels, the roughness coefficient may change during floodflow because of the changing form of the channel bed in parts of the channel cross section (Davidian, 1984). Bedforms, such as dunes, antidunes, and plane bed have been observed during large floods. Within a few minutes, dunes can appear, disappear, and reappear at different locations across a large stream channel. The Manning roughness coefficient can double or triple when the bedform changes from plane to dunes. A method of defining reliable values of Manning's *n* for unstable alluvial channels is not available. A plane bedform is common during large floods, and for this report, plane-bed conditions are assumed where the roughness coefficient is related to the size of the channel material and not the form of the channel bed. Plane-bed conditions were assumed for nearly all indirect measurements of peak discharge where the slope-area method was used.

Table 1.--*Base values of Manning's n for stable channels*

[Modified from Aldridge and Garrett, 1973, table 1]

Channel material	Size of bed material		Base *n* values	
	Millimeters	Inches	Benson and Dalrymple (1967)[1]	Chow (1959)[2]
Concrete.....	-------	--------	0.012-0.018	0.011
Rock cut.....	-------	--------	----------	.025
Firm soil.....	-------	--------	.025- .032	.020
Coarse sand.....	1-2	--------	.026- .035	-----
Fine gravel.....	-------	--------	----------	.024
Gravel.....	2-64	0.08-2.5	.028- .035	-----
Coarse gravel.....	-------	--------	----------	.028
Cobble.....	64-256	2.5-10.0	.030- .050	-----
Boulder.....	>256	>10.0	.040- .070	-----

[1]Straight uniform channel.
[2]Smoothest channel attainable in indicated material.

Table 2.--*Adjustment factors for the determination of overall Manning's n values*

[Modified from Chow, 1959]

Channel conditions	Manning's n adjustment[1]	Example
Degree of irregularity:		
Smooth	0.000	Smoothest channel attainable in given bed material.
Minor	.001- .005	Channels with slightly eroded or scoured side slopes.
Moderate	.006- .010	Channels with moderately sloughed or eroded side slopes.
Severe	.011- .020	Channels with badly sloughed banks; unshaped, jagged, and irregular surfaces of channels in rock.
Effects of obstruction[2]:		
Negligible	.000- .004	A few scattered obstructions, which include debris deposits, stumps, exposed roots, logs, piers, or isolated boulders, that occupy less than 5 percent of the cross-sectional area.
Minor	.005- .015	Obstructions occupy 5 to 15 percent of the cross-sectional area and the spacing between obstructions is such that the sphere of influence around one obstruction does not extend to the sphere of influence around another obstruction. Smaller adjustments are used for curved smooth-surfaced objects than are used for sharp-edged angular objects.
Appreciable	.020- .030	Obstructions occupy from 15 to 50 percent of the cross-sectional area or the space between obstructions is small enough to cause the effects of several obstructions to be additive, thereby blocking an equivalent part of a cross section.
Severe	.040- .060	Obstructions occupy more than 50 percent of the cross-sectional area or the space between obstructions is small enough to cause turbulence across most of the cross section.
Vegetation:		
Small	.002- .010	Dense growths of flexible turf grass, such as Bermuda, or weeds where the average depth of flow is at least two times the height of the vegetation; supple tree seedlings such as willow, cottonwood, arrow weed, or saltcedar where the average depth of flow is at least three times the height of the vegetation.
Medium	.010- .025	Grass or weeds where the average depth of flow is from one to two times the height of the vegetation; moderately dense stemmy grass, weeds, or tree seedlings where the average depth of flow is from two to three times the height of the vegetation; moderately dense brush, similar to 1- to 2-year-old saltcedar in the dormant season, along the banks and no significant vegetation along the channel bottoms where the hydraulic radius exceeds 2 feet.
Large	.025- .050	Turf grass or weeds where the average depth to flow is about equal to the height of vegetation; small trees intergrown with some weeds and brush where the hydraulic radius exceeds 2 feet.

See footnotes at end of table.

Table 2.--*Adjustment factors for the determination of overall Manning's n values*--Continued

Channel conditions	Manning's n adjustment[1]	Example
Vegetation—Continued:		
Very large	.050- .100	Turf grass or weeds where the average depth of flow is less than half the height of vegetation; small bushy trees intergrown with weeds along side slopes of dense cattails growing along channel bottom; trees intergrown with weeds and brush.
Variations in channel cross section:		
Gradual	.000	Size and shape of cross sections change gradually.
Alternating	.001- .005	Large and small cross sections alternate occasionally, or the main flow occasionally shifts from side to side owing to changes in cross-sectional shape.
Alternating	.010- .015	Large and small cross sections alternate frequently, or the main flow frequently shifts from side to side owing to changes in cross-sectional shape.
Degree of meadering[3]:		
Minor	1.00	Ratio of the meander length to the straight length of the channel reach is 1.0 to 1.2.
Appreciable	1.15	Ratio of the meader length to the straight length of channel is 1.2 to 1.5.
Severe	1.30	Ratio of the meander length to the straight length of channel is greater than 1.5.

[1]Adjustments for degree of irregularity, variations in cross section, effect of obstructions, and vegetation are added to the base n value (table 1) before multiplying by the adjustment for meander.

[2]Conditions considered in other steps must not be reevaluated or duplicated in this section.

[3]Adjustment values apply to flow confined in the channel and do not apply where downvalley flow crosses meanders. The adjustment is a multiplier.

For floodflows in sand channels with moveable beds, roughness mainly is a function of the size of the bed material as shown in the following table (Benson and Dalrymple, 1967, p. 22).

Median grain size, in millimeters	Manning's *n*	Median grain size, in millimeters	Manning's *n*
0.2	0.012	0.6	.023
.3	.017	.8	.025
.4	.020	1.0	.026
.5	.022		

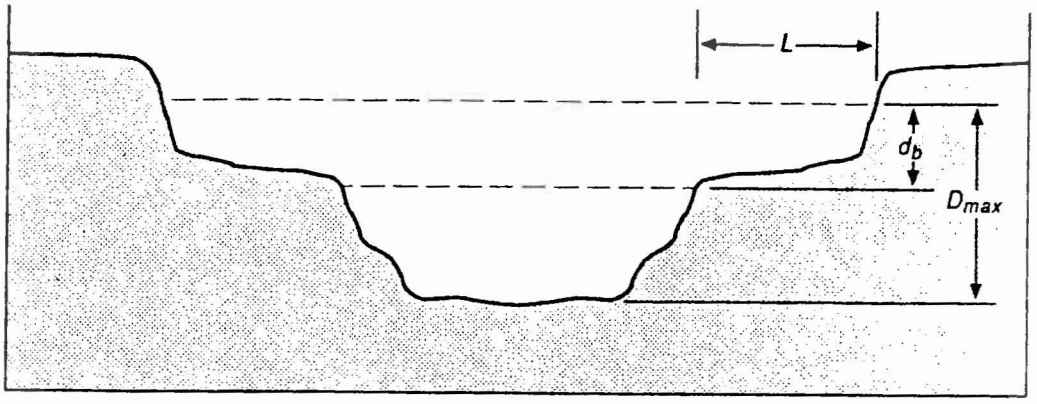
The major adjustments to the base value of *n* used in this report are for cross-section characteristics. Other adjustments for the reach characteristics between cross sections that include changes in shape and size of cross sections and channel meandering are not given. Procedures for evaluating the adjustment factors for the reach characteristics are given in several publications including Chow (1959), Aldridge and Garrett (1973), Jarrett (1985a, b), and Arcement and Schneider (1989).

SUBDIVISION OF CROSS SECTIONS

Sections with distinct changes in shape were divided into subsections, and *n* values were determined separately for each subsection. Subdivision location primarily was based on major breaks in cross-sectional geometry. Cross sections were subdivided if main channel depth was more than twice the depth at the stream edge of the overflow area (fig. 2). Subdivision also commonly was made where the depth of the overflow at the stream edge is nearly half the depth of the main channel and the width of the overflow area is at least five times the depth of the overflow area (fig. 2). Values of *n* for overflow areas commonly were estimated from table 2.

For sections or subsections with a nonuniform distribution of vegetation, a composite *n* was computed by using weighted values for segments having different roughness. Where sections were divided into segments of equal roughness, dividing lines were selected to parallel the general flow line and to represent the average contact between segments of different roughness. Composite *n* values were computed by using weighted values of either area (*A*) or wetted perimeter (*P*). Weighting was done by estimating area or wetted perimeter for each portion of channel and assigning weighting factors that were proportional to the total area or wetted perimeter. The general rule for deciding which weighting method to use is as follows: Use area weighting where vegetation is dense and occupies a distinct part of the cross section. Use wetted-perimeter weighting where the roughness factor for each segment is the result of low-lying boundary material.

Where overflow areas are cultivated fields, *n* values are for fields without crops. Values of *n* for fields with crops can be based on the work of Chow (1959). Fields of mature cotton plants are comparable to dense brush in summer; defoliated cotton to medium to dense brush in winter (fig. 3). Fields of alfalfa are comparable to field crops with *n* value depending on height of the crop and depth of water (table 3). The value of *n* generally varies with the stage of submergence of the vegetation. In all instances, *n* values associated with cultivated fields will change with time.



Subdivide if D_{max} is greater than or equal to $2d_b$

Subdivide if D_{max} is approximately equal to $2d_b$ and if L/d_b is equal to or greater than 5

L = width of flood plain
d_b = depth of flow on flood plain, in feet
D_{max} = maximum depth of flow in cross section, in feet

Modified from Davidian (1984)

Figure 2.--Subdivision criteria commonly used for streams in Maricopa County, Arizona.

Table 3.--*Values of Manning's n for flood plains*

[Modified from Chow, 1959]

Description	Minimum	Normal	Maximum
Pasture, no brush:			
Short grass.....	0.025	0.030	0.035
High grass.....	.030	.035	.050
Cultivated areas:			
No crop.....	.020	.030	.040
Mature row crops.....	.025	.035	.045
Mature field crops.....	.030	.040	.050
Brush:			
Scattered brush, heavy weeds.....	.035	.050	.070
Light brush and trees, in winter.....	.035	.050	.060
Light brush and trees, in summer.....	.040	.060	.080
Medium to dense brush, in winter.....	.045	.070	.110
Medium to dense brush, in summer.....	.070	.100	.160
Trees:			
Dense willows, summer, straight.....	.110	.150	.200
Cleared land with tree stumps, no sprouts.....	.030	.040	.050
Same as above, but heavy growth off sprouts.....	.050	.060	.080
Heavy stand of timber, a few down trees, little undergrowth, flood stage below branches.....	.080	.100	.120
Same as above, but with flood stage reaching branches.....	.100	.120	.160

SITE INFORMATION

The following sets of site information consist of a description of the site, a table showing values of *n* for sections and subsections of the channel for the 10-year and 100-year floods, channel cross sections, and photographs (tables 4-19; figs. 4-35). Photographs of the 16 sites taken during the spring and summer of 1989 include an overview showing the location of the cross section; additional photographs show major items that affect the *n* value. The frame of the square grid shown in several photographs is 1.5 ft outside dimension on a side with an internal square of 1 ft on a side and grid spacing of 1 in. Cross-section diagrams show approximate elevations of the 10-year and 100-year flood levels, appropriate subdivisions, selected *n* values, and the approximate location and height of the vegetation. The approximate flood elevations were computed from conveyance-slope computations using cross-section geometry furnished by Flood Control District of Maricopa County.

The photographs were taken from different locations on the ground and from an aircraft. For most sites, a photograph of typical bed material is included. The photographs of the channel and flood plain can be used for comparison of field conditions with photographs of channels and flood plains where *n* values have been verified (Arcement and Schneider, 1989; Chow, 1959; Barnes,1964; Aldridge and Garrett, 1973). Several of the photographs and descriptions refer to the horizontal stationing of the cross section.

The description of each site includes the location of the channel cross section, the description of the channel, the basis for subdivision of the cross section, and the evaluation of the estimated *n* value. Changes in channel geometry and type and distribution and density of vegetation are described. The area or wetted-perimeter basis for weighting of *n* for portions of sections and subsections is defined. The channel cross section and the photographs should be used in conjunction with the site description to assess how *n* was defined.

The table shows the components of the roughness coefficient for the 10-year and 100-year floods that were estimated for the sections and subsections. The total *n* values are the sum of the base value of *n* for a straight uniform channel (n_b); surface irregularities (n_1); obstruction (n_2); and vegetation (n_3). Dashes indicate that a roughness coefficient of zero was used. Where portions of sections and subsections were used, the part of the section or subsection used for the estimate of the composite *n* is listed under "Portion of area or wetted perimeter of subsection from left end." Where portions of sections or subsections were not used, values for portions and weighted and composite values were not listed. The sum of the parts for each portion of the section and (or) subsection is equal to 1. The composite value of *n* for the sections and subsections is the sum of the weighted *n* values for each portion.

NEW RIVER ABOVE INTERSTATE HIGHWAY 17

Location of cross section: 700 ft upstream from bridge.

Description of channel: Bed material is firm soil with boulders protruding in the low-flow channel. Edges of low-flow channel are lined with trees, and the rest of the main channel has scattered brush. The overflow plain has a medium to dense cover of brush and trees except for a small ditch and a narrow roadway that are parallel to the main channel.

Subdivision of cross section and evaluation of *n*: Cross section is subdivided at left edge of main channel on basis of channel shape. Composite *n* value computed for main channel because of distinct differences in vegetation across section. Weighting of *n* for portions of subsections was done on the basis of wetted perimeter.

NEW RIVER ABOVE INTERSTATE HIGHWAY 17--Continued

Table 12.--Components and weighted and composite values of Manning's n

[Dashes indicate a roughness coefficient of zero]

10-Year Flood

Subsection A

Portion of area or wetted perimeter of subsection from left end		Components		Weighted and composite values
		n_b = .030 n_1 = ---- n_2 = ---- n_3 = ----		
.35	x	n = .030	=	.010
		n_b = .030 n_1 = .010 n_2 = ---- n_3 = .050		
.20	x	n = .090	=	.018
		n_b = .030 n_1 = .010 n_2 = ---- n_3 = .010		
.45	x	n = .050	=	.022
1.00				.050

100-Year Flood

Subsection A

Portion of area or wetted perimeter of subsection from left end		Components		Weighted and composite values
		n_b = .030 n_1 = ---- n_2 = ---- n_3 = .065		
		n = .095		

Subsection B

Portion of area or wetted perimeter of subsection from left end		Components		Weighted and composite values
		n_b = .030 n_1 = ---- n_2 = ----		
.35	x	n = .030	=	.010
		n_b = .030 n_1 = .010 n_2 = ---- n_3 = .050		
.20	x	n = .090	=	.018
		n_b = .030 n_1 = .005 n_2 = ---- n_3 = .007		
.45	x	n = .042	=	.019
1.00				.047

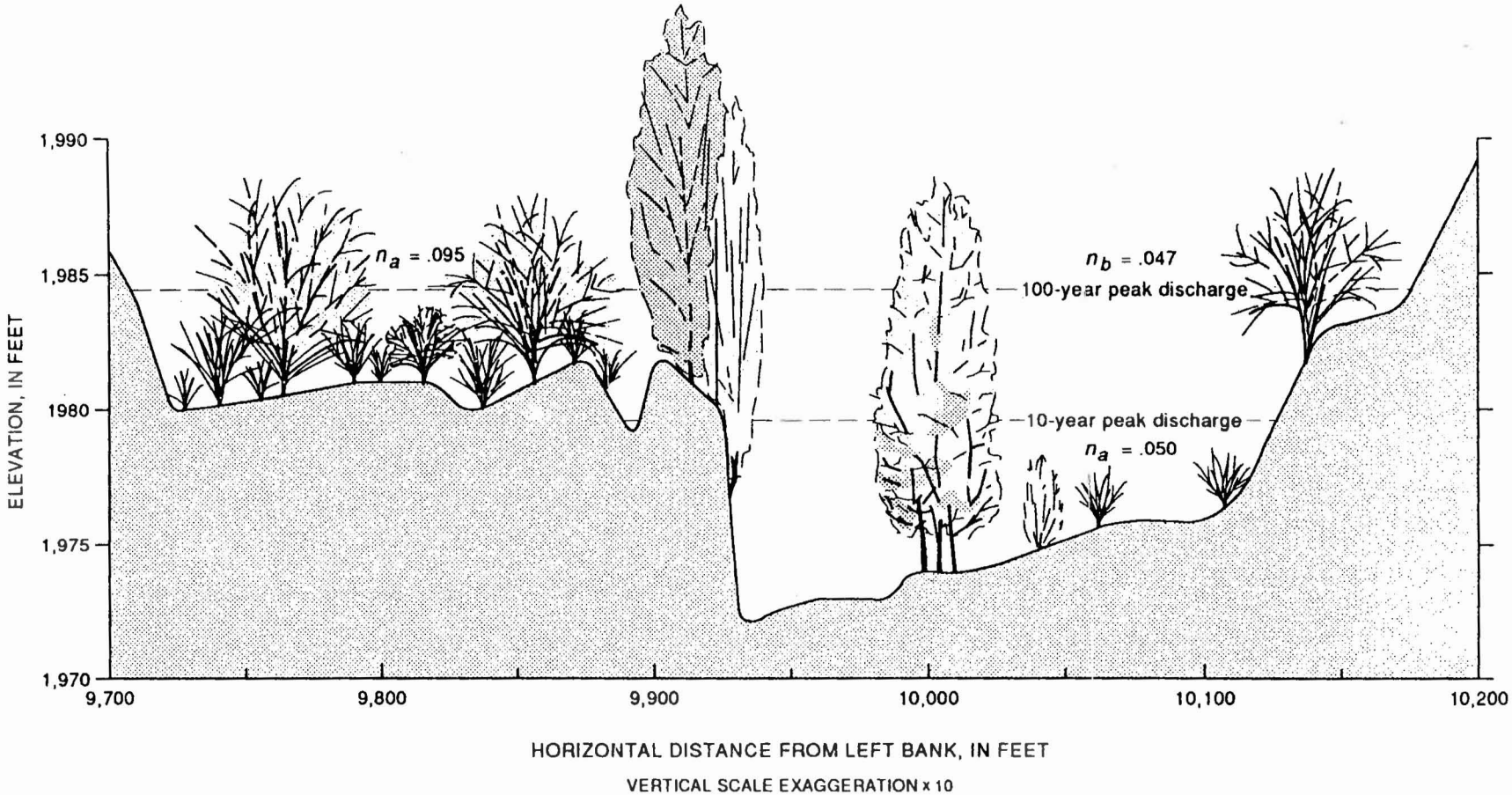
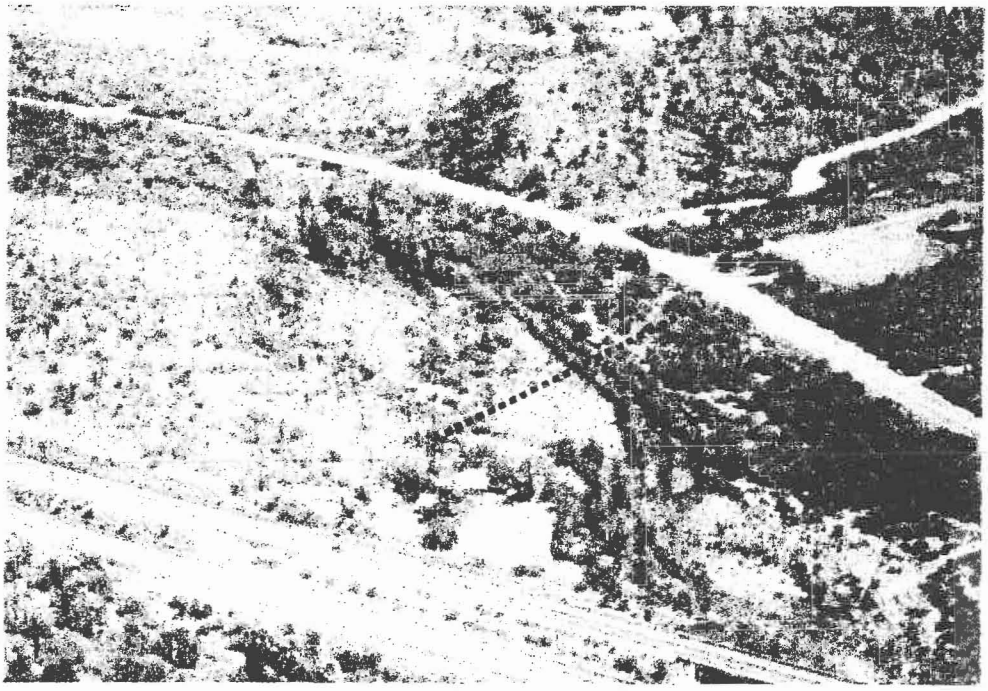
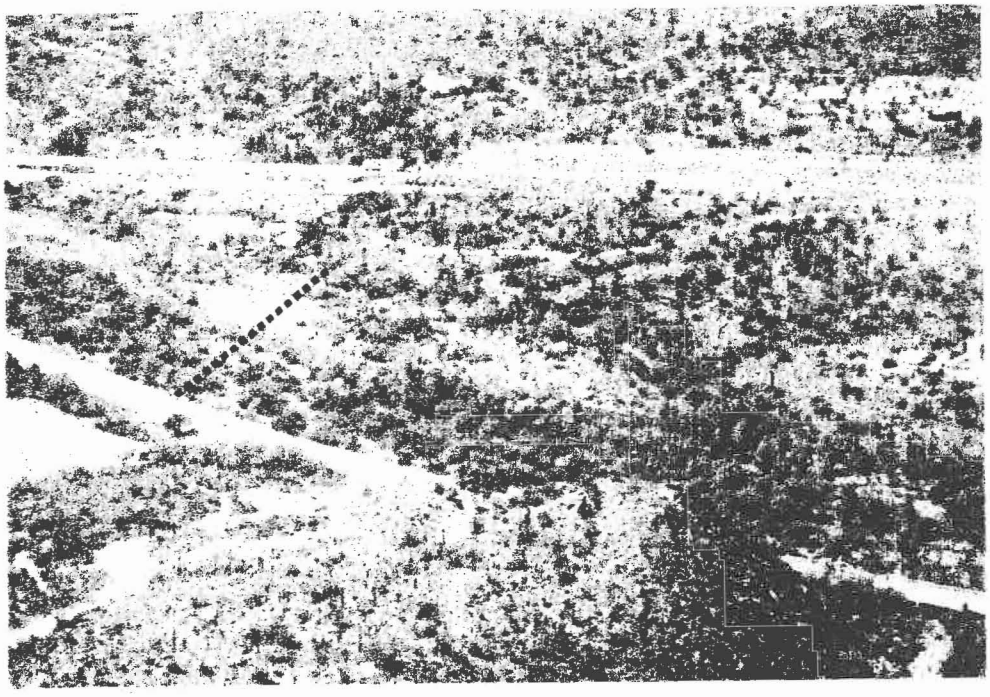


Figure 20.--Cross section of New River above Interstate Highway 17.

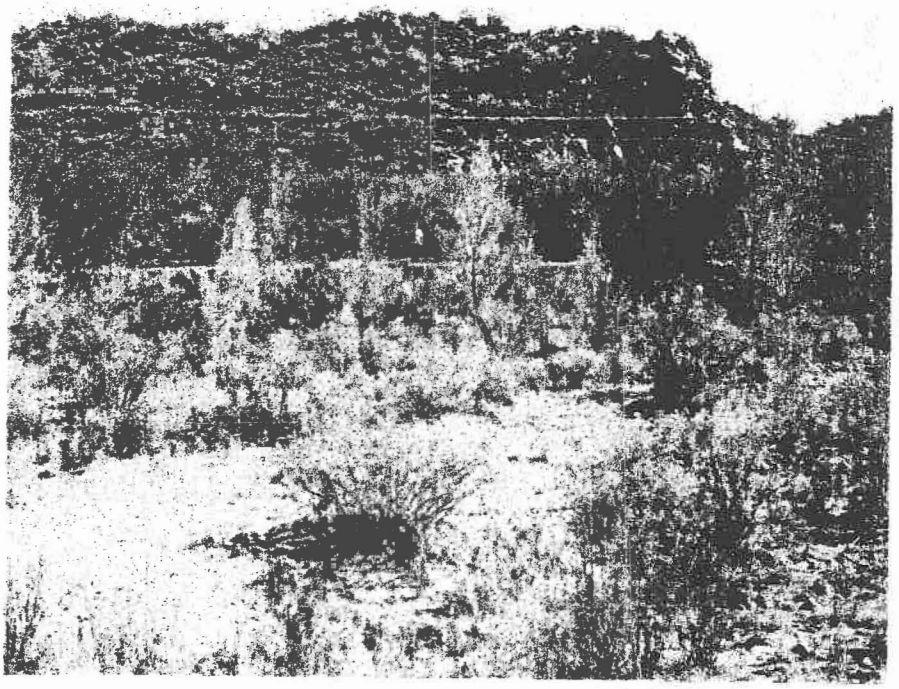


A. Looking upstream at cross section from above Interstate Highway 17.

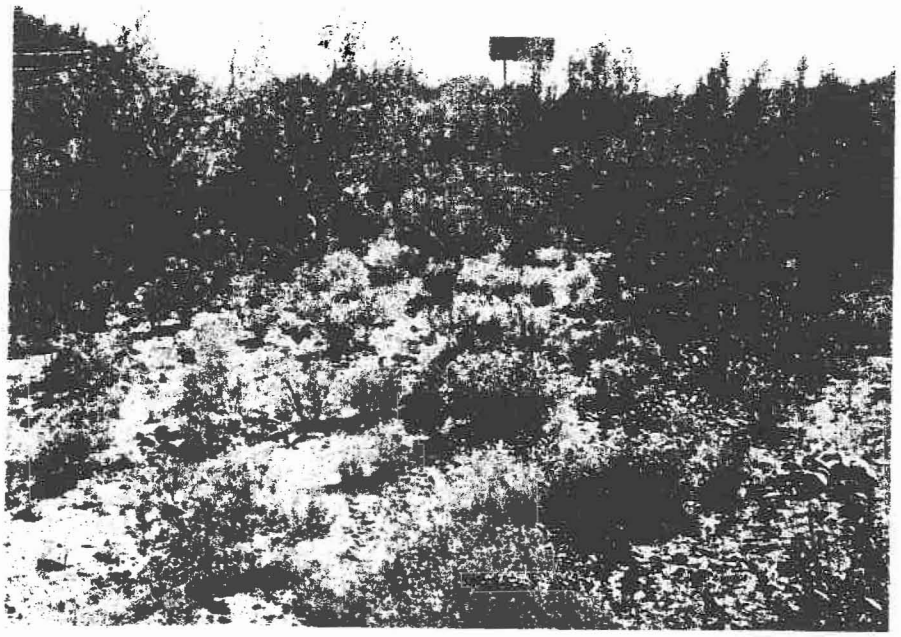


B. Looking downstream and across channel from above left bank.

Figure 21.--New River above Interstate Highway 17.

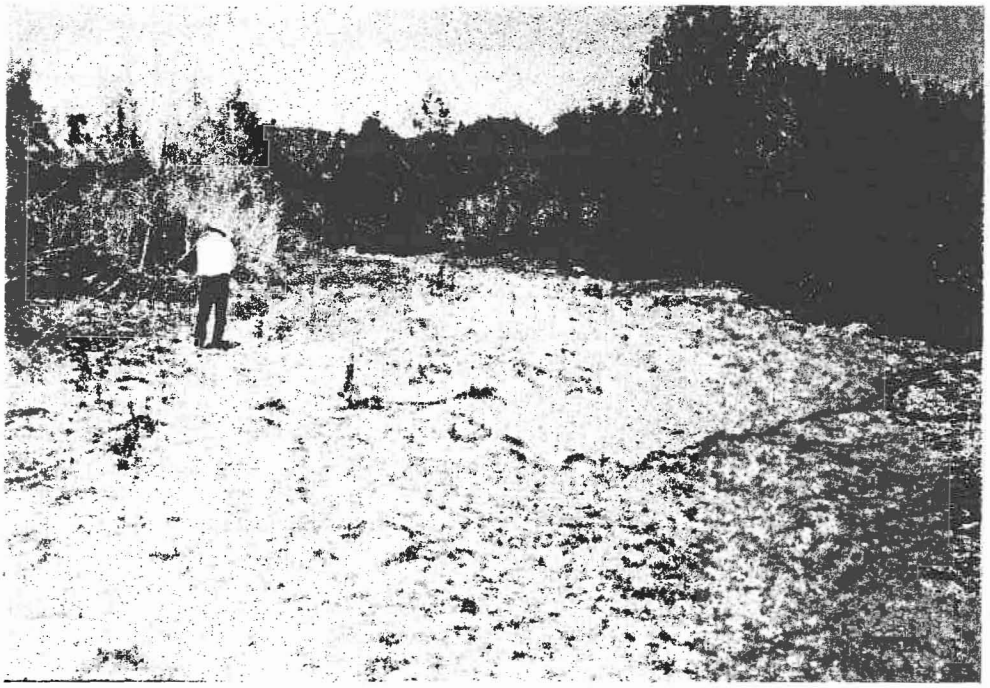


C. Looking across channel from right bank. Man standing on left bank edge of main channel at cross-section station 9,900.



D. Looking downstream along right bank. Man is at cross-section station 10,030 feet.

Figure 21.--New River above Interstate Highway 17--Continued.



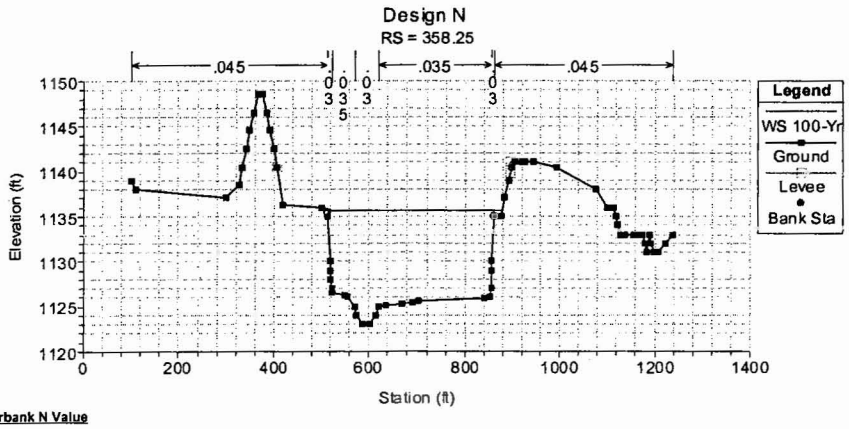
E. Looking upstream at low-flow part of main channel. Man is at cross-section station 9,960 feet.

Figure 21.--New River above Interstate Highway 17--Continued.

Appendix B: N- Value Calculations

Subject: N- Value estimation
Designer: K. Duffy
Date 4/1/2004

Notes: Channel base material in the inverts is cobbles with some boulders - well rounded - Av size 5-12 inches.
Overbank base materials were generally finer firm soil to coarse gravel - 0.5 inches to 1 inch.
During the 100-year and SPF events it was assumed that the gabion baskets on the side slopes will be exposed. N for the gabions was assumed to be 0.03.



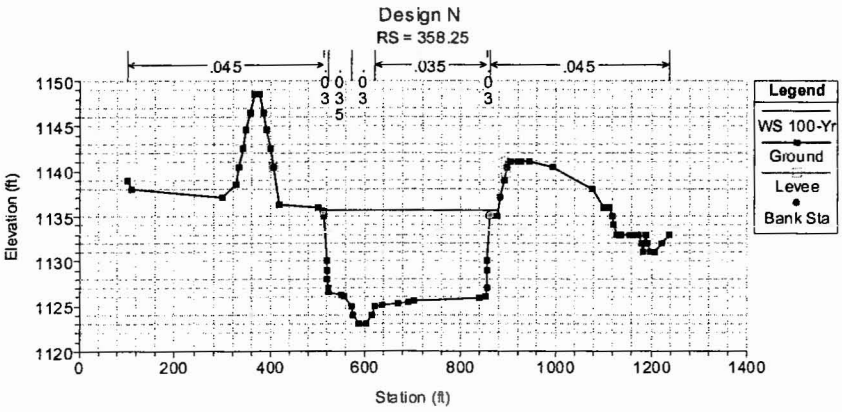
Overbank N Value

Estimation of $n = (n_0+n_1+n_2+n_3+n_4)*m_5$					
No -Base N value					
Channel Materials	**Bed Material Size**	**Benson & Dalrymple**	**Chow (1959)**	**Used**	**Comments**
Concrete	-----	0.012-.018	0.011		
Rock Cut	-----	-----	0.025		
Firm Soil	-----	.025-.032	0.02	0.020	Finer surface soils on overbank (.5" to 2")
Coarse Sand	-----	.026-.035	-----		
Fine Gravel	-----	-----	0.024		
Gravel	0.08-2.5	.028-.035	-----		
Coarse Gravel	-----	-----	0.028		
Cobble	2.5-10.0	.030-.050	-----		
Boulder	>10	.04-.071	-----		
N1 - Degree of Irregularity					
Effect			**Range**	**Used**	
Smooth-Smoothest Channel attainable in given bed material			0	NA	Overbanks - sides not included - part of main channel
Minor-Channels with slightly eroded or scoured side slopes			.001-.005	NA	
Moderate-Channels with moderately sloughed or eroded side slopes			.006-.010	NA	
Severe-Channels with badly sloughed banks; unshaped, jagged, and irregular surfaces of channels in rock.			.011-.020	NA	
N2 - Effect of Obstruction					
Effect			**Range**	**Used**	
Neglible -0 to 5% obstruction			.000-.004	0.004	some small stumps and concrete debris
Minor-5-15% obstruction			.005-0.015		
Appreciable-15-50% obstruction			0.02-.03		
Severe->50% obstruction			.04-.060		
N3 - Vegetation					
Effect			**Range**	**Used**	
Small-D_{flow}/D_{veg}>=2			0.002-.01		
Medium-1<D_{flow}/D_{veg}<2			.01-.025	0 02	Existing mesquite, Palo Verde and cactus'
Large-D_{flow}/D_{veg}<=1			.025-.05		
Very Large-D_{flow}/D_{veg}<=0.5			.05-.10		
N4 - Variations in Channel Cross Section					
Effect			**Range**	**Used**	
Gradual			0	0	
Alternating(Occasionally)			.0001-.005		
Alternaltng (Frequently)			.010-.015		
M5 - Meandering					
Effect			**Range**	**Used**	
Minor			1	1	
Appreciable			1.15		
Severe			1.3		

Recommended N =	0.044
Used =	0.045
Warning	None

Subject: N- Value estimation
Designer: K. Duffy
Date 4/1/2004

Notes: Channel base material in the inverts is cobbles with some boulders - well rounded - Av size 5-12 inches.
Overbank base materials were generally finer firm soil to coarse gravel - 0.5 inches to 1 inch.
During the 100-year and SPF events it was assumed that the gabion baskets on the side slopes
will be exposed. N for the gabions was assumed to be 0.03.



Main Channel - Adjacent to Low Flow (n = 0.035)

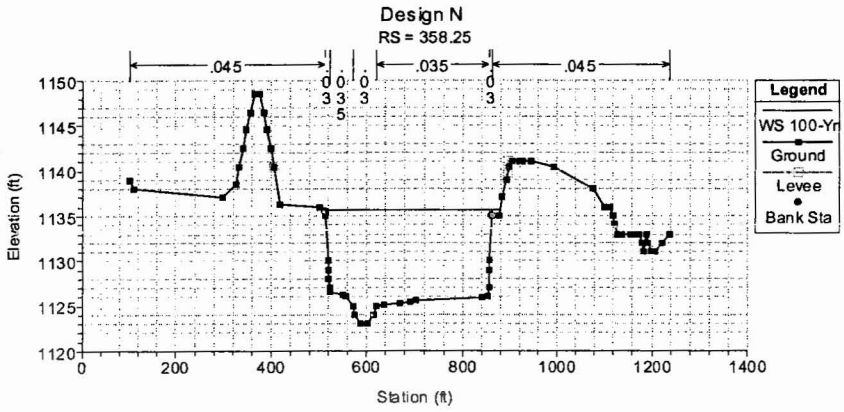
Note: Trees planted in invert shall be Cottonwood - (50' high x 30' wide at top of canopy), Gooding'sWillow (25'x20') and Sandbar Willow (15'x6')

Estimation of $n = (n_0+n_1+n_2+n_3+n_4)*m_5$					
No -Base N value					
Channel Materials	Bed Material Size	Benson & Dalrymple	Chow (1959)	Used	Comments
Concrete	-----	0.012-.018	0.011		
Rock Cut	-----	-----	0.025		
Firm Soil	-----	.025-.032	0.02		
Coarse Sand	-----	.026-.035	-----		
Fine Gravel	-----	-----	0.024		
Gravel	0.08-2.5	.028-.035	-----		
Coarse Gravel	-----	-----	0.028		
Cobble	2.5-10.0	.030-.050	-----	0.030	Base matrl. in the invert is cobbles and sm. boulders
Boulder	>10	.04-.071	-----		
N1 - Degree of Irregularity					
Effect			**Range**	**Used**	
Smooth-Smoothest Channel attainable in given bed material			0	NA	Gabion sides - very regular sides
Minor-Channels with slightly eroded or scoured side slopes			.001-.005	NA	
Moderate-Channels with moderately sloughed or eroded side slopes			.006-.010	NA	
Severe-Channels with badly sloughed banks; unshaped, jagged, and irregular surfaces of channels in rock.			.011-.020	NA	
N2 - Effect of Obstruction					
Effect			**Range**	**Used**	
Neglible -0 to 5% obstruction			.000-.004	0.001	Effect of obstructions are considered less in the
Minor-5-15% obstruction			.005-0.015		main channel since the depth of flow is deeper.
Appreciable-15-50% obstruction			0.02-.03		
Severe->50% obstruction			.04-.060		
N3 - Vegetation					
Effect			**Range**	**Used**	
Small-D_{flow}/D_{veg}>=2			0.002-.01	0.003	New tree planting has low density- Cottonwood & Sandb
Medium-1<D_{flow}/D_{veg}<2			.01-.025		Sandbar Willow.
Large-D_{flow}/D_{veg}<=1			.025-.05		
Very Large-D_{flow}/D_{veg}<=0.5			.05-.10		
N4 - Variations in Channel Cross Section					
Effect			**Range**	**Used**	
Gradual			0		
Alternating(Occasionally)			.0001-.005	0.001	
Alternaitng (Frequently)			.010-.015		
M5 - Meandering					
Effect			**Range**	**Used**	
Minor			1	1	
Appreciable			1.15		
Severe			1.3		

Recommended N =	0.035
Used =	0.035
Warning	None

Subject: N- Value estimation
Designer: K. Duffy
Date 4/1/2004

Notes: Channel base material in the inverts is cobbles with some boulders - well rounded - Av size 5-12 inches.
Overbank base materials were generally finer firm soil to coarse gravel - 0.5 inches to 1 inch.
During the 100-year and SPF events it was assumed that the gabion baskets on the side slopes
will be exposed. N for the gabions was assumed to be 0.03.



Main Channel - Low Flow (n = 0.030)

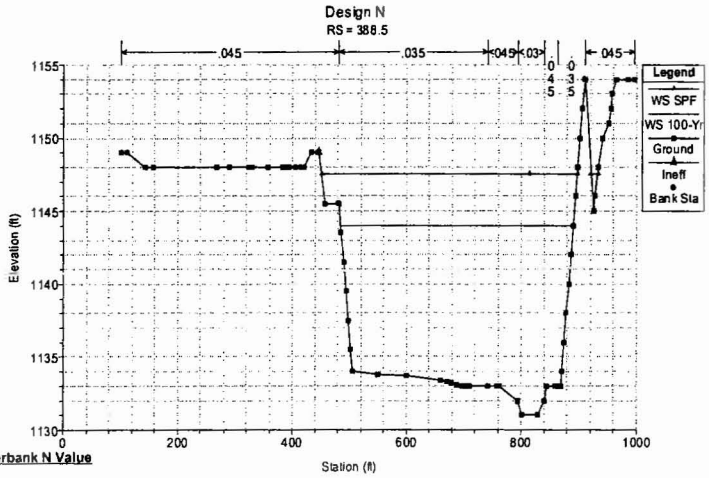
Note: Low flow shall generally have a clean bottom - e.g. cobbles and small boulders.

Estimation of $n = (n_0+n_1+n_2+n_3+n_4)*m_5$					
No -Base N value					
Channel Materials	Bed Material Size	Benson & Dalrymple	Chow (1959)	Used	Comments
Concrete	-----	0.012-.018	0.011		
Rock Cut	-----	-----	0.025		
Firm Soil	-----	.025-.032	0.02		
Coarse Sand	-----	.026-.035	-----		
Fine Gravel	-----	-----	0.024		
Gravel	0.08-2.5	.028-.035	-----		
Coarse Gravel	-----	-----	0.028		
Cobble	2.5-10.0	.030-.050	-----	0.030	Base matrl. in the invert is cobbles and sm. boulders
Boulder	>10	.04-.071	-----		
N1 - Degree of Irregularity					
Effect			**Range**	**Used**	
Smooth-Smoothest Channel attainable in given bed material			0	NA	Gabion sides - very regular sides
Minor-Channels with slightly eroded or scoured side slopes			.001-.005	NA	
Moderate-Channels with moderately sloughed or eroded side slopes			.006-.010	NA	
Severe-Channels with badly sloughed banks; unshaped, jagged, and irregular surfaces of channels in rock.			.011-.020	NA	
N2 - Effect of Obstruction					
Effect			**Range**	**Used**	
Neglible -0 to 5% obstruction			.000-.004	NA	Effect of obstructions are considered less in the
Minor-5-15% obstruction			.005-0.015	NA	main channel since the depth of flow is deeper.
Appreciable-15-50% obstruction			0.02-.03	NA	
Severe->50% obstruction			.04-.060	NA	
N3 - Vegetation					
Effect			**Range**	**Used**	
Small-D_{flow}/D_{veg}>=2			0.002-.01	NA	
Medium-1<D_{flow}/D_{veg}<2			.01-.025	NA	
Large-D_{flow}/D_{veg}<=1			.025-.05	NA	
Very Large-D_{flow}/D_{veg}<=0.5			.05-.10	NA	
N4 - Variations in Channel Cross Section					
Effect			**Range**	**Used**	
Gradual			0	NA	
Alternating(Occasionally)			.0001-.005	NA	
Alternating (Frequently)			.010-.015	NA	
M5 - Meandering					
Effect			**Range**	**Used**	
Minor			1	1	
Appreciable			1.15		
Severe			1.3		

Recommended N =	0.030
Used =	0.030
Warning	None

Subject: N- Value estimation
Designer: K. Duffy
Date 4/1/2004

Notes: Channel base material in the inverts is cobbles with some boulders - well rounded - Av size 5-12 inches. Overbank base materials were generally finer firm soil to coarse gravel - 0.5 inches to 1 inch. During the 100-year and SPF events it was assumed that the gabion baskets on the side slopes will be exposed. N for the gabions was assumed to be 0.03.



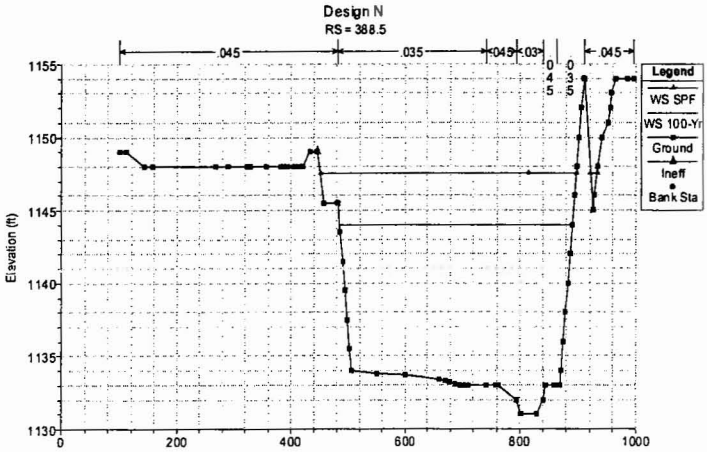
Overbank N Value

Estimation of $n = (n_b + n_1 + n_2 + n_3 + n_4) * m_5$					
No -Base N value					
Channel Materials	**Bed Material Size**	**Benson & Dalrymple**	**Chow (1959)**	**Used**	**Comments**
Concrete	-----	0.012-.018	0.011		
Rock Cut	-----	-----	0.025		
Firm Soil	-----	.025-.032	0.02	0.020	Finer surface soils on overbank (.5" to 2")
Coarse Sand	-----	.026-.035	-----		
Fine Gravel	-----	-----	0.024		
Gravel	0.08-2.5	.028-.035	-----		
Coarse Gravel	-----	-----	0.028		
Cobble	2.5-10.0	.030-.050	-----		
Boulder	>10	.04-.071	-----		
N1 - Degree of Irregularity					
Effect			**Range**	**Used**	
Smooth-Smoothest Channel attainable in given bed material			0	NA	
Minor-Channels with slightly eroded or scoured side slopes			.001-.005	NA	
Moderate-Channels with moderately sloughed or eroded side slopes			.006-.010	NA	
Severe-Channels with badly sloughed banks; unshaped, jagged, and irregular surfaces of channels in rock.			.011-.020	NA	
N2 - Effect of Obstruction					
Effect			**Range**	**Used**	
Neglible -0 to 5% obstruction			.000-.004	0.004	Some small stumps and concrete debris
Minor-5-15% obstruction			.005-0.015		
Appreciable-15-50% obstruction			0.02-.03		
Severe->50% obstruction			.04-.060		
N3 - Vegetation					
Effect			**Range**	**Used**	
Small-D_{flow}/D_{veg}>=2			0.002-.01		
Medium-1<D_{flow}/D_{veg}<2			.01-.025	0.02	Existing Mesquite, Palo Verde and cactus'
Large-D_{flow}/D_{veg}<=1			.025-.05		
Very Large-D_{flow}/D_{veg}<=0.5			.05-.10		
N4 - Variations in Channel Cross Section					
Effect			**Range**	**Used**	
Gradual			0		
Alternating(Occasionally)			.0001-.005	0.001	
Alternaltng (Frequently)			.010-.015		
M5 - Meandering					
Effect			**Range**	**Used**	
Minor			1	1	
Appreciable			1.15		
Severe			1.3		

Recommended N =	0.045
Used =	0.045
Warning	None

Subject: N- Value estimation
Designer: K. Duffy
Date 4/1/2004

Notes: Channel base material in the inverts is cobbles with some boulders - well rounded - Av size 5-12 inches. Overbank base materials were generally finer firm soil to coarse gravel - 0.5 inches to 1 inch. During the 100-year and SPF events it was assumed that the gabion baskets on the side slopes will be exposed. N for the gabions was assumed to be 0.03.



Main Channel - Main Channel 1% slope to Low Flow (n = 0.035)

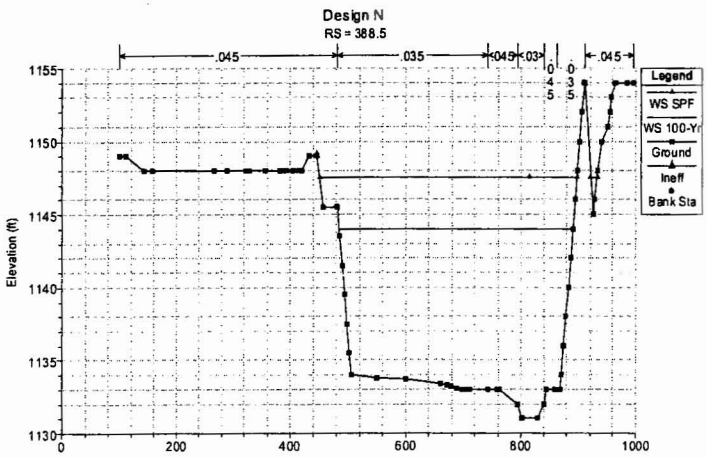
Note: Trees planted in invert shall be Cottonwood - (50' high x 30' wide at top of canopy), Gooding'sWillow (25'x20') and Sandbar Willow (15'x6')

Estimation of n $=(n_b+n_1+n_2+n_3+n_4)*m_5$					
No -Base N value					
Channel Materials	Bed Material Size	Benson & Dalrymple	Chow (1959)	Used	Comments
Concrete	-----	0.012-.018	0.011		
Rock Cut	-----	-----	0.025		
Firm Soil	-----	.025-.032	0.02		
Coarse Sand	-----	.026-.035	-----		
Fine Gravel	-----	-----	0.024		
Gravel	0.08-2.5	.028-.035	-----		
Coarse Gravel	-----	-----	0.028		
Cobble	2.5-10.0	.030-.050	-----	0.030	Base matrl. in the invert is cobbles and sm. boulders
Boulder	>10	.04-.071	-----		
N1 - Degree of Irregularity					
Effect			**Range**	**Used**	
Smooth-Smoothest Channel attainable in given bed material			0	0.001	
Minor-Channels with slightly eroded or scoured side slopes			.001-.005		
Moderate-Channels with moderately sloughed or eroded side slopes			.006-.010		
Severe-Channels with badly sloughed banks; unshaped, jagged, and irregular surfaces of channels in rock.			.011-.020		
N2 - Effect of Obstruction					
Effect			**Range**	**Used**	
Neglible -0 to 5% obstruction			.000-.004	0.001	Effect of obstructions are considered less in the
Minor-5-15% obstruction			.005-0.015		main channel since the depth of flow is deeper.
Appreciable-15-50% obstruction			0.02-.03		
Severe->50% obstruction			.04-.060		
N3 - Vegetation					
Effect			**Range**	**Used**	
Small-D_{flow}/D_{veg}>=2			0.002-.01	0.002	No trees - small shrubbery assumed to fold over
Medium-1<D_{flow}/D_{veg}<2			.01-.025		during large event
Large-D_{flow}/D_{veg}<=1			.025-.05		
Very Large-D_{flow}/D_{veg}<=0.5			.05-.10		
N4 - Variations in Channel Cross Section					
Effect			**Range**	**Used**	
Gradual			0		
Alternating(Occasionally)			.0001-.005	0.001	
Alternaitng (Frequently)			.010-.015		
M5 - Meandering					
Effect			**Range**	**Used**	
Minor			1	1	
Appreciable			1.15		
Severe			1.3		

Recommended N =	0.035
Used =	0.035
Warning	None

Subject: N- Value estimation
Designer: K. Duffy
Date 4/1/2004

Notes: Channel base material in the inverts is cobbles with some boulders - well rounded - Av size 5-12 inches. Overbank base materials were generally finer firm soil to coarse gravel - 0.5 inches to 1 inch. During the 100-year and SPF events it was assumed that the gabion baskets on the side slopes will be exposed. N for the gabions was assumed to be 0.03.



Main Channel - Main Channel Adjacent to Low Flow to Low Flow (n = 0.045)

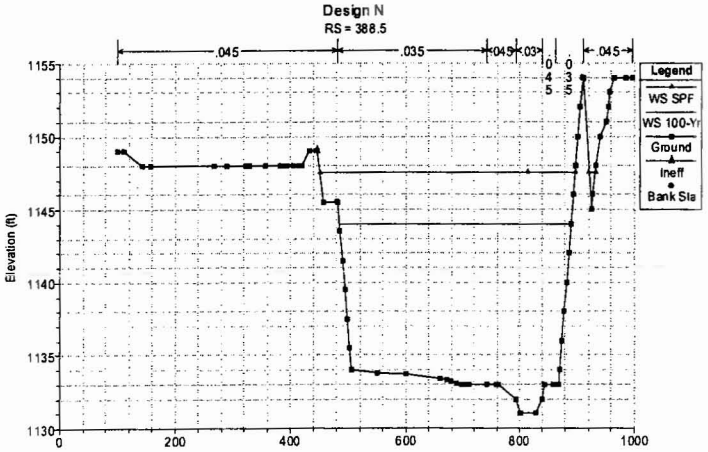
Note: Trees planted in invert shall be Cottonwood - (50' high x 30' wide at top of canopy), Gooding'sWillow (25'x20') and Sandbar Willow (15'x6')

Estimation of $n = (n_b + n_1 + n_2 + n_3 + n_4) * m_5$					
No -Base N value					
Channel Materials	Bed Material Size	Benson & Dalrymple	Chow (1959)	Used	Comments
Concrete	-----	0.012-.018	0.011		
Rock Cut	-----	-----	0.025		
Firm Soil	-----	.025-.032	0.02		
Coarse Sand	-----	.028-.035	-----		
Fine Gravel	-----	-----	0.024		
Gravel	0.08-2.5	.028-.035	-----		
Coarse Gravel	-----	-----	0.028		
Cobble	2.5-10.0	.030-.050	-----	0.030	Base matrl. in the invert is cobbles and sm. boulders
Boulder	>10	.04-.071	-----		
N1 - Degree of Irregularity					
Effect			**Range**	**Used**	
Smooth-Smoothest Channel attainable in given bed material			0	NA	Overbanks - sides not included - part of main channel
Minor-Channels with slightly eroded or scoured side slopes			.001-.005	NA	
Moderate-Channels with moderately sloughed or eroded side slopes			.006-.010	NA	
Severe-Channels with badly sloughed banks; unshaped, jagged, and irregular surfaces of channels in rock.			.011-.020	NA	
N2 - Effect of Obstruction					
Effect			**Range**	**Used**	
Neglible -0 to 5% obstruction			.000-.004	0.001	Effect of obstructions are considered less in the
Minor-5-15% obstruction			.005-0.015		main channel since the depth of flow is deeper.
Appreciable-15-50% obstruction			0.02-.03		
Severe->50% obstruction			.04-.060		
N3 - Vegetation					
Effect			**Range**	**Used**	
Small-D_{flow}/D_{veg}>=2			0.002-.01		
Medium-1<D_{flow}/D_{veg}<2			.01-.025	0.012	Low density of Cottonwoods, Gooding and Sandbar
Large-D_{flow}/D_{veg}<=1			.025-.05		Willows
Very Large-D_{flow}/D_{veg}<=0.5			.05-.10		
N4 - Variations in Channel Cross Section					
Effect			**Range**	**Used**	
Gradual			0	0	
Alternating(Occasionally)			.0001-.005		
Alternating (Frequently)			.010-.015		
M5 - Meandering					
Effect			**Range**	**Used**	
Minor			1	1	
Appreciable			1.15		
Severe			1.3		

Recommended N =	0.043
Used =	0.045
Warning	None

Subject: N- Value estimation
Designer: K. Duffy
Date 4/1/2004

Notes: Channel base material in the inverts is cobbles with some boulders - well rounded - Av size 5-12 inches. Overbank base materials were generally finer firm soil to coarse gravel - 0.5 inches to 1 inch. During the 100-year and SPF events it was assumed that the gabion baskets on the side slopes will be exposed. N for the gabions was assumed to be 0.03.



Main Channel - Low Flow (n = 0.030)

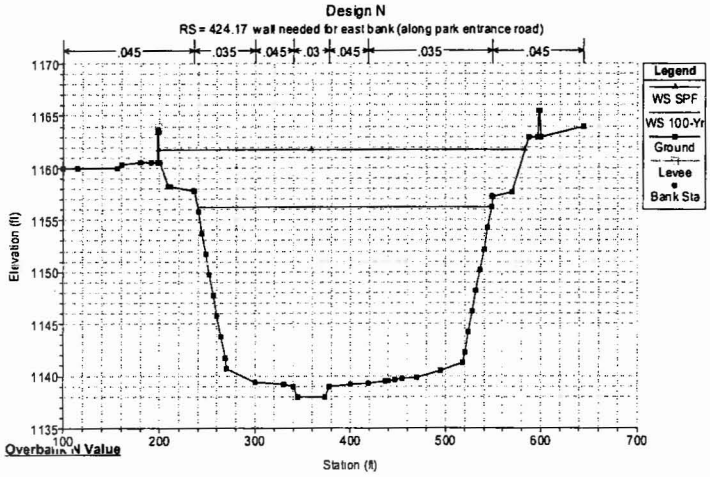
Note: Low flow shall generally have a clean bottom - e.g. cobbles and small boulders.

Estimation of $n = (n_b+n_1+n_2+n_3+n_4)*m_5$					
No -Base N value					
Channel Materials	**Bed Material Size**	**Benson & Dalrymple**	**Chow (1959)**	**Used**	**Comments**
Concrete	-----	0.012-.018	0.011		
Rock Cut	-----	-----	0.025		
Firm Soil	-----	.025-.032	0.02		
Coarse Sand	-----	.026-.035	-----		
Fine Gravel	-----	-----	0.024		
Gravel	0.08-2.5	.028-.035	-----		
Coarse Gravel	-----	-----	0.028		
Cobble	2.5-10.0	.030-.050	-----	0.030	Base matrl. in the invert is cobbles and sm. boulders
Boulder	>10	.04-.071	-----		
N1 - Degree of Irregularity					
Effect			**Range**	**Used**	
Smooth-Smoothest Channel attainable in given bed material			0	NA	Gabion sides - very regular sides
Minor-Channels with slightly eroded or scoured side slopes			.001-.005	NA	
Moderate-Channels with moderately sloughed or eroded side slopes			.006-.010	NA	
Severe-Channels with badly sloughed banks; unshaped, jagged, and irregular surfaces of channels in rock.			.011-.020	NA	
N2 - Effect of Obstruction					
Effect			**Range**	**Used**	
Neglible -0 to 5% obstruction			.000-.004	NA	Effect of obstructions are considered less in the
Minor-5-15% obstruction			.005-0.015	NA	main channel since the depth of flow is deeper.
Appreciable-15-50% obstruction			0.02-.03	NA	
Severe->50% obstruction			.04-.060	NA	
N3 - Vegetation					
Effect			**Range**	**Used**	
Small-D_{flow}/D_{veg}>=2			0.002-.01	NA	
Medium-1<D_{flow}/D_{veg}<2			.01-.025	NA	
Large-D_{flow}/D_{veg}<=1			.025-.05	NA	
Very Large-D_{flow}/D_{veg}<=0.5			.05-.10	NA	
N4 - Variations in Channel Cross Section					
Effect			**Range**	**Used**	
Gradual			0	NA	
Alternating(Occasionally)			.0001-.005	NA	
Alternaitng (Frequently)			.010-.015	NA	
M5 - Meandering					
Effect			**Range**	**Used**	
Minor			1	1	
Appreciable			1.15		
Severe			1.3		

Recommended N =	0.030
Used =	0.030
Warning	None

Subject: N- Value estimation
Designer: K. Duffy
Date 4/1/2004

Notes: Channel base material in the inverts is cobbles with some boulders - well rounded - Av size 5-12 inches. Overbank base materials were generally finer firm soil to coarse gravel - 0.5 inches to 1 inch. During the 100-year and SPF events it was assumed that the gabion baskets on the side slopes will be exposed. N for the gabions was assumed to be 0.03.



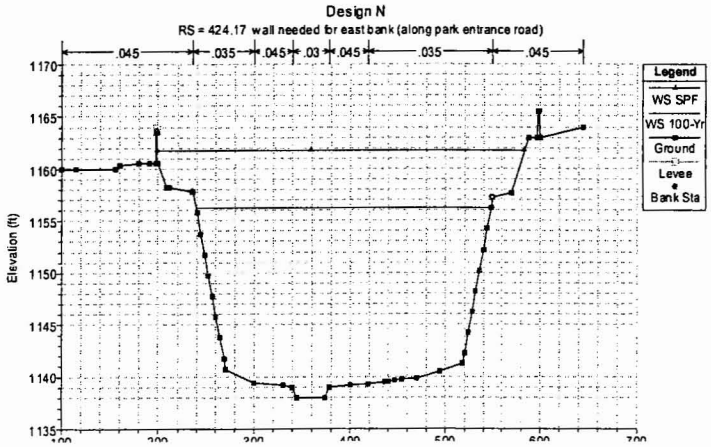
Overbank N Value

Estimation of n =(n_b+n_1+n_2+n_3+n_4)*m_5					
No -Base N value					
Channel Materials	**Bed Material Size**	**Benson & Dalrymple**	**Chow (1959)**	**Used**	**Comments**
Concrete	-----	0.012-.018	0.011		
Rock Cut	-----	-----	0.025		
Firm Soil	-----	.025-.032	0.02	0.020	Finer surface soils on overbank (.5" to 2")
Coarse Sand	-----	.026-.035	-----		
Fine Gravel	-----	-----	0.024		
Gravel	0.08-2.5	.028-.035	-----		
Coarse Gravel	-----	-----	0.028		
Cobble	2.5-10.0	.030-.050	-----		
Boulder	>10	.04-.071	-----		
N1 - Degree of Irregularity					
Effect			**Range**	**Used**	
Smooth-Smoothest Channel attainable in given bed material			0	NA	
Minor-Channels with slightly eroded or scoured side slopes			.001-.005	NA	
Moderate-Channels with moderately sloughed or eroded side slopes			.006-.010	NA	
Severe-Channels with badly sloughed banks; unshaped, jagged, and irregular surfaces of channels in rock.			.011-.020	NA	
N2 - Effect of Obstruction					
Effect			**Range**	**Used**	
Neglible -0 to 5% obstruction			.000-.004	0.004	some small stumps and concrete debris
Minor-5-15% obstruction			.005-0.015		
Appreciable-15-50% obstruction			0.02-.03		
Severe->50% obstruction			.04-.060		
N3 - Vegetation					
Effect			**Range**	**Used**	
Small-D_{flow}/D_{veg}>=2			0.002-.01		
Medium-1<D_{flow}/D_{veg}<2			.01-.025	0 02	Existing mesquite, Palo Verde and cactus'
Large-D_{flow}/D_{veg}<=1			.025-.05		
Very Large-D_{flow}/D_{veg}<=0.5			.05-.10		
N4 - Variations in Channel Cross Section					
Effect			**Range**	**Used**	
Gradual			0		
Alternating(Occasionally)			.0001-.005	0 001	
Alternaltng (Frequently)			.010-.015		
M5 - Meandering					
Effect			**Range**	**Used**	
Minor			1	1	
Appreciable			1.15		
Severe			1.3		

Recommended N =	0.045
Used =	0.045
Warning	None

Subject: N- Value estimation
Designer: K. Duffy
Date 4/1/2004

Notes: Channel base material in the inverts is cobbles with some boulders - well rounded - Av size 5-12 inches. Overbank base materials were generally finer firm soil to coarse gravel - 0.5 inches to 1 inch. During the 100-year and SPF events it was assumed that the gabion baskets on the side slopes will be exposed. N for the gabions was assumed to be 0.03.



Main Channel - Main Channel 1% slope to Low Flow (n = 0.035)

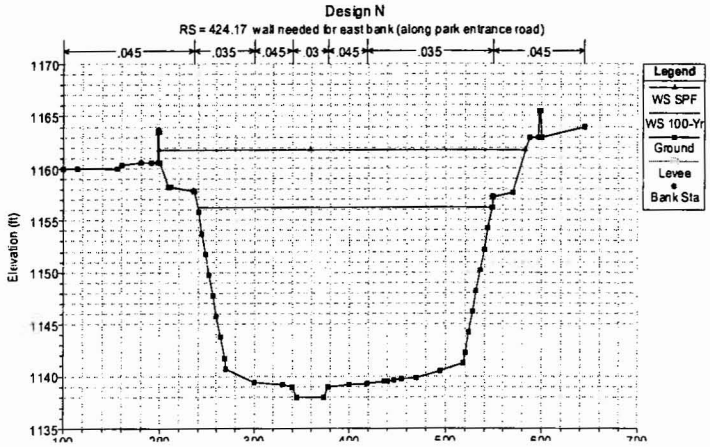
Note: Trees planted in invert shall be Cottonwood - (50' high x 30' wide at top of canopy), Gooding'sWillow (25'x20') and Sandbar Willow (15'x6')

Estimation of n $=(n_b+n_1+n_2+n_3+n_4)*m_5$					
No -Base N value					
Channel Materials	Bed Material Size	Benson & Dalrymple	Chow (1959)	Used	Comments
Concrete	-----	0.012-.018	0.011		
Rock Cut	-----	-----	0.025		
Firm Soil	-----	.025-.032	0.02		
Coarse Sand	-----	.026-.035	-----		
Fine Gravel	-----	-----	0.024		
Gravel	0.08-2.5	.028-.035	-----		
Coarse Gravel	-----	-----	0.028		
Cobble	2.5-10.0	.030-.050	-----	0.030	Base matrl. in the invert is cobbles and sm. boulders
Boulder	>10	.04-.071	-----		
N1 - Degree of Irregularity					
Effect			**Range**	**Used**	
Smooth-Smoothest Channel attainable in given bed material			0	0.001	
Minor-Channels with slightly eroded or scoured side slopes			.001-.005		
Moderate-Channels with moderately sloughed or eroded side slopes			.006-.010		
Severe-Channels with badly sloughed banks; unshaped, jagged, and irregular surfaces of channels in rock.			.011-.020		
N2 - Effect of Obstruction					
Effect			**Range**	**Used**	
Neglible -0 to 5% obstruction			.000-.004	0.001	Effect of obstructions are considered less in the
Minor-5-15% obstruction			.005-0.015		main channel since the depth of flow is deeper.
Appreciable-15-50% obstruction			0.02-.03		
Severe->50% obstruction			.04-.060		
N3 - Vegetation					
Effect			**Range**	**Used**	
Small-D_{flow}/D_{veg}>=2			0.002-.01	0.002	No trees - small shrubbery assumed to fold over
Medium-1<D_{flow}/D_{veg}<2			.01-.025		during large event
Large-D_{flow}/D_{veg}<=1			.025-.05		
Very Large-D_{flow}/D_{veg}<=0.5			.05-.10		
N4 - Variations In Channel Cross Section					
Effect			**Range**	**Used**	
Gradual			0		
Alternating(Occasionally)			.0001-.005	0.001	
Alternaitng (Frequently)			.010-.015		
M5 - Meandering					
Effect			**Range**	**Used**	
Minor			1	1	
Appreciable			1.15		
Severe			1.3		

Recommended N =	0.035
Used =	0.035
Warning	None

Subject: N- Value estimation
Designer: K. Duffy
Date 4/1/2004

Notes: Channel base material in the inverts is cobbles with some boulders - well rounded - Av size 5-12 inches. Overbank base materials were generally finer firm soil to coarse gravel - 0.5 inches to 1 inch. During the 100-year and SPF events it was assumed that the gabion baskets on the side slopes will be exposed. N for the gabions was assumed to be 0.03.



Main Channel - Main Channel Adjacent to Low Flow to Low Flow (n = 0.045)

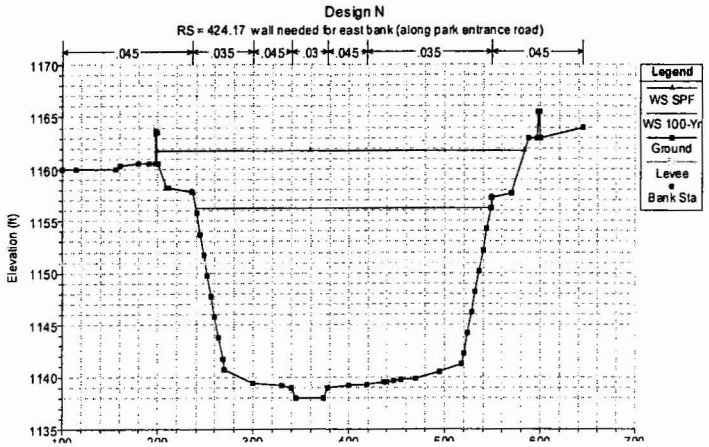
Note: Trees planted in invert shall be Cottonwood - (50' high x 30' wide at top of canopy), Gooding'sWillow (25'x20') and Sandbar Willow (15'x6')

Estimation of n $=(n_b+n_1+n_2+n_3+n_4)*m_5$					
No -Base N value					
Channel Materials	Bed Material Size	Benson & Dalrymple	Chow (1959)	Used	Comments
Concrete	-----	0.012-.018	0.011		
Rock Cut	-----	-----	0.025		
Firm Soil	-----	.025-.032	0.02		
Coarse Sand	-----	.026-.035	-----		
Fine Gravel	-----	-----	0.024		
Gravel	0.08-2.5	.028-.035	-----		
Coarse Gravel	-----	-----	0.028		
Cobble	2.5-10.0	.030-.050	-----	0.030	Base matrl. in the invert is cobbles and sm. boulders
Boulder	>10	.04-.071	-----		
N1 - Degree of Irregularity					
Effect			**Range**	**Used**	
Smooth-Smoothest Channel attainable in given bed material			0	NA	Overbanks - sides not included - part of main channel
Minor-Channels with slightly eroded or scoured side slopes			.001-.005	NA	
Moderate-Channels with moderately sloughed or eroded side slopes			.006-.010	NA	
Severe-Channels with badly sloughed banks; unshaped, jagged, and irregular surfaces of channels in rock.			.011-.020	NA	
N2 - Effect of Obstruction					
Effect			**Range**	**Used**	
Neglible -0 to 5% obstruction			.000-.004	0.001	Effect of obstructions are considered less in the
Minor-5-15% obstruction			.005-0.015		main channel since the depth of flow is deeper.
Appreciable-15-50% obstruction			0.02-.03		
Severe->50% obstruction			.04-.060		
N3 - Vegetation					
Effect			**Range**	**Used**	
Small-D_{flow}/D_{veg}>=2			0.002-.01		
Medium-1<D_{flow}/D_{veg}<2			.01-.025	0.012	Low density of Cottonwoods, Gooding and Sandbar
Large-D_{flow}/D_{veg}<=1			.025-.05		Willows
Very Large-D_{flow}/D_{veg}<=0.5			.05-.10		
N4 - Variations In Channel Cross Section					
Effect			**Range**	**Used**	
Gradual			0	0	
Alternating(Occasionally)			.0001-.005		
Alternating (Frequently)			.010-.015		
M5 - Meandering					
Effect			**Range**	**Used**	
Minor			1	1	
Appreciable			1.15		
Severe			1.3		

Recommended N =	0.043
Used =	0.045
Warning	None

Subject: N- Value estimation
Designer: K. Duffy
Date 4/1/2004

Notes: Channel base material in the inverts is cobbles with some boulders - well rounded - Av size 5-12 inches. Overbank base materials were generally finer firm soil to coarse gravel - 0.5 inches to 1 inch. During the 100-year and SPF events it was assumed that the gabion baskets on the side slopes will be exposed. N for the gabions was assumed to be 0.03.



Main Channel - Low Flow (n = 0.030)

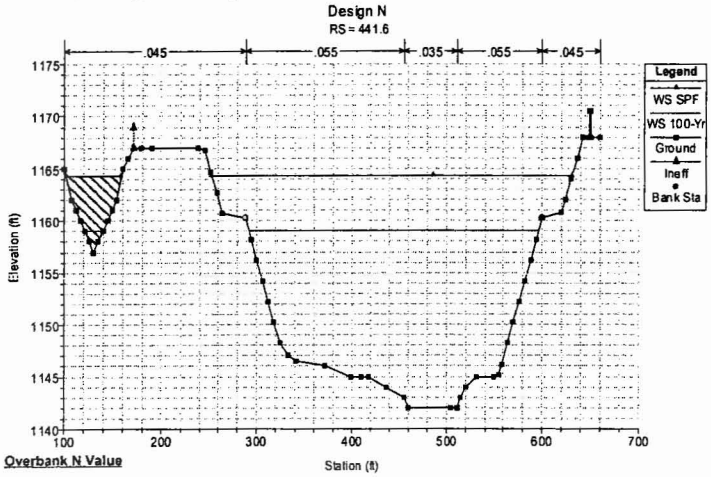
Note: Low flow shall generally have a clean bottom - e.g. cobbles and small boulders.

Estimation of $n = (n_0+n_1+n_2+n_3+n_4)*m_5$					
No -Base N value					
Channel Materials	Bed Material Size	Benson & Dalrymple	Chow (1959)	Used	Comments
Concrete	-----	0.012-.018	0.011		
Rock Cut	-----	-----	0.025		
Firm Soil	-----	.025-.032	0.02		
Coarse Sand	-----	.026-.035	-----		
Fine Gravel	-----	-----	0.024		
Gravel	0.08-2.5	.028-.035	-----		
Coarse Gravel	-----	-----	0.028		
Cobble	2.5-10.0	.030-.050	-----	0.030	Base matrl. in the invert is cobbles and sm. boulders
Boulder	>10	.04-.071	-----		
N1 - Degree of Irregularity					
Effect			**Range**	**Used**	
Smooth-Smoothest Channel attainable in given bed material			0	NA	Gabion sides - very regular sides
Minor-Channels with slightly eroded or scoured side slopes			.001-.005	NA	
Moderate-Channels with moderately sloughed or eroded side slopes			.006-.010	NA	
Severe-Channels with badly sloughed banks; unshaped, jagged, and irregular surfaces of channels in rock.			.011-.020	NA	
N2 - Effect of Obstruction					
Effect			**Range**	**Used**	
Neglible -0 to 5% obstruction			.000-.004	NA	Effect of obstructions are considered less in the
Minor-5-15% obstruction			.005-0.015	NA	main channel since the depth of flow is deeper.
Appreciable-15-50% obstruction			0.02-.03	NA	
Severe->50% obstruction			.04-.060	NA	
N3 - Vegetation					
Effect			**Range**	**Used**	
Small-D_{flow}/D_{veg}>=2			0.002-.01	NA	
Medium-1<D_{flow}/D_{veg}<2			.01-.025	NA	
Large-D_{flow}/D_{veg}<=1			.025-.05	NA	
Very Large-D_{flow}/D_{veg}<=0.5			.05-.10	NA	
N4 - Variations in Channel Cross Section					
Effect			**Range**	**Used**	
Gradual			0	NA	
Alternating(Occasionally)			.0001-.005	NA	
Alternaitng (Frequently)			.010-.015	NA	
M5 - Meandering					
Effect			**Range**	**Used**	
Minor			1	1	
Appreciable			1.15		
Severe			1.3		

Recommended N =	0.030
Used =	0.030
Warning	None

Subject: N- Value estimation
Designer: K. Duffy
Date 4/1/2004

Notes: Channel base material in the inverts is cobbles with some boulders - well rounded - Av size 5-12 inches. Overbank base materials were generally finer firm soil to coarse gravel - 0.5 inches to 1 inch. During the 100-year and SPF events it was assumed that the gabion baskets on the side slopes will be exposed. N for the gabions was assumed to be 0.03.



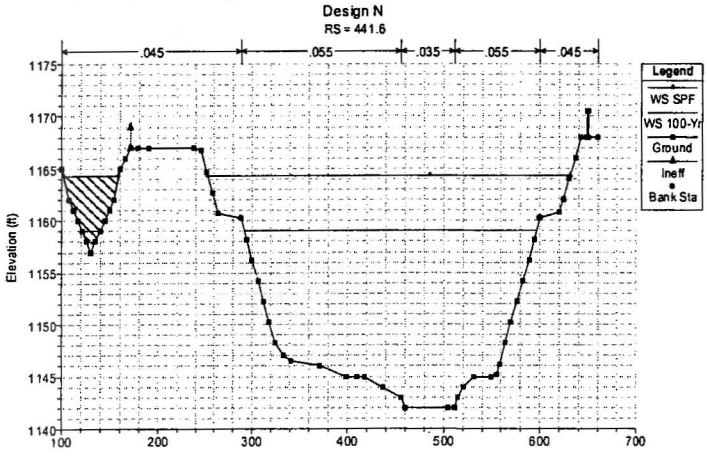
Overbank N Value

Estimation of $n = (n_0+n_1+n_2+n_3+n_4)*m_5$					
No -Base N value					
Channel Materials	**Bed Material Size**	**Benson & Dalrymple**	**Chow (1959)**	**Used**	**Comments**
Concrete	-----	0.012-.018	0.011		
Rock Cut	-----	-----	0.025		
Firm Soil	-----	.025-.032	0.02	0.020	Finer surface soils on overbank (5" to 2")
Coarse Sand	-----	.026-.035	-----		
Fine Gravel	-----	-----	0.024		
Gravel	0.08-2.5	.028-.035	-----		
Coarse Gravel	-----	-----	0.028		
Cobble	2.5-10.0	.030-.050	-----		
Boulder	>10	.04-.071	-----		
N1 - Degree of Irregularity					
Effect			**Range**	**Used**	
Smooth-Smoothest Channel attainable in given bed material			0	NA	
Minor-Channels with slightly eroded or scoured side slopes			.001-.005	NA	
Moderate-Channels with moderately sloughed or eroded side slopes			.006-.010	NA	
Severe-Channels with badly sloughed banks; unshaped, jagged, and irregular surfaces of channels in rock.			.011-.020	NA	
N2 - Effect of Obstruction					
Effect			**Range**	**Used**	
Neglible -0 to 5% obstruction			.000-.004	0.004	some small stumps and concrete debris
Minor-5-15% obstruction			.005-0.015		
Appreciable-15-50% obstruction			0.02-.03		
Severe->50% obstruction			.04-.060		
N3 - Vegetation					
Effect			**Range**	**Used**	
Small-D_{flow}/D_{veg}>=2			0.002-.01		
Medium-1<D_{flow}/D_{veg}<2			.01-.025	0.02	Existing mesquite, Palo Verde and cactus'
Large-D_{flow}/D_{veg}<=1			.025-.05		
Very Large-D_{flow}/D_{veg}<=0.5			.05-.10		
N4 - Variations in Channel Cross Section					
Effect			**Range**	**Used**	
Gradual			0		
Alternating(Occasionally)			.0001-.005	0.001	
Alternaitng (Frequently)			.010-.015		
M5 - Meandering					
Effect			**Range**	**Used**	
Minor			1	1	
Appreciable			1.15		
Severe			1.3		

Recommended N =	0.045
Used =	0.045
Warning	None

Subject: N- Value estimation
Designer: K. Duffy
Date 4/1/2004

Notes: Channel base material in the inverts is cobbles with some boulders - well rounded - Av size 5-12 inches. Overbank base materials were generally finer firm soil to coarse gravel - 0.5 inches to 1 inch. During the 100-year and SPF events it was assumed that the gabion baskets on the side slopes will be exposed. N for the gabions was assumed to be 0.03.



Main Channel - Main Channel 1% slope adjacent to Low Flow (n = 0.055)

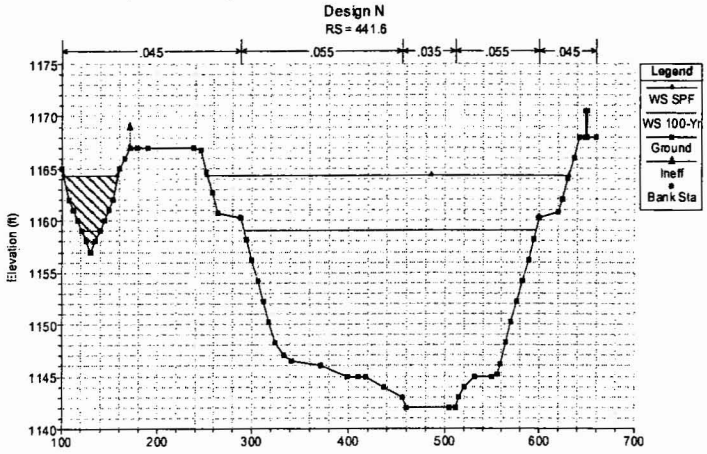
Note: Trees planted in invert shall be Cottonwood - (50' high x 30' wide at top of canopy), Gooding'sWillow (25'x20') and Sandbar Willow (15'x6')

Estimation of $n = (n_b+n_1+n_2+n_3+n_4)*m_5$					
No -Base N value					
Channel Materials	Bed Material Size	Benson & Dalrymple	Chow (1959)	Used	Comments
Concrete	-----	0.012-.018	0.011		
Rock Cut	-----	-----	0.025		
Firm Soil	-----	.025-.032	0.02		
Coarse Sand	-----	.026-.035	-----		
Fine Gravel	-----	-----	0.024		
Gravel	0.08-2.5	.028-.035	-----		
Coarse Gravel	-----	-----	0.028		
Cobble	2.5-10.0	.030-.050	-----	0.030	Base matrl. in the invert is cobbles and sm. boulders
Boulder	>10	.04-.071	-----		
N1 - Degree of Irregularity					
Effect			**Range**	**Used**	
Smooth-Smoothest Channel attainable in given bed material			0	0.001	
Minor-Channels with slightly eroded or scoured side slopes			.001-.005		
Moderate-Channels with moderately sloughed or eroded side slopes			.006-.010		
Severe-Channels with badly sloughed banks; unshaped, jagged, and irregular surfaces of channels in rock.			.011-.020		
N2 - Effect of Obstruction					
Effect			**Range**	**Used**	
Neglible -0 to 5% obstruction			.000-.004	0.001	Effect of obstructions are considered less in the
Minor-5-15% obstruction			.005-0.015		main channel since the depth of flow is deeper.
Appreciable-15-50% obstruction			0.02-.03		
Severe->50% obstruction			.04-.060		
N3 - Vegetation					
Effect			**Range**	**Used**	
Small-D_{flow}/D_{veg}>=2			0.002-.01	0 002	No trees - small shrubbery assumed to fold over
Medium-1<D_{flow}/D_{veg}<2			.01-.025		during large event
Large-D_{flow}/D_{veg}<=1			.025-.05		
Very Large-D_{flow}/D_{veg}<=0.5			.05-.10		
N4 - Variations in Channel Cross Section					
Effect			**Range**	**Used**	
Gradual			0		
Alternating(Occasionally)			.0001-.005	0.001	
Alternaitng (Frequently)			.010-.015		
M5 - Meandering					
Effect			**Range**	**Used**	
Minor			1	1	
Appreciable			1.15		
Severe			1.3		

Recommended N =	0.035
Used =	0.055
Warning	None

Subject: N- Value estimation
Designer: K. Duffy
Date 4/1/2004

Notes: Channel base material in the inverts is cobbles with some boulders - well rounded - Av size 5-12 inches. Overbank base materials were generally finer firm soil to coarse gravel - 0.5 inches to 1 inch. During the 100-year and SPF events it was assumed that the gabion baskets on the side slopes will be exposed. N for the gabions was assumed to be 0.03.

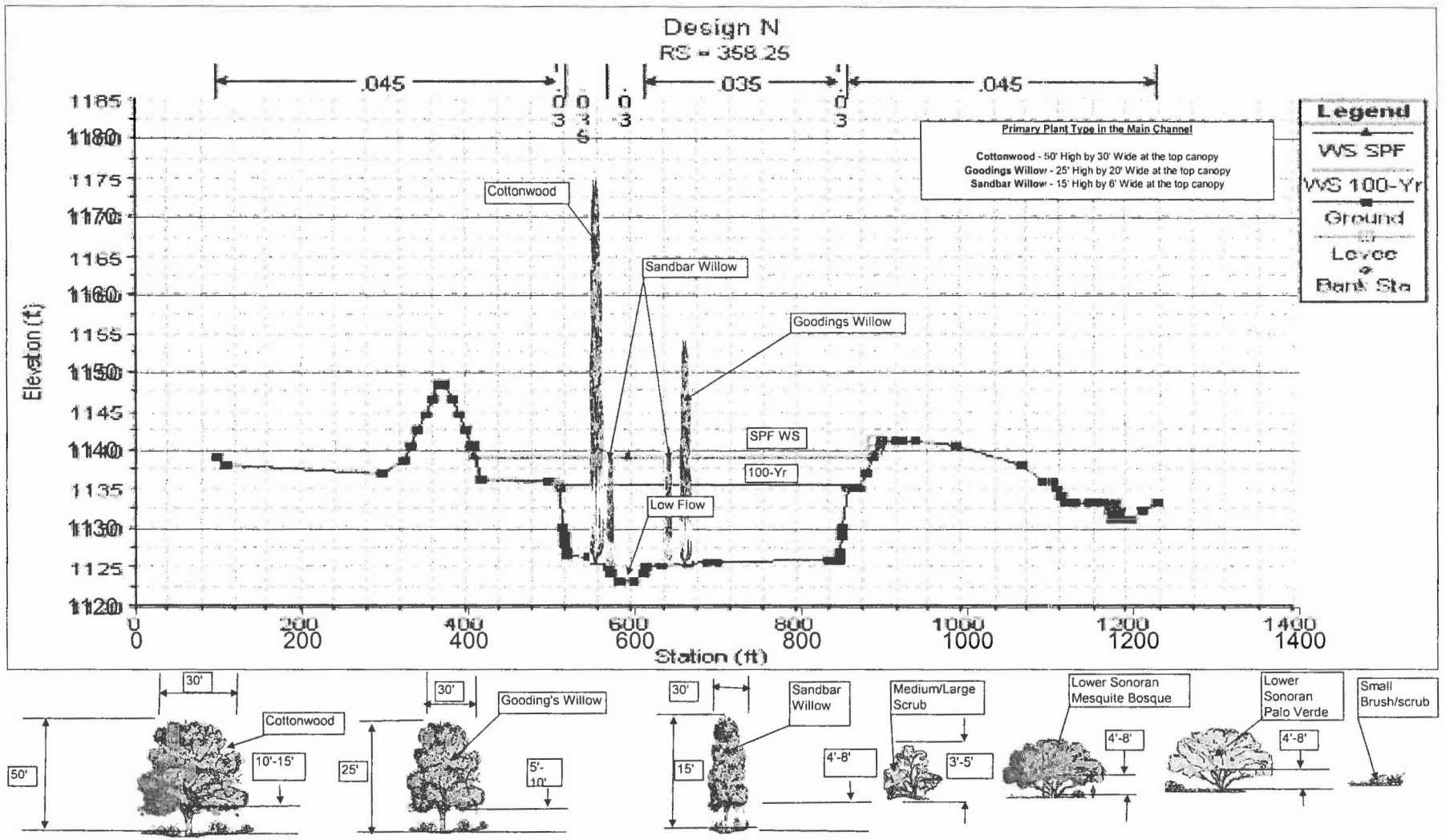


Main Channel - Low Flow (n = 0.035)

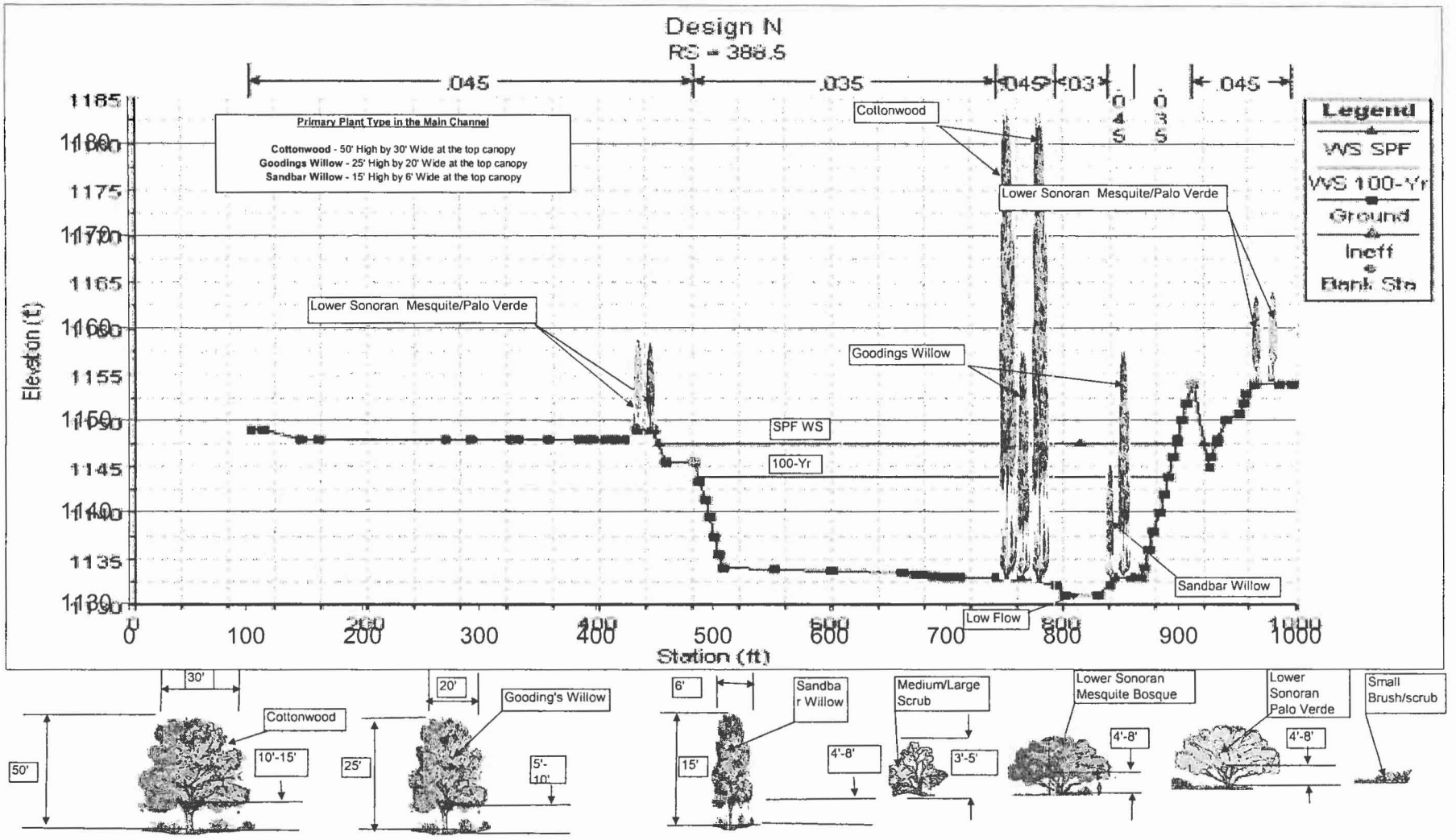
Note: Low flow shall generally have a clean bottom - e.g. cobbles and small boulders.

Estimation of $n = (n_b+n_1+n_2+n_3+n_4)*m_5$					
No -Base N value					
Channel Materials	Bed Material Size	Benson & Dalrymple	Chow (1959)	Used	Comments
Concrete	-----	0.012-.018	0.011		
Rock Cut	-----	-----	0.025		
Firm Soil	-----	.025-.032	0.02		
Coarse Sand	-----	.026-.035	-----		
Fine Gravel	-----	-----	0.024		
Gravel	0.08-2.5	.028-.035	-----		
Coarse Gravel	-----	-----	0.028		
Cobble	2.5-10.0	.030-.050	-----	0.030	Base matrl. in the invert is cobbles and sm. Boulders
Boulder	>10	.04-.071	-----		
N1 - Degree of Irregularity					
Effect			**Range**	**Used**	
Smooth-Smoothest Channel attainable in given bed material			0	NA	Gabion sides - very regular sides
Minor-Channels with slightly eroded or scoured side slopes			.001-.005	NA	
Moderate-Channels with moderately sloughed or eroded side slopes			.006-.010	NA	
Severe-Channels with badly sloughed banks; unshaped, jagged, and irregular surfaces of channels in rock.			.011-.020	NA	
N2 - Effect of Obstruction					
Effect			**Range**	**Used**	
Neglible -0 to 5% obstruction			.000-.004	NA	Effect of obstructions are considered less in the
Minor-5-15% obstruction			.005-0.015	NA	main channel since the depth of flow is deeper.
Appreciable-15-50% obstruction			0.02-.03	NA	
Severe->50% obstruction			.04-.060	NA	
N3 - Vegetation					
Effect			**Range**	**Used**	
Small-D_{flow}/D_{veg}>=2			0.002-.01	0.005	Minor shrubs
Medium-1<D_{flow}/D_{veg}<2			.01-.025		
Large-D_{flow}/D_{veg}<=1			.025-.05		
Very Large-D_{flow}/D_{veg}<=0.5			.05-.10		
N4 - Variations in Channel Cross Section					
Effect			**Range**	**Used**	
Gradual			0	NA	
Alternating(Occasionally)			.0001-.005	NA	
Alternaitng (Frequently)			.010-.015	NA	
M5 - Meandering					
Effect			**Range**	**Used**	
Minor			1	1	
Appreciable			1.15		
Severe			1.3		

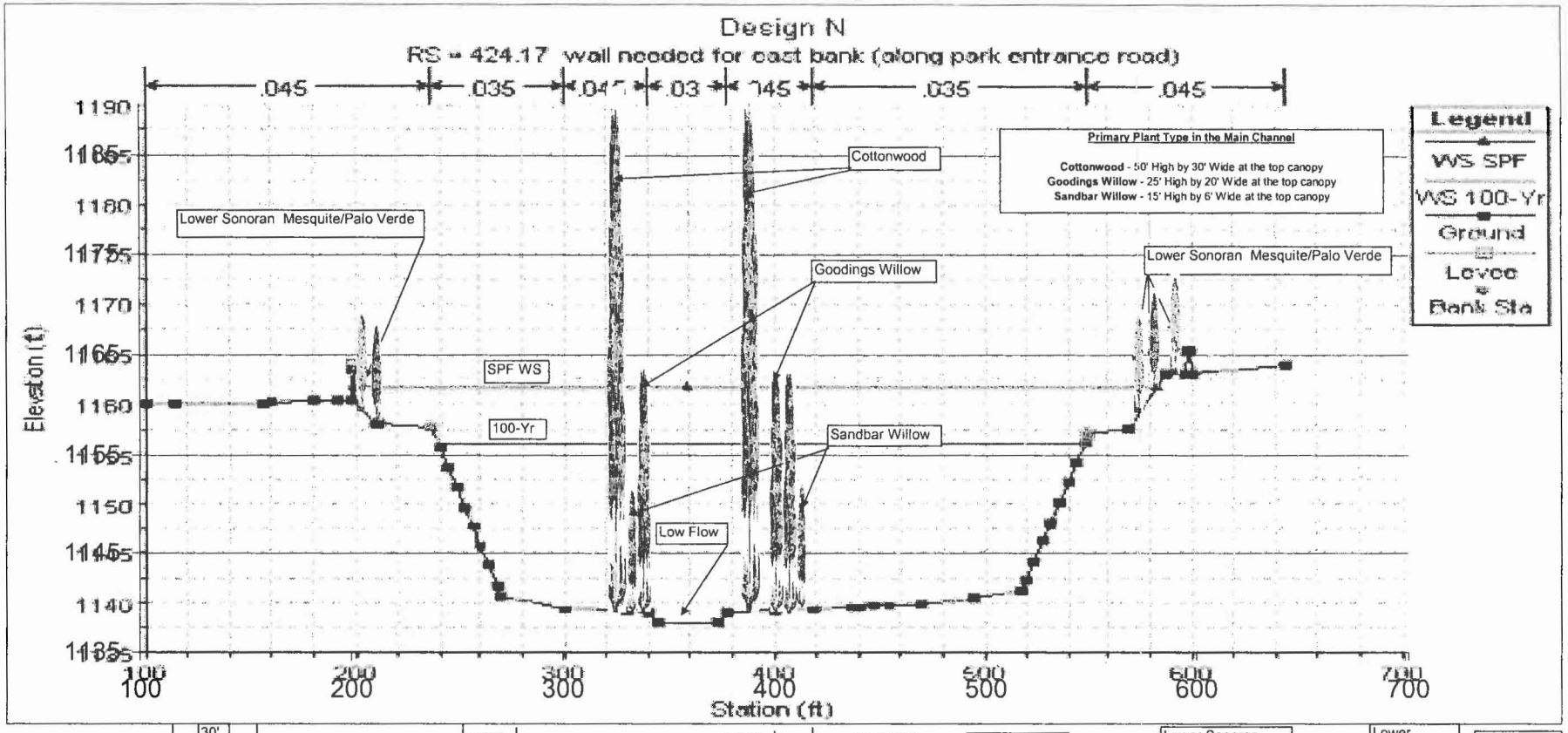
Recommended N =	0.035
Used =	0.035
Warning	None

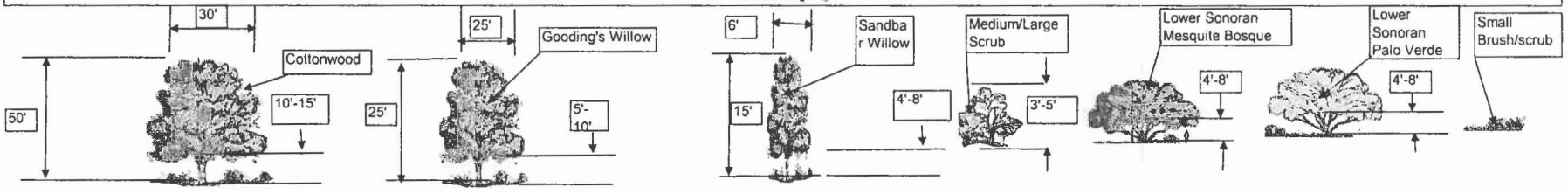

Design N
RS = 358.25
.045
.035
.045
Primary Plant Type in the Main Channel
Cottonwood - 50' High by 30' Wide at the top canopy
Goodings Willow - 25' High by 20' Wide at the top canopy
Sandbar Willow - 15' High by 6' Wide at the top canopy
Legend
WS SPF
WS 100-Yr
Ground
Levee
Bank Sta
Cottonwood
Sandbar Willow
Goodings Willow
SPF WS
100-Yr
Low Flow
Elevation (ft)
Station (ft)
1185
1180
1175
1170
1165
1160
1155
1150
1145
1140
1135
1130
1125
1120
0
200
400
600
800
1000
1200
1400

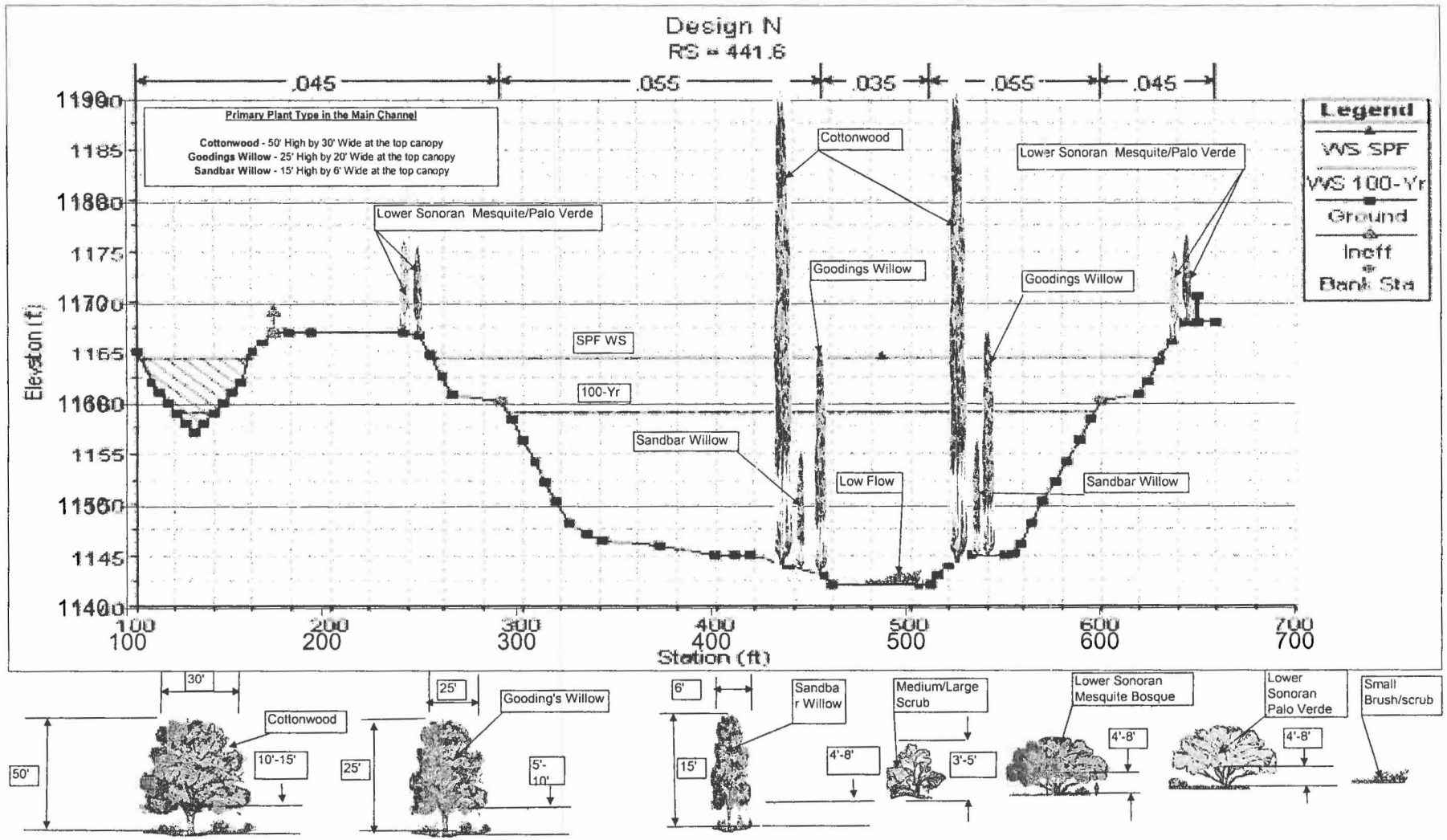
30'
Cottonwood
50'
10'-15'
30'
Gooding's Willow
25'
5'-10'
30'
Sandbar Willow
15'
4'-8'
Medium/Large Scrub
3'-5'
Lower Sonoran Mesquite Bosque
4'-8'
Lower Sonoran Palo Verde
4'-8'
Small Brush/scrub


Design N
RS = 388.5
.045
.035
.045
.03
.045
Primary Plant Type in the Main Channel
Cottonwood - 50' High by 30' Wide at the top canopy
Goodings Willow - 25' High by 20' Wide at the top canopy
Sandbar Willow - 15' High by 6' Wide at the top canopy
Cottonwood
Lower Sonoran Mesquite/Palo Verde
Lower Sonoran Mesquite/Palo Verde
Goodings Willow
SPF WS
100-Yr
Sandbar Willow
Low Flow
Legend
WS SPF
WS 100-Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
1185
1180
1175
1170
1165
1160
1155
1150
1145
1140
1135
1130
0
100
200
300
400
500
600
700
800
900
1000

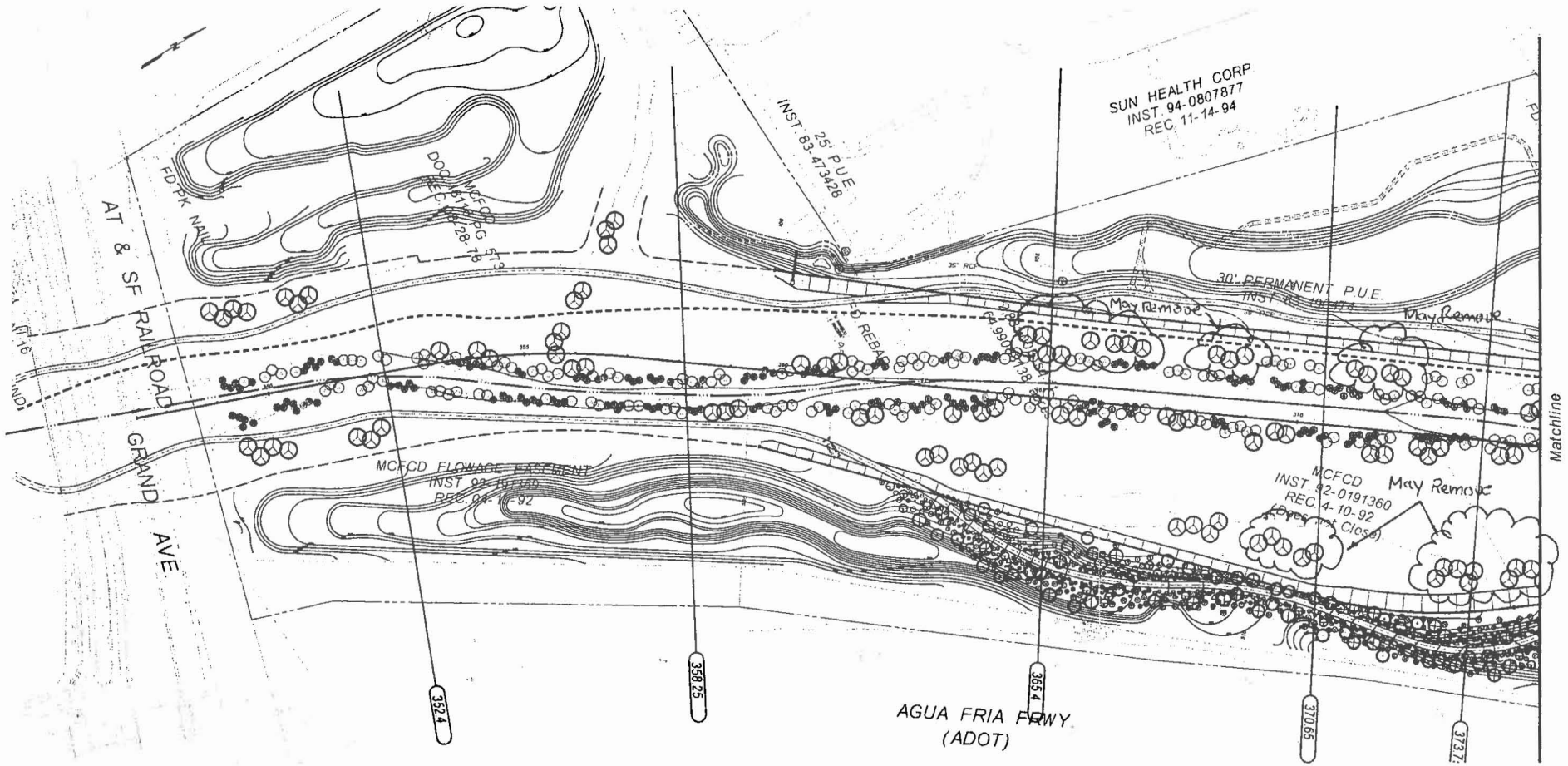
30'
50'
Cottonwood
10'-15'
20'
25'
Gooding's Willow
5'-10'
6'
15'
Sandbar Willow
4'-8'
Medium/Large Scrub
3'-5'
Lower Sonoran Mesquite Bosque
4'-8'
Lower Sonoran Palo Verde
4'-8'
Small Brush/scrub


Design N
RS = 424.17 wall needed for east bank (along park entrance road)
.045
.035
.03
.035
.045
Primary Plant Type in the Main Channel
Cottonwood - 50' High by 30' Wide at the top canopy
Goodings Willow - 25' High by 20' Wide at the top canopy
Sandbar Willow - 15' High by 6' Wide at the top canopy
Legend
WS SPF
WS 100-Yr
Ground
Levee
Bank Sta
Cottonwood
Lower Sonoran Mesquite/Palo Verde
Goodings Willow
Lower Sonoran Mesquite/Palo Verde
SPF WS
100-Yr
Sandbar Willow
Low Flow
Elevation (ft)
Station (ft)


30'
50'
Cottonwood
10'-15'
25'
25'
Gooding's Willow
5'-10'
6'
15'
Sandbar Willow
4'-8'
Medium/Large Scrub
3'-5'
Lower Sonoran Mesquite Bosque
4'-8'
Lower Sonoran Palo Verde
4'-8'
Small Brush/scrub


Design N
RS = 441.6
.045
.055
.035
.055
.045
Primary Plant Type in the Main Channel
Cottonwood - 50' High by 30' Wide at the top canopy
Goodings Willow - 25' High by 20' Wide at the top canopy
Sandbar Willow - 15' High by 6' Wide at the top canopy
Lower Sonoran Mesquite/Palo Verde
Cottonwood
Goodings Willow
Lower Sonoran Mesquite/Palo Verde
Goodings Willow
SPF WS
100-Yr
Sandbar Willow
Low Flow
Sandbar Willow
Legend
WS SPF
WS 100-Yr
Ground
Ineff
Bank Sta
Elevation (ft)
1190
1185
1180
1175
1170
1165
1160
1155
1150
1145
1140
100
200
300
400
500
600
700
Station (ft)

30'
50'
Cottonwood
10'-15'
25'
25'
Gooding's Willow
5'-10'
6'
15'
Sandbar Willow
4'-8'
Medium/Large Scrub
3'-5'
Lower Sonoran Mesquite Bosque
4'-8'
Lower Sonoran Palo Verde
4'-8'
Small Brush/scrub



NOTE:
TREES IN THE OVERBANK AREAS WILL HAVE CANOPIES ABOVE THE SPF WSEL IT IS ASSUMED THE TREES IN THE OVERBANKS WILL HAVE TRUNKS OF 1 FOOT DIAMTER THE SHRUBS MATERIAL WILL NOT EXCEED 5'X5' AND THE AVERAGE WILL BE 3'X3'.

50 0 50 100
Scale in Feet

MAIN CHANNEL PLANTING

BOTANICAL NAME	COMMON NAME	DIMMENSION (HxW)	AREA (SQ.FT)
POPULUS FREMONTII	COTTONWOOD	50'X30'	750 SQ.FT
SALIX EXIGUA	SANDBAR WILLOW	15'X6'	45 SQ.FT
SALIX GOODDINGII	GOODDING'S WILLOW	25'X20'	250 SQ.FT

NO.	REVISION	BY	DATE
3			
2			
1			

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
ENGINEERING DIVISION

NEW RIVER - GRAND AVENUE TO SKUNK CREEK
PROJECT NUMBER
FCD2003C001

		BY	DATE
PRELIMINARY NOT FOR CONSTRUCTION	DESIGNED	KD	12-03
	DRAWN	KD	12-03
	CHECKED	JH	12-03

J2 engineering and environmental design
8222 south 48th street, suite 135
phoenix, arizona 85044 phone 602 438 2221

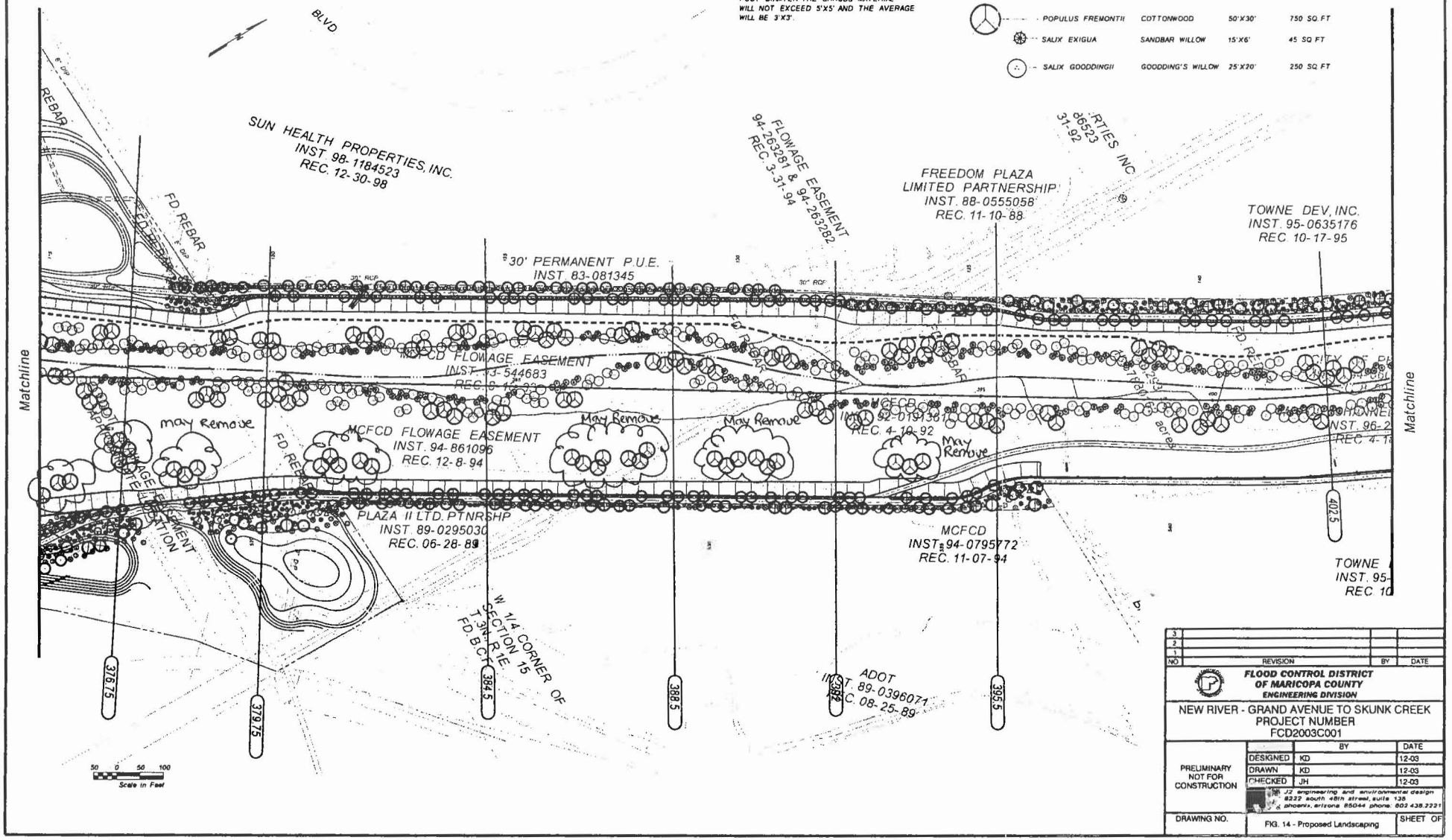
DRAWING NO. | FIG. 13 - Proposed Planting | SHEET OF

...\Proposed Landscape Fig 1.dgn 4/13/2004 8:19:00 PM

NOTE:
TREES IN THE OVERBANK AREAS WILL HAVE CANOPIES ABOVE THE SPF WSEL IT IS ASSUMED THE TREES IN THE OVERBANKS WILL HAVE TRUNKS OF 1 FOOT DIAMTER THE SHRUBS MATERIAL WILL NOT EXCEED 5'X5' AND THE AVERAGE WILL BE 3'X3'.

MAIN CHANNEL PLANTING

BOTANICAL NAME	COMMON NAME	DIMMENSION (HxW)	AREA (SQ FT)
POPULUS FREMONTII	COTTONWOOD	50'X30'	750 SQ FT
SALIX EXIGUA	SANDBAR WILLOW	15'X6'	45 SQ FT
SALIX GOODDINGII	GOODDING'S WILLOW	25'X20'	250 SQ FT



NO	REVISION	BY	DATE
3			
2			
1			

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
ENGINEERING DIVISION

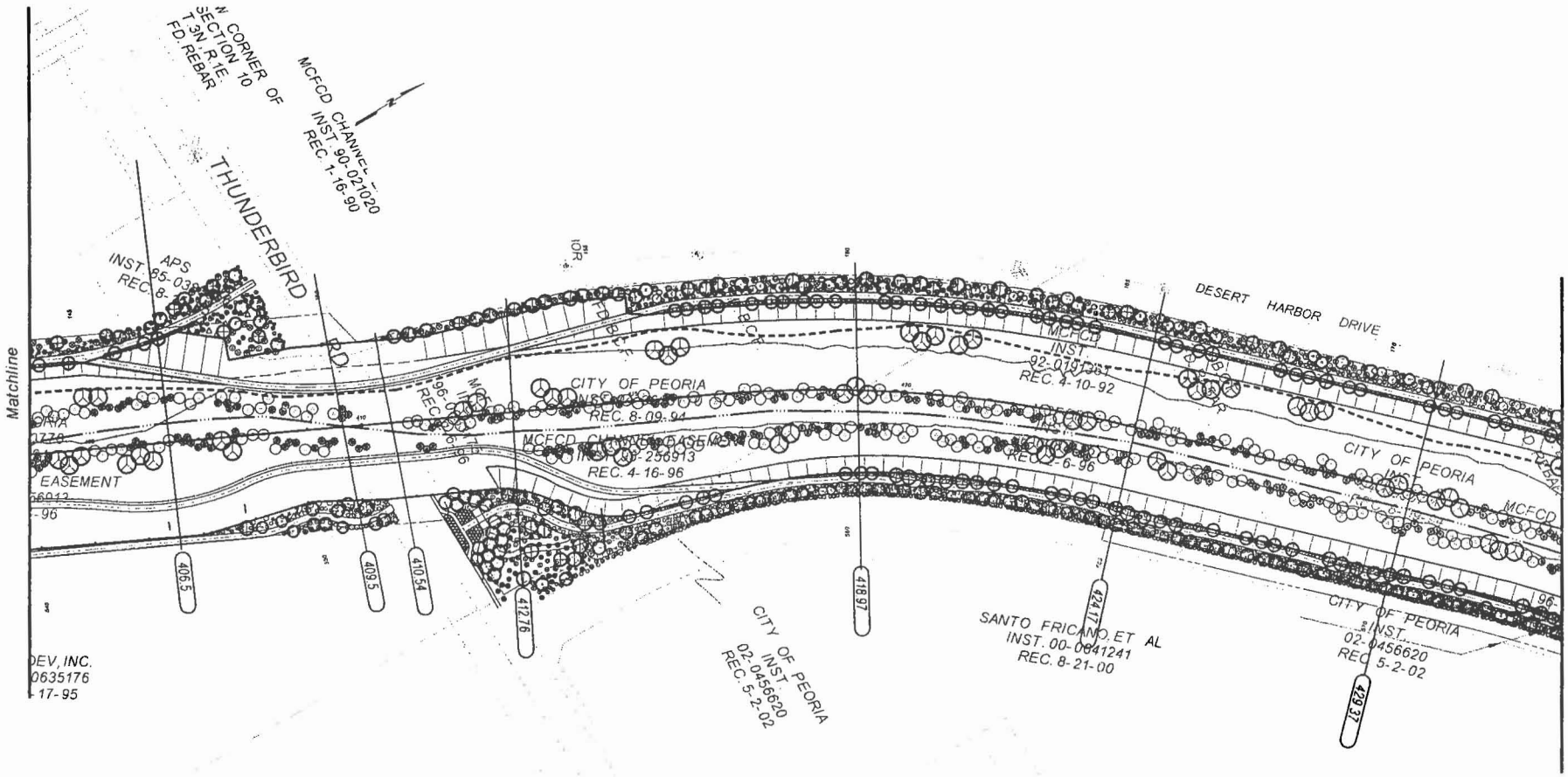
NEW RIVER - GRAND AVENUE TO SKUNK CREEK
PROJECT NUMBER
FCD2003C001

		BY	DATE
PRELIMINARY NOT FOR CONSTRUCTION	DESIGNED	KD	12-03
	DRAWN	KD	12-03
	CHECKED	JH	12-03

J2 engineering and environmental design
8232 south 48th street, suite 135
phoenix, arizona 85044 phone: 602 438.2221

DRAWING NO. | FIG. 14 - Proposed Landscaping | SHEET OF

...\Proposed Landscape Fig 2.dgn 4/13/2004 8:19:31 PM



NOTE:
TREES IN THE OVERBANK AREAS WILL HAVE CANOPIES ABOVE THE SPF WSEL IT IS ASSUMED THA TREES IN THE OVERBANKS WILL HAVE TRUNKS OF 1 FOOT DIAMTER THE SHRUBS MATERIAL WILL NOT EXCEED 5'X5' AND THE AVERAGE WILL BE 3'X3'.

50 0 50 100
Scale In Feet

MAIN CHANNEL PLANTING

BOTANICAL NAME	COMMON NAME	DIMMENSION (HxW)	AREA (SQ.FT)
POPULUS FREMONTII	COTTONWOOD	50'X30'	750 SQ.FT
SALIX EXIGUA	SANDBAR WILLOW	15'X8'	45 SQ.FT
SALIX GOODDINGII	GOODDING'S WILLOW	25'X20'	250 SQ.FT

NO	REVISION	BY	DATE
3			
2			
1			

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
ENGINEERING DIVISION

NEW RIVER - GRAND AVENUE TO SKUNK CREEK
PROJECT NUMBER
FCD2003C001

PRELIMINARY NOT FOR CONSTRUCTION

	BY	DATE
DESIGNED	KD	12-03
DRAWN	KD	12-03
CHECKED	JH	12-03

J2 engineering and environmental design
8222 south 48th street, suite 138
phoenix, arizona 85044 phone: 602.438.2221

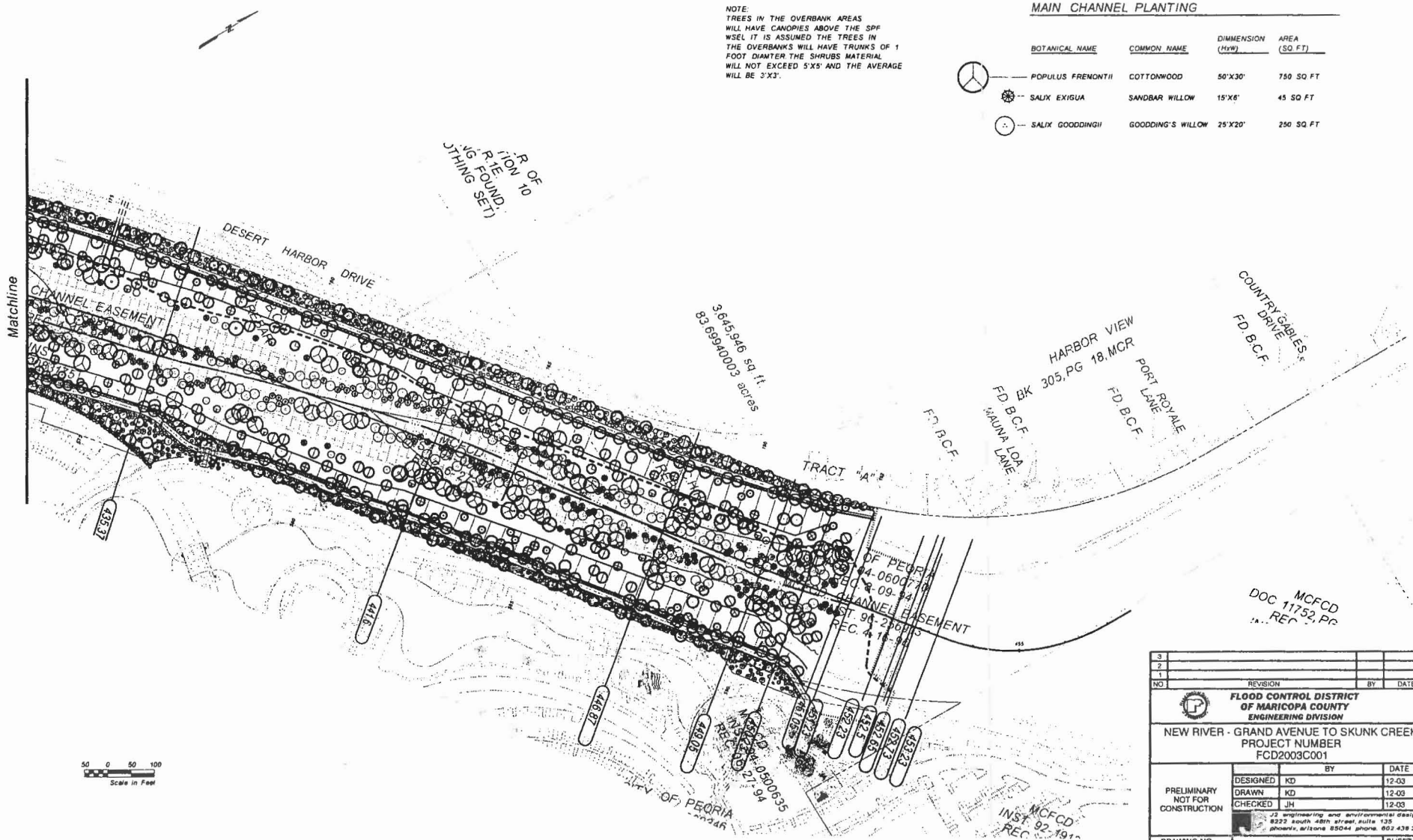
DRAWING NO. FIG 15 - Proposed Landscaping SHEET OF

...\Proposed Landscape Fig 3.dgn 4/13/2004 8:19:52 PM

NOTE:
TREES IN THE OVERBANK AREAS WILL HAVE CANOPIES ABOVE THE SPF WSEL IT IS ASSUMED THE TREES IN THE OVERBANKS WILL HAVE TRUNKS OF 1 FOOT DIAMTER.THE SHRUBS MATERIAL WILL NOT EXCEED 5'X5' AND THE AVERAGE WILL BE 3'X3'.

MAIN CHANNEL PLANTING

BOTANICAL NAME	COMMON NAME	DIMMENSION (HxW)	AREA (SQ FT)
POPULUS FREMONTII	COTTONWOOD	50'X30'	750 SQ FT
SALIX EXIGUA	SANDBAR WILLOW	15'X6'	45 SQ FT
SALIX GOODDINGII	GOODDING'S WILLOW	25'X20'	250 SQ FT



NO	REVISION	BY	DATE
3			
2			
1			

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
ENGINEERING DIVISION

NEW RIVER - GRAND AVENUE TO SKUNK CREEK
PROJECT NUMBER
FCD2003C001

PRELIMINARY NOT FOR CONSTRUCTION

	BY	DATE
DESIGNED	KD	12-03
DRAWN	KD	12-03
CHECKED	JH	12-03

J2 engineering and environmental design
8222 south 48th street, suite 135
phoenix, arizona 85044 phone 602 438 2221

DRAWING NO. | FIG. 16 - Proposed Landscaping | SHEET OF

...\Proposed Landscape Fig 4.dgn 4/13/2004 8:20.28 PM

Keith Duffy

From: Catherine Regester - FCDX [cwr@mail.maricopa.gov]
Sent: Thursday, April 08, 2004 9:22 AM
To: Keith Duffy
Cc: Scott Vogel - FCDX; Jeff Holzmeister
Subject: New River Channelization

Keith,

I have received the roll plots. Thank you for getting those to me so quickly.

Just a few words to help clarify the 'n' value justification... Yesterday I said that I would like to see a few typical sections renderings. At this point, i feel that this would be the easiest way to show the different 'n' value areas. However, earlier, we had discussed using photographs to illustrate the various 'n' values. I have no problem with photographs - provided they are directly correlated to the proposed design, i.e. riparian planting area photograph: shows mature vegetation, typical of what you will be planting. Then, further discussion of the height, density, ground cover, etc. Although the selection of the n3 value, for example, is somewhat subjective, there is a reason that different values were chosen for different areas along the river and I would like to have some documentation in the report for the differences.

One comment I will be making for the 60% review is in regard to the reference for the 'n' value report. The submitted design report refers to the ADOT Drainage Design Manual. My comment will be that the District's *Estimated Manning's Roughness Coefficients for Stream Channels and Flood Plains in Maricopa County, Arizona* publication should be the reference. If you do not have a copy of this, please let me know and I will get you one. That publication shows renderings (just sketches, nothing real elaborate) of different rivers/washes in Maricopa County and may give you a better idea of what I am looking for in the 'n' value justification. And, if you have an area which is similar to one of examples in the book, just refer to or include a copy of that section/figure in the book.

If you have any questions or you need a copy of the District's *Estimated Manning's Roughness ...* publication, please let me know.

Thank you,

Cathy

Appendix C: HEC-RAS N- Value Sensitivity Analysis

SPF N-Sensitivity

HEC-RAS River: New River Reach: Grand Ave - Drop Profile: SPF

Reach	River Sta	Profile	Plan	Q Total	Min Ch El	W.S. Elev	Max Chl Dpth	Vel Chnl	Flow Area	Froude # Chl	Mann Comp	Mann Wtd Chnl	Mann Wtd Left	Mann Wtd Right
				(cfs)	(ft)	(ft)	(ft)	(ft/s)	(sq ft)					
Grand Ave - Drop	453.23	SPF	0.055	68000.00	1154.00	1171.02	17.02	13.64	5056.29	0.61		0.055	0.045	0.045
Grand Ave - Drop	453.23	SPF	0.045	68000.00	1154.00	1170.33	16.33	14.32	4780.94	0.66		0.045	0.045	0.045
Grand Ave - Drop	453.23	SPF	0.030	68000.00	1154.00	1169.92	15.92	14.75	4626.62	0.69		0.030	0.045	0.045
Grand Ave - Drop	453.23	SPF	0.035	68000.00	1154.00	1170.05	16.05	14.62	4673.38	0.68		0.035	0.045	0.045
Grand Ave - Drop	453.23	SPF	0.040	68000.00	1154.00	1170.19	16.19	14.47	4725.40	0.67		0.040	0.045	0.045
Grand Ave - Drop	453.23	SPF	0.050	68000.00	1154.00	1170.49	16.49	14.16	4842.37	0.65		0.050	0.045	0.045
Grand Ave - Drop	452.73	SPF	0.055	68000.00	1154.00	1170.10	16.09	14.73	4632.59	0.68		0.055	0.045	0.045
Grand Ave - Drop	452.73	SPF	0.045	68000.00	1154.00	1169.49	15.49	15.39	4423.19	0.73		0.045	0.045	0.045
Grand Ave - Drop	452.73	SPF	0.030	68000.00	1154.00	1169.39	15.39	15.49	4391.20	0.73		0.030	0.045	0.045
Grand Ave - Drop	452.73	SPF	0.035	68000.00	1154.00	1169.42	15.42	15.46	4401.11	0.73		0.035	0.045	0.045
Grand Ave - Drop	452.73	SPF	0.040	68000.00	1154.00	1169.45	15.45	15.42	4412.32	0.73		0.040	0.045	0.045
Grand Ave - Drop	452.73	SPF	0.050	68000.00	1154.00	1169.53	15.53	15.34	4436.93	0.72		0.050	0.045	0.045
Grand Ave - Drop	452.65	SPF	0.055	68000.00	1155.00	1169.18	14.18	16.30	4171.74	0.79		0.055	0.045	0.045
Grand Ave - Drop	452.65	SPF	0.045	68000.00	1155.00	1167.12	12.12	19.26	3530.48	1.00		0.045		
Grand Ave - Drop	452.65	SPF	0.030	68000.00	1155.00	1167.10	12.10	19.29	3524.81	1.00		0.030		
Grand Ave - Drop	452.65	SPF	0.035	68000.00	1155.00	1167.10	12.10	19.29	3524.81	1.00		0.035		
Grand Ave - Drop	452.65	SPF	0.040	68000.00	1155.00	1167.10	12.10	19.29	3524.81	1.00		0.040		
Grand Ave - Drop	452.65	SPF	0.050	68000.00	1155.00	1167.12	12.12	19.26	3530.48	1.00		0.050		
Grand Ave - Drop	452.5	SPF	0.055	68000.00	1153.00	1169.83	16.83	13.90	4900.23	0.62		0.055	0.045	0.045
Grand Ave - Drop	452.5	SPF	0.045	68000.00	1153.00	1162.75	9.75	24.68	2753.70	1.42		0.045		
Grand Ave - Drop	452.5	SPF	0.030	68000.00	1153.00	1162.63	9.63	25.02	2717.76	1.45		0.030		
Grand Ave - Drop	452.5	SPF	0.035	68000.00	1153.00	1162.66	9.66	24.93	2727.81	1.44		0.035		
Grand Ave - Drop	452.5	SPF	0.040	68000.00	1153.00	1162.70	9.70	24.82	2739.81	1.43		0.040		
Grand Ave - Drop	452.5	SPF	0.050	68000.00	1153.00	1168.24	15.24	15.45	4399.99	0.72		0.050		
Grand Ave - Drop	452.23	SPF	0.055	68000.00	1144.00	1170.88	26.88	9.40	7274.11	0.34		0.055	0.045	0.045
Grand Ave - Drop	452.23	SPF	0.045	68000.00	1144.00	1168.77	24.77	10.32	6588.00	0.39		0.045		
Grand Ave - Drop	452.23	SPF	0.030	68000.00	1144.00	1165.53	21.53	12.09	5623.90	0.49		0.030		
Grand Ave - Drop	452.23	SPF	0.035	68000.00	1144.00	1166.54	22.54	11.48	5922.38	0.45		0.035		
Grand Ave - Drop	452.23	SPF	0.040	68000.00	1144.00	1167.77	23.77	10.81	6288.70	0.42		0.040		
Grand Ave - Drop	452.23	SPF	0.050	68000.00	1144.00	1169.68	25.68	9.91	6866.23	0.37		0.050		0.045
Grand Ave - Drop	451.23	SPF	0.055	68000.00	1144.00	1170.67	26.67	9.46	7211.95	0.34		0.055	0.045	0.045
Grand Ave - Drop	451.23	SPF	0.045	68000.00	1144.00	1168.58	24.58	10.37	6557.27	0.39		0.045		
Grand Ave - Drop	451.23	SPF	0.030	68000.00	1144.00	1165.41	21.41	12.09	5623.32	0.49		0.030		
Grand Ave - Drop	451.23	SPF	0.035	68000.00	1144.00	1166.39	22.39	11.51	5910.32	0.45		0.035		
Grand Ave - Drop	451.23	SPF	0.040	68000.00	1144.00	1167.60	23.60	10.85	6267.08	0.42		0.040		
Grand Ave - Drop	451.23	SPF	0.050	68000.00	1144.00	1169.47	25.47	9.97	6823.47	0.37		0.050		
Grand Ave - Drop	451.05	SPF	0.055	68000.00	1144.00	1170.68	26.67	9.26	7392.07	0.34		0.055	0.045	0.045
Grand Ave - Drop	451.05	SPF	0.045	68000.00	1144.00	1168.58	24.58	10.21	6663.31	0.39		0.045		
Grand Ave - Drop	451.05	SPF	0.030	68000.00	1144.00	1165.42	21.42	11.97	5681.55	0.49		0.030		
Grand Ave - Drop	451.05	SPF	0.035	68000.00	1144.00	1166.40	22.40	11.37	5981.34	0.45		0.035		
Grand Ave - Drop	451.05	SPF	0.040	68000.00	1144.00	1167.61	23.61	10.70	6356.69	0.42		0.040		
Grand Ave - Drop	451.05	SPF	0.050	68000.00	1144.00	1169.47	25.47	9.79	6950.26	0.37		0.050		0.045
Grand Ave - Drop	450.23	SPF	0.055	68000.00	1143.00	1170.61	27.61	8.84	7784.15	0.32		0.055	0.045	0.045
Grand Ave - Drop	450.23	SPF	0.045	68000.00	1143.00	1168.55	25.55	9.73	6987.67	0.37		0.045		
Grand Ave - Drop	450.23	SPF	0.030	68000.00	1143.00	1165.48	22.47	11.36	5986.10	0.46		0.030		
Grand Ave - Drop	450.23	SPF	0.035	68000.00	1143.00	1166.42	23.42	10.81	6289.22	0.43		0.035		
Grand Ave - Drop	450.23	SPF	0.040	68000.00	1143.00	1167.60	24.60	10.19	6674.11	0.40		0.040		
Grand Ave - Drop	450.23	SPF	0.050	68000.00	1143.00	1169.41	26.41	9.34	7297.69	0.35		0.050	0.045	0.045
Grand Ave - Drop	449.05	SPF	0.055	68000.00	1143.00	1170.24	27.24	9.43	7446.20	0.36		0.055	0.045	0.045
Grand Ave - Drop	449.05	SPF	0.045	68000.00	1143.00	1168.07	25.07	10.59	6464.28	0.42		0.045	0.045	0.045
Grand Ave - Drop	449.05	SPF	0.030	68000.00	1143.00	1164.77	21.77	12.76	5328.79	0.55		0.030		
Grand Ave - Drop	449.05	SPF	0.035	68000.00	1143.00	1165.80	22.80	12.01	5660.13	0.51		0.035		
Grand Ave - Drop	449.05	SPF	0.040	68000.00	1143.00	1167.07	24.07	11.19	6081.27	0.46		0.040	0.045	0.045
Grand Ave - Drop	449.05	SPF	0.050	68000.00	1143.00	1168.98	25.98	10.09	6839.26	0.40		0.050	0.045	0.045
Grand Ave - Drop	446.87	SPF	0.055	68000.00	1142.00	1169.39	27.39	10.47	6732.53	0.40		0.055	0.045	0.045
Grand Ave - Drop	446.87	SPF	0.045	68000.00	1142.00	1167.06	25.06	11.92	5864.08	0.48		0.045	0.045	0.045
Grand Ave - Drop	446.87	SPF	0.030	68000.00	1142.00	1163.24	21.24	15.03	4534.05	0.67		0.030	0.045	0.045
Grand Ave - Drop	446.87	SPF	0.035	68000.00	1142.00	1164.47	22.47	13.90	4951.38	0.60		0.035	0.045	0.045
Grand Ave - Drop	446.87	SPF	0.040	68000.00	1142.00	1165.96	23.96	12.71	5469.98	0.52		0.040	0.045	0.045
Grand Ave - Drop	446.87	SPF	0.050	68000.00	1142.00	1168.02	26.02	11.29	6217.31	0.44		0.050	0.045	0.045
Grand Ave - Drop	441.6	SPF	0.055	68000.00	1142.00	1168.00	26.00	10.47	6804.91	0.41		0.055	0.045	0.045
Grand Ave - Drop	441.6	SPF	0.045	68000.00	1142.00	1165.62	23.62	11.99	5813.19	0.49		0.045	0.045	0.045
Grand Ave - Drop	441.6	SPF	0.030	68000.00	1142.00	1161.61	19.61	15.49	4388.58	0.72		0.030		
Grand Ave - Drop	441.6	SPF	0.035	68000.00	1142.00	1162.86	20.86	14.24	4807.08	0.64		0.035	0.045	0.045
Grand Ave - Drop	441.6	SPF	0.040	68000.00	1142.00	1164.55	22.55	12.79	5416.83	0.54		0.040	0.045	0.045
Grand Ave - Drop	441.6	SPF	0.050	68000.00	1142.00	1166.53	24.52	11.36	6154.85	0.46		0.050	0.045	0.045
Grand Ave - Drop	435.37	SPF	0.055	68000.00	1138.00	1167.32	29.32	8.22	9054.76	0.29		0.055	0.045	0.045
Grand Ave - Drop	435.37	SPF	0.045	68000.00	1138.00	1165.02	27.02	9.52	7436.74	0.36		0.045	0.045	0.045
Grand Ave - Drop	435.37	SPF	0.030	68000.00	1138.00	1161.80	23.80	11.32	6102.05	0.46		0.030	0.045	0.045
Grand Ave - Drop	435.37	SPF	0.035	68000.00	1138.00	1162.65	24.65	10.82	6441.74	0.43		0.035	0.045	0.045
Grand Ave - Drop	435.37	SPF	0.040	68000.00	1138.00	1164.14	26.14	9.98	7065.02	0.38		0.040	0.045	0.045
Grand Ave - Drop	435.37	SPF	0.050	68000.00	1138.00	1165.81	27.81	9.02	8135.28	0.33		0.050	0.045	0.045
Grand Ave - Drop	429.37	SPF	0.055	68000.00	1139.00	1166.50	27.50	8.21	9059.64	0.29		0.055	0.045	0.045
Grand Ave - Drop	429.37	SPF	0.045	68000.00	1139.00	1164.14	25.14	9.59	7316.86	0.36		0.045	0.045	0.045
Grand Ave - Drop	429.37	SPF	0.030	68000.00	1139.00	1161.18	22.18	11.24	6164.88	0.46		0.030	0.045	0.045
Grand Ave - Drop	429.37	SPF	0.035	68000.00	1139.00	1161.89	22.89	10.80	6438.03	0.43		0.035	0.045	0.045
Grand Ave - Drop	429.37	SPF	0.040	68000.00	1139.00	1163.37	24.37	9.98	7011.11	0.38		0.040	0.045	0.045
Grand Ave - Drop	429.37	SPF	0.050	68000.00	1139.00	1164.91	25.91	9.04	8109.11	0.34		0.050	0.045	0.045
Grand Ave - Drop	424.17	SPF	0.055	68000.00	1138.00	1165.76	27.76	8.28	8901.17	0.30		0.055	0.045	0.045
Grand Ave - Drop	424.17	SPF	0.045	68000.00	1138.00	1163.38	25.38	9.64	7303.48	0.36		0.045	0.045	0.045
Grand Ave - Drop	424.17	SPF	0.030	68000.00	1138.00	1160.66	22.66	11.15	6240.41	0.45		0.030	0.045	0.045
Grand Ave - Drop	424.17	SPF	0.035	68000.00	1138.00	1161.24	23.24	10.80	6461.65	0.43		0.035	0.045	0.045
Grand Ave - Drop	424.17	SPF	0.040	68000.00	1138.00	1162.70	24.70	9.99	7030.41	0.38		0.040	0.045	0.045
Grand Ave - Drop	424.17	SPF	0.050	68000.00	1138.00	1164.10	26.10	9.12	7998.91	0.34		0.050	0.045	0.045
Grand Ave - Drop	418.97	SPF	0.055	68000.00	1138.00	1165.03	27.03	8.30	8932.22	0.30		0.055	0.045	0.045
Grand Ave - Drop	418.97	SPF	0.045	68000.00	1138.00	1162.49	24.49	9.93	7070.03	0.38		0.045	0.045	0.045
Grand Ave - Drop	418.97	SPF	0.030	68000.00	1138.00	1160.00	22.00	11.42	6077.99	0.47		0.030	0.045	0.045

HEC-RAS River: New River Reach: Grand Ave - Drop Profile: SPF (Continued)

Reach	River Sta	Profile	Plan	Q Total	Min Ch El	W S Elev	Max Chl Dpth	Vel Chnl	Flow Area	Froude # Chl	Mann Comp	Mann Wtd Chnl	Mann Wtd Left	Mann Wtd Right
				(cfs)	(ft)	(ft)	(ft)	(ft/s)	(sq ft)					
Grand Ave - Drop	418.97	SPF	0.035	68000.00	1138.00	1160.41	22.41	11.15	6237.96	0.46		0.035	0.045	0.045
Grand Ave - Drop	418.97	SPF	0.040	68000.00	1138.00	1161.91	23.91	10.26	6823.90	0.40		0.040	0.045	0.045
Grand Ave - Drop	418.97	SPF	0.050	68000.00	1138.00	1163.22	25.22	9.30	7907.54	0.35		0.050	0.045	0.045
Grand Ave - Drop	412.76	SPF	0.055	68000.00	1137.00	1164.11	27.11	8.14	8913.03	0.30		0.055	0.045	0.045
Grand Ave - Drop	412.76	SPF	0.045	68000.00	1137.00	1161.37	24.37	9.96	6834.41	0.40		0.045	0.045	
Grand Ave - Drop	412.76	SPF	0.030	68000.00	1137.00	1159.35	22.35	11.11	6122.09	0.46		0.030		
Grand Ave - Drop	412.76	SPF	0.035	68000.00	1137.00	1159.51	22.51	11.01	6176.83	0.46		0.035		
Grand Ave - Drop	412.76	SPF	0.040	68000.00	1137.00	1160.98	23.98	10.16	6695.30	0.41		0.040	0.045	
Grand Ave - Drop	412.76	SPF	0.050	68000.00	1137.00	1162.12	25.12	9.23	7804.01	0.36		0.050	0.045	
Grand Ave - Drop	410.54	SPF	0.055	68000.00	1137.30	1162.52	25.22	11.35	6034.99	0.44		0.055	0.045	0.045
Grand Ave - Drop	410.54	SPF	0.045	68000.00	1137.30	1159.47	22.17	13.36	5106.35	0.56		0.045	0.045	
Grand Ave - Drop	410.54	SPF	0.030	68000.00	1137.30	1157.01	19.71	15.48	4393.18	0.68		0.030		
Grand Ave - Drop	410.54	SPF	0.035	68000.00	1137.30	1157.01	19.71	15.48	4393.48	0.68		0.035		
Grand Ave - Drop	410.54	SPF	0.040	68000.00	1137.30	1159.11	21.81	13.64	4998.49	0.58		0.040	0.045	
Grand Ave - Drop	410.54	SPF	0.050	68000.00	1137.30	1160.13	22.83	12.87	5304.20	0.53		0.050	0.045	
Grand Ave - Drop	410.02			Bridge										
Grand Ave - Drop	409.5	SPF	0.055	68000.00	1136.97	1157.75	20.78	14.46	4703.33	0.62		0.055		
Grand Ave - Drop	409.5	SPF	0.045	68000.00	1136.97	1155.85	18.88	16.28	4177.57	0.73		0.045		
Grand Ave - Drop	409.5	SPF	0.030	68000.00	1136.97	1151.15	14.18	23.02	2953.63	1.18		0.030		
Grand Ave - Drop	409.5	SPF	0.035	68000.00	1136.97	1151.15	14.18	23.02	2954.00	1.18		0.035		
Grand Ave - Drop	409.5	SPF	0.040	68000.00	1136.97	1154.67	17.70	17.62	3859.34	0.81		0.040		
Grand Ave - Drop	409.5	SPF	0.050	68000.00	1136.97	1156.86	19.89	15.27	4453.14	0.67		0.050		
Grand Ave - Drop	408.5	SPF	0.055	68000.00	1136.00	1156.66	20.66	11.53	5971.04	0.49		0.055	0.045	0.045
Grand Ave - Drop	408.5	SPF	0.045	68000.00	1136.00	1155.07	19.07	12.77	5352.66	0.57		0.045	0.045	0.045
Grand Ave - Drop	408.5	SPF	0.030	68000.00	1136.00	1147.73	11.73	23.40	2906.26	1.36		0.030		
Grand Ave - Drop	408.5	SPF	0.035	68000.00	1136.00	1153.02	17.02	14.69	4628.55	0.70		0.035		
Grand Ave - Drop	408.5	SPF	0.040	68000.00	1136.00	1154.08	18.08	13.64	4984.67	0.63		0.040		
Grand Ave - Drop	408.5	SPF	0.050	68000.00	1136.00	1155.91	19.91	12.09	5678.62	0.53		0.050	0.045	0.045
Grand Ave - Drop	402.5	SPF	0.055	68000.00	1136.00	1154.84	18.84	11.72	5987.34	0.51		0.055	0.045	0.045
Grand Ave - Drop	402.5	SPF	0.045	68000.00	1136.00	1153.32	17.32	13.02	5290.02	0.59		0.045		0.045
Grand Ave - Drop	402.5	SPF	0.030	68000.00	1136.00	1149.70	13.70	17.16	3961.67	0.88		0.030		
Grand Ave - Drop	402.5	SPF	0.035	68000.00	1136.00	1151.07	15.07	15.35	4446.46	0.75		0.035		0.045
Grand Ave - Drop	402.5	SPF	0.040	68000.00	1136.00	1152.28	16.28	14.01	4895.40	0.66		0.040		0.045
Grand Ave - Drop	402.5	SPF	0.050	68000.00	1136.00	1154.07	18.07	12.39	5605.81	0.55		0.050	0.045	0.045
Grand Ave - Drop	395.5	SPF	0.055	68000.00	1133.00	1152.33	19.33	10.37	7014.08	0.45		0.055	0.045	0.045
Grand Ave - Drop	395.5	SPF	0.045	68000.00	1133.00	1150.71	17.71	12.13	5625.65	0.55		0.045	0.045	0.045
Grand Ave - Drop	395.5	SPF	0.030	68000.00	1133.00	1147.36	14.36	15.56	4368.78	0.79		0.030		
Grand Ave - Drop	395.5	SPF	0.035	68000.00	1133.00	1148.87	15.87	14.04	4844.18	0.68		0.035		
Grand Ave - Drop	395.5	SPF	0.040	68000.00	1133.00	1149.80	16.80	12.92	5263.51	0.61		0.040		
Grand Ave - Drop	395.5	SPF	0.050	68000.00	1133.00	1151.65	18.65	10.99	6603.60	0.49		0.050	0.045	0.045
Grand Ave - Drop	392	SPF	0.055	68000.00	1131.00	1151.68	20.68	8.68	8469.80	0.36		0.055	0.045	0.045
Grand Ave - Drop	392	SPF	0.045	68000.00	1131.00	1150.24	19.24	9.93	6980.22	0.43		0.045	0.045	0.045
Grand Ave - Drop	392	SPF	0.030	68000.00	1131.00	1147.57	16.57	11.96	5721.80	0.57		0.030	0.045	
Grand Ave - Drop	392	SPF	0.035	68000.00	1131.00	1148.55	17.55	11.14	6160.20	0.51		0.035	0.045	
Grand Ave - Drop	392	SPF	0.040	68000.00	1131.00	1149.49	18.49	10.45	6580.71	0.47		0.040	0.045	
Grand Ave - Drop	392	SPF	0.050	68000.00	1131.00	1150.95	19.95	9.46	7366.73	0.41		0.050	0.045	0.045
Grand Ave - Drop	388.5	SPF	0.055	68000.00	1131.00	1150.60	19.60	9.28	8026.03	0.40		0.055	0.045	0.045
Grand Ave - Drop	388.5	SPF	0.045	68000.00	1131.00	1149.14	18.14	10.60	6815.60	0.48		0.045	0.045	0.045
Grand Ave - Drop	388.5	SPF	0.030	68000.00	1131.00	1146.24	15.24	13.29	5137.53	0.66		0.030	0.045	0.045
Grand Ave - Drop	388.5	SPF	0.035	68000.00	1131.00	1147.34	16.34	12.18	5632.06	0.59		0.035	0.045	0.045
Grand Ave - Drop	388.5	SPF	0.040	68000.00	1131.00	1148.33	17.33	11.32	6087.75	0.53		0.040	0.045	0.045
Grand Ave - Drop	388.5	SPF	0.050	68000.00	1131.00	1149.94	18.94	9.88	7474.05	0.44		0.050	0.045	0.045
Grand Ave - Drop	384.5	SPF	0.055	68000.00	1130.50	1149.36	18.86	9.40	7904.75	0.41		0.055	0.045	0.045
Grand Ave - Drop	384.5	SPF	0.045	68000.00	1130.50	1147.89	17.39	10.76	6640.78	0.50		0.045	0.045	
Grand Ave - Drop	384.5	SPF	0.030	68000.00	1130.50	1145.11	14.61	13.42	5092.48	0.68		0.030	0.045	
Grand Ave - Drop	384.5	SPF	0.035	68000.00	1130.50	1146.22	15.72	12.26	5592.96	0.60		0.035	0.045	
Grand Ave - Drop	384.5	SPF	0.040	68000.00	1130.50	1147.17	16.67	11.40	6030.69	0.54		0.040	0.045	
Grand Ave - Drop	384.5	SPF	0.050	68000.00	1130.50	1148.70	18.20	10.02	7303.17	0.45		0.050	0.045	0.045
Grand Ave - Drop	379.75	SPF	0.055	68000.00	1129.00	1148.63	19.63	7.58	10091.90	0.32		0.055	0.045	0.045
Grand Ave - Drop	379.75	SPF	0.045	68000.00	1129.00	1147.27	18.27	8.76	8771.39	0.39		0.045	0.045	0.045
Grand Ave - Drop	379.75	SPF	0.030	68000.00	1129.00	1144.72	15.72	11.26	6077.58	0.54		0.030	0.045	
Grand Ave - Drop	379.75	SPF	0.035	68000.00	1129.00	1145.60	16.60	10.56	6496.13	0.49		0.035	0.045	
Grand Ave - Drop	379.75	SPF	0.040	68000.00	1129.00	1146.66	17.66	9.32	8187.81	0.42		0.040	0.045	0.045
Grand Ave - Drop	379.75	SPF	0.050	68000.00	1129.00	1148.04	19.03	8.09	9511.62	0.35		0.050	0.045	0.045
Grand Ave - Drop	376.75	SPF	0.055	68000.00	1128.00	1147.67	19.67	8.63	8490.12	0.38		0.055	0.045	0.045
Grand Ave - Drop	376.75	SPF	0.045	68000.00	1128.00	1146.25	18.25	9.83	7101.29	0.45		0.045	0.045	0.045
Grand Ave - Drop	376.75	SPF	0.030	68000.00	1128.00	1144.04	16.04	11.65	5902.08	0.57		0.030	0.045	0.045
Grand Ave - Drop	376.75	SPF	0.035	68000.00	1128.00	1144.91	16.91	10.88	6368.04	0.52		0.035	0.045	0.045
Grand Ave - Drop	376.75	SPF	0.040	68000.00	1128.00	1145.73	17.73	10.22	6819.08	0.47		0.040	0.045	0.045
Grand Ave - Drop	376.75	SPF	0.050	68000.00	1128.00	1147.08	19.08	9.09	8027.84	0.40		0.050	0.045	0.045
Grand Ave - Drop	373.75	SPF	0.055	68000.00	1127.00	1147.19	20.19	7.62	9195.71	0.33		0.055	0.045	0.045
Grand Ave - Drop	373.75	SPF	0.045	68000.00	1127.00	1145.95	18.95	8.32	8405.86	0.37		0.045	0.045	0.045
Grand Ave - Drop	373.75	SPF	0.030	68000.00	1127.00	1144.09	17.09	9.55	7246.85	0.45		0.030	0.045	0.045
Grand Ave - Drop	373.75	SPF	0.035	68000.00	1127.00	1144.82	17.82	9.04	7700.32	0.42		0.035	0.045	0.045
Grand Ave - Drop	373.75	SPF	0.040	68000.00	1127.00	1145.55	18.55	8.57	8152.70	0.39		0.040	0.045	0.045
Grand Ave - Drop	373.75	SPF	0.050	68000.00	1127.00	1146.68	19.68	7.90	8871.83	0.34		0.050	0.045	0.045
Grand Ave - Drop	370.65	SPF	0.055	68000.00	1126.50	1146.40	19.90	8.18	8608.26	0.36		0.055	0.045	0.045
Grand Ave - Drop	370.65	SPF	0.045	68000.00	1126.50	1145.19	18.68	8.97	7832.60	0.41		0.045	0.045	0.045
Grand Ave - Drop	370.65	SPF	0.030	68000.00	1126.50	1143.44	16.94	10.29	6741.88	0.50		0.030	0.045	0.045
Grand Ave - Drop	370.65	SPF	0.035	68000.00	1126.50	1144.15	17.65	9.73	7183.89	0.46		0.035	0.045	0.045
Grand Ave - Drop	370.65	SPF	0.040	68000.00	1126.50	1144.86	18.36	9.21	7627.31	0.42		0.040	0.045	0.045
Grand Ave - Drop	370.65	SPF	0.050	68000.00	1126.50	1145.93	19.43	8.48	8305.56	0.38		0.050	0.045	0.045
Grand Ave - Drop	365.4	SPF	0.055	68000.00	1125.50	1144.37	18.87	9.99	7590.91	0.45		0.055	0.045	0.045
Grand Ave - Drop	365.4	SPF	0.045	68000.00	1125.50	1143.15	17.65	11.05	6568.91	0.52		0.045	0.045	0.045
Grand Ave - Drop	365.4	SPF	0.030	68000.00	1125.50	1141.33	15.83	13.18	5477.96	0.67		0.030	0.045	0.045
Grand Ave - Drop	365.4	SPF	0.035	68000.00	1125.50	1142.24	16.74	12.10	6014.44	0.59		0.035	0.045	0.045

HEC-RAS River: New River Reach: Grand Ave - Drop Profile: SPF (Continued)

Reach	River Sta	Profile	Plan	Q Total	Min Ch El	W.S. Elev	Max Chl Dpth	Vel Chnl	Flow Area	Froude # Chl	Manc Comp	Mann Wtd Chnl	Mann Wtd Left	Mann Wtd Right
				(cfs)	(ft)	(ft)	(ft)	(ft/s)	(sq ft)					
Grand Ave - Drop	365.4	SPF	0.040	68000.00	1125.50	1143.07	17.57	11.20	6514.74	0.53		0.040	0.045	0.045
Grand Ave - Drop	365.4	SPF	0.050	68000.00	1125.50	1143.83	18.33	10.61	7102.07	0.49		0.050	0.045	0.045
Grand Ave - Drop	358.25	SPF	0.035	68000.00	1123.00	1142.92	19.92	7.96	10225.78	0.34		0.055	0.045	0.045
Grand Ave - Drop	358.25	SPF	0.045	68000.00	1123.00	1141.64	18.64	9.65	8844.13	0.43		0.045	0.045	0.045
Grand Ave - Drop	358.25	SPF	0.030	68000.00	1123.00	1138.35	15.35	15.04	4720.57	0.75		0.030	0.045	0.045
Grand Ave - Drop	358.25	SPF	0.035	68000.00	1123.00	1139.31	16.31	13.82	5181.36	0.67		0.035	0.045	0.045
Grand Ave - Drop	358.25	SPF	0.040	68000.00	1123.00	1140.15	17.15	12.85	5586.93	0.60		0.040	0.045	0.045
Grand Ave - Drop	358.25	SPF	0.050	68000.00	1123.00	1142.45	19.45	8.60	9716.41	0.37		0.050	0.045	0.045
Grand Ave - Drop	352.4	SPF	0.055	68000.00	1122.00	1141.55	19.55	8.33	9746.01	0.35		0.055	0.045	0.045
Grand Ave - Drop	352.4	SPF	0.045	68000.00	1122.00	1138.97	16.97	11.92	6084.26	0.54		0.045	0.045	0.045
Grand Ave - Drop	352.4	SPF	0.030	68000.00	1122.00	1136.49	14.49	14.81	4772.40	0.74		0.030	0.045	0.045
Grand Ave - Drop	352.4	SPF	0.035	68000.00	1122.00	1137.08	15.08	14.05	5077.14	0.69		0.035	0.045	0.045
Grand Ave - Drop	352.4	SPF	0.040	68000.00	1122.00	1137.64	15.64	13.36	5373.09	0.64		0.040	0.045	0.045
Grand Ave - Drop	352.4	SPF	0.050	68000.00	1122.00	1139.98	17.98	10.94	6650.34	0.48		0.050	0.045	0.045
Grand Ave - Drop	347.4	SPF	0.055	68000.00	1120.50	1139.38	18.88	10.42	6531.11	0.43		0.055	0.045	0.045
Grand Ave - Drop	347.4	SPF	0.045	68000.00	1120.50	1137.07	16.57	11.95	5693.01	0.53		0.045	0.045	0.045
Grand Ave - Drop	347.4	SPF	0.030	68000.00	1120.50	1135.71	15.21	13.08	5198.28	0.61		0.030	0.045	0.045
Grand Ave - Drop	347.4	SPF	0.035	68000.00	1120.50	1135.71	15.21	13.08	5198.59	0.61		0.035	0.045	0.045
Grand Ave - Drop	347.4	SPF	0.040	68000.00	1120.50	1135.71	15.21	13.08	5198.94	0.61		0.040	0.045	0.045
Grand Ave - Drop	347.4	SPF	0.050	68000.00	1120.50	1137.98	17.48	11.30	6021.09	0.49		0.050	0.045	0.045
Grand Ave - Drop	347.255			Bridge										
Grand Ave - Drop	347.1	SPF	0.055	68000.00	1120.40	1138.28	17.88	11.04	6163.82	0.47		0.055	0.045	0.045
Grand Ave - Drop	347.1	SPF	0.045	68000.00	1120.40	1136.42	16.02	12.39	5489.76	0.56		0.045	0.045	0.045
Grand Ave - Drop	347.1	SPF	0.030	68000.00	1120.40	1129.41	9.00	22.99	2957.98	1.39		0.030		
Grand Ave - Drop	347.1	SPF	0.035	68000.00	1120.40	1129.41	9.01	22.98	2959.65	1.39		0.035		
Grand Ave - Drop	347.1	SPF	0.040	68000.00	1120.40	1129.42	9.02	22.96	2961.62	1.39		0.040		
Grand Ave - Drop	347.1	SPF	0.050	68000.00	1120.40	1137.07	16.66	11.88	5723.25	0.53		0.050	0.045	0.045
Grand Ave - Drop	346.8	SPF	0.055	68000.00	1119.92	1138.15	18.23	11.10	6125.05	0.47		0.055		
Grand Ave - Drop	346.8	SPF	0.045	68000.00	1119.92	1136.29	16.37	12.47	5454.77	0.56		0.045		
Grand Ave - Drop	346.8	SPF	0.030	68000.00	1119.92	1134.25	14.33	14.40	4722.29	0.70		0.030		
Grand Ave - Drop	346.8	SPF	0.035	68000.00	1119.92	1134.29	14.37	14.36	4735.42	0.70		0.035		
Grand Ave - Drop	346.8	SPF	0.040	68000.00	1119.92	1134.32	14.40	14.32	4748.51	0.69		0.040		
Grand Ave - Drop	346.8	SPF	0.050	68000.00	1119.92	1136.93	17.01	11.96	5683.60	0.53		0.050		
Grand Ave - Drop	346.4	SPF	0.055	68000.00	1119.80	1138.10	18.30	10.93	6225.77	0.46		0.055	0.045	0.045
Grand Ave - Drop	346.4	SPF	0.045	68000.00	1119.80	1136.27	16.47	12.21	5571.18	0.54		0.045	0.045	0.045
Grand Ave - Drop	346.4	SPF	0.030	68000.00	1119.80	1134.33	14.53	13.94	4877.45	0.66		0.030	0.045	0.045
Grand Ave - Drop	346.4	SPF	0.035	68000.00	1119.80	1134.33	14.53	13.94	4877.89	0.66		0.035	0.045	0.045
Grand Ave - Drop	346.4	SPF	0.040	68000.00	1119.80	1134.33	14.53	13.94	4878.32	0.66		0.040	0.045	0.045
Grand Ave - Drop	346.4	SPF	0.050	68000.00	1119.80	1136.88	17.08	11.75	5790.89	0.51		0.050	0.045	0.045
Grand Ave - Drop	345.95			Bridge										
Grand Ave - Drop	345.5	SPF	0.055	68000.00	1119.40	1135.55	16.15	12.48	5449.17	0.56		0.055	0.045	0.045
Grand Ave - Drop	345.5	SPF	0.045	68000.00	1119.40	1133.92	14.52	13.98	4865.87	0.67		0.045	0.045	0.045
Grand Ave - Drop	345.5	SPF	0.030	68000.00	1119.40	1129.33	9.93	21.04	3231.75	1.22		0.030		
Grand Ave - Drop	345.5	SPF	0.035	68000.00	1119.40	1129.33	9.93	21.04	3232.39	1.22		0.035		
Grand Ave - Drop	345.5	SPF	0.040	68000.00	1119.40	1129.33	9.93	21.05	3231.07	1.22		0.040		
Grand Ave - Drop	345.5	SPF	0.050	68000.00	1119.40	1134.86	15.46	13.08	5201.63	0.60		0.050	0.045	0.045
Grand Ave - Drop	343.7	SPF	0.055	68000.00	1117.62	1134.80	17.18	11.40	6402.57	0.50		0.055	0.045	
Grand Ave - Drop	343.7	SPF	0.045	68000.00	1117.62	1133.10	15.48	13.21	5149.13	0.62		0.045		
Grand Ave - Drop	343.7	SPF	0.030	68000.00	1117.62	1127.74	10.12	20.91	3252.29	1.21		0.030		
Grand Ave - Drop	343.7	SPF	0.035	68000.00	1117.62	1130.90	13.28	15.58	4364.20	0.78		0.035		
Grand Ave - Drop	343.7	SPF	0.040	68000.00	1117.62	1132.07	14.45	14.22	4780.32	0.69		0.040		
Grand Ave - Drop	343.7	SPF	0.050	68000.00	1117.62	1134.00	16.38	12.42	5476.22	0.56		0.050		
Grand Ave - Drop	342	SPF	0.055	68000.00	1116.62	1134.27	17.65	10.50	7190.37	0.46		0.055	0.045	0.045
Grand Ave - Drop	342	SPF	0.045	68000.00	1116.62	1132.51	15.89	12.41	5478.16	0.57		0.045		
Grand Ave - Drop	342	SPF	0.030	68000.00	1116.62	1129.35	12.73	15.83	4294.59	0.82		0.030		
Grand Ave - Drop	342	SPF	0.035	68000.00	1116.62	1130.47	13.85	14.43	4711.69	0.72		0.035		
Grand Ave - Drop	342	SPF	0.040	68000.00	1116.62	1131.55	14.93	13.29	5115.81	0.63		0.040		
Grand Ave - Drop	342	SPF	0.050	68000.00	1116.62	1133.36	16.74	11.73	5798.94	0.53		0.050		
Grand Ave - Drop	337	SPF	0.055	68000.00	1114.22	1132.01	17.79	10.98	6664.46	0.48		0.055	0.045	0.045
Grand Ave - Drop	337	SPF	0.045	68000.00	1114.22	1130.31	16.09	12.60	5543.58	0.58		0.045	0.045	0.045
Grand Ave - Drop	337	SPF	0.030	68000.00	1114.22	1127.00	12.78	16.28	4177.03	0.84		0.030		
Grand Ave - Drop	337	SPF	0.035	68000.00	1114.22	1128.18	13.96	14.78	4601.39	0.73		0.035		
Grand Ave - Drop	337	SPF	0.040	68000.00	1114.22	1129.30	15.08	13.59	5018.87	0.64		0.040		0.045
Grand Ave - Drop	337	SPF	0.050	68000.00	1114.22	1131.21	16.99	11.74	6107.31	0.52		0.050	0.045	0.045

100-Yr N-Sensitivity

HEC-RAS River: New River Reach: Grand Ave - Drop Profile: 100-Yr

Reach	River Sta	Profile	Plan	Q Total	Min Ch El	W S Elev	Max Chl Dpth	Vel Chnl	Flow Area	Froude # Chl	Mann Comp	Mann Wtd Chnl	Mann Wtd Left	Mann Wtd Right
				(cfs)	(ft)	(ft)	(ft)	(ft/s)	(sq ft)					
Grand Ave - Drop	453.23	100-Yr	0.055	41000.00	1154.00	1166.55	12.55	11.61	3530.89	0.61		0.055		
Grand Ave - Drop	453.23	100-Yr	0.045	41000.00	1154.00	1166.27	12.27	11.90	3445.44	0.63		0.045		
Grand Ave - Drop	453.23	100-Yr	0.030	41000.00	1154.00	1165.91	11.91	12.30	3332.69	0.66		0.030		
Grand Ave - Drop	453.23	100-Yr	0.035	41000.00	1154.00	1166.02	12.02	12.18	3367.29	0.65		0.035		
Grand Ave - Drop	453.23	100-Yr	0.040	41000.00	1154.00	1166.14	12.14	12.04	3405.14	0.64		0.040		
Grand Ave - Drop	453.23	100-Yr	0.050	41000.00	1154.00	1166.41	12.41	11.75	3487.91	0.62		0.050		
Grand Ave - Drop	452.73	100-Yr	0.055	41000.00	1154.00	1165.67	11.67	12.71	3226.49	0.69		0.055		
Grand Ave - Drop	452.73	100-Yr	0.045	41000.00	1154.00	1165.60	11.59	12.79	3205.05	0.69		0.045		
Grand Ave - Drop	452.73	100-Yr	0.030	41000.00	1154.00	1165.51	11.51	12.90	3177.98	0.70		0.030		
Grand Ave - Drop	452.73	100-Yr	0.035	41000.00	1154.00	1165.53	11.53	12.87	3185.85	0.70		0.035		
Grand Ave - Drop	452.73	100-Yr	0.040	41000.00	1154.00	1165.56	11.56	12.83	3194.94	0.70		0.040		
Grand Ave - Drop	452.73	100-Yr	0.050	41000.00	1154.00	1165.63	11.63	12.75	3216.19	0.69		0.050		
Grand Ave - Drop	452.65	100-Yr	0.055	41000.00	1155.00	1163.70	8.70	16.43	2495.70	1.00		0.055		
Grand Ave - Drop	452.65	100-Yr	0.045	41000.00	1155.00	1163.68	8.67	16.48	2488.42	1.00		0.045		
Grand Ave - Drop	452.65	100-Yr	0.030	41000.00	1155.00	1163.68	8.68	16.47	2488.75	1.00		0.030		
Grand Ave - Drop	452.65	100-Yr	0.035	41000.00	1155.00	1163.68	8.68	16.47	2488.75	1.00		0.035		
Grand Ave - Drop	452.65	100-Yr	0.040	41000.00	1155.00	1163.68	8.67	16.48	2488.42	1.00		0.040		
Grand Ave - Drop	452.65	100-Yr	0.050	41000.00	1155.00	1163.68	8.67	16.48	2488.42	1.00		0.050		
Grand Ave - Drop	452.5	100-Yr	0.055	41000.00	1153.00	1159.77	6.77	21.69	1889.91	1.49		0.055		
Grand Ave - Drop	452.5	100-Yr	0.045	41000.00	1153.00	1159.67	6.67	22.05	1859.47	1.53		0.045		
Grand Ave - Drop	452.5	100-Yr	0.030	41000.00	1153.00	1159.56	6.55	22.44	1827.03	1.57		0.030		
Grand Ave - Drop	452.5	100-Yr	0.035	41000.00	1153.00	1159.59	6.59	22.33	1836.22	1.55		0.035		
Grand Ave - Drop	452.5	100-Yr	0.040	41000.00	1153.00	1159.62	6.62	22.20	1847.02	1.54		0.040		
Grand Ave - Drop	452.5	100-Yr	0.050	41000.00	1153.00	1159.72	6.72	21.88	1873.85	1.51		0.050		
Grand Ave - Drop	452.23	100-Yr	0.055	41000.00	1144.00	1164.97	20.97	7.51	5457.51	0.31		0.055		
Grand Ave - Drop	452.23	100-Yr	0.045	41000.00	1144.00	1163.21	19.21	8.29	4944.69	0.35		0.045		
Grand Ave - Drop	452.23	100-Yr	0.030	41000.00	1144.00	1160.50	16.50	9.84	4167.35	0.45		0.030		
Grand Ave - Drop	452.23	100-Yr	0.035	41000.00	1144.00	1161.37	17.37	9.29	4414.77	0.42		0.035		
Grand Ave - Drop	452.23	100-Yr	0.040	41000.00	1144.00	1162.29	18.29	8.76	4678.81	0.38		0.040		
Grand Ave - Drop	452.23	100-Yr	0.050	41000.00	1144.00	1164.11	20.10	7.88	5204.69	0.33		0.050		
Grand Ave - Drop	451.23	100-Yr	0.055	41000.00	1144.00	1164.80	20.80	7.53	5445.25	0.31		0.055		
Grand Ave - Drop	451.23	100-Yr	0.045	41000.00	1144.00	1163.06	19.06	8.29	4943.92	0.35		0.045		
Grand Ave - Drop	451.23	100-Yr	0.030	41000.00	1144.00	1160.40	16.40	9.79	4188.82	0.45		0.030		
Grand Ave - Drop	451.23	100-Yr	0.035	41000.00	1144.00	1161.24	17.24	9.26	4427.66	0.41		0.035		
Grand Ave - Drop	451.23	100-Yr	0.040	41000.00	1144.00	1162.15	18.15	8.75	4684.45	0.38		0.040		
Grand Ave - Drop	451.23	100-Yr	0.050	41000.00	1144.00	1163.94	19.94	7.89	5197.93	0.33		0.050		
Grand Ave - Drop	451.05	100-Yr	0.055	41000.00	1144.00	1164.78	20.78	7.47	5486.28	0.31		0.055		
Grand Ave - Drop	451.05	100-Yr	0.045	41000.00	1144.00	1163.04	19.04	8.26	4965.76	0.36		0.045		
Grand Ave - Drop	451.05	100-Yr	0.030	41000.00	1144.00	1160.37	16.37	9.79	4186.07	0.45		0.030		
Grand Ave - Drop	451.05	100-Yr	0.035	41000.00	1144.00	1161.22	17.22	9.25	4432.24	0.42		0.035		
Grand Ave - Drop	451.05	100-Yr	0.040	41000.00	1144.00	1162.13	18.13	8.73	4697.36	0.38		0.040		
Grand Ave - Drop	451.05	100-Yr	0.050	41000.00	1144.00	1163.92	19.92	7.84	5229.12	0.33		0.050		
Grand Ave - Drop	450.23	100-Yr	0.055	41000.00	1143.00	1164.69	21.69	7.15	5736.78	0.30		0.055		
Grand Ave - Drop	450.23	100-Yr	0.045	41000.00	1143.00	1162.98	19.98	7.88	5200.32	0.34		0.045		
Grand Ave - Drop	450.23	100-Yr	0.030	41000.00	1143.00	1160.39	17.39	9.30	4410.08	0.43		0.030		
Grand Ave - Drop	450.23	100-Yr	0.035	41000.00	1143.00	1161.21	18.21	8.80	4656.74	0.40		0.035		
Grand Ave - Drop	450.23	100-Yr	0.040	41000.00	1143.00	1162.09	19.09	8.32	4925.70	0.37		0.040		
Grand Ave - Drop	450.23	100-Yr	0.050	41000.00	1143.00	1163.85	20.85	7.49	5471.24	0.32		0.050		
Grand Ave - Drop	449.05	100-Yr	0.055	41000.00	1143.00	1164.32	21.32	7.90	5186.90	0.34		0.055		
Grand Ave - Drop	449.05	100-Yr	0.045	41000.00	1143.00	1162.54	19.54	8.85	4635.19	0.40		0.045		
Grand Ave - Drop	449.05	100-Yr	0.030	41000.00	1143.00	1159.76	16.76	10.76	3809.22	0.52		0.030		
Grand Ave - Drop	449.05	100-Yr	0.035	41000.00	1143.00	1160.66	17.65	10.07	4069.95	0.48		0.035		
Grand Ave - Drop	449.05	100-Yr	0.040	41000.00	1143.00	1161.60	18.60	9.42	4350.85	0.44		0.040		
Grand Ave - Drop	449.05	100-Yr	0.050	41000.00	1143.00	1163.45	20.45	8.34	4914.18	0.37		0.050		
Grand Ave - Drop	448.87	100-Yr	0.055	41000.00	1142.00	1163.46	21.46	8.93	4609.19	0.40		0.055	0.045	0.045
Grand Ave - Drop	448.87	100-Yr	0.045	41000.00	1142.00	1161.62	19.62	10.08	4067.09	0.46		0.045		
Grand Ave - Drop	448.87	100-Yr	0.030	41000.00	1142.00	1158.62	16.62	12.57	3262.83	0.62		0.030		
Grand Ave - Drop	448.87	100-Yr	0.035	41000.00	1142.00	1159.60	17.60	11.65	3520.68	0.56		0.035		
Grand Ave - Drop	448.87	100-Yr	0.040	41000.00	1142.00	1160.62	18.62	10.81	3793.87	0.51		0.040		
Grand Ave - Drop	448.87	100-Yr	0.050	41000.00	1142.00	1162.57	20.56	9.47	4331.33	0.43		0.050		
Grand Ave - Drop	441.6	100-Yr	0.055	41000.00	1142.00	1161.73	19.73	9.26	4425.47	0.43		0.055		
Grand Ave - Drop	441.6	100-Yr	0.045	41000.00	1142.00	1159.87	17.87	10.60	3868.58	0.51		0.045		
Grand Ave - Drop	441.6	100-Yr	0.030	41000.00	1142.00	1156.39	14.39	14.21	2884.59	0.77		0.030		
Grand Ave - Drop	441.6	100-Yr	0.035	41000.00	1142.00	1157.65	15.64	12.69	3231.57	0.66		0.035		
Grand Ave - Drop	441.6	100-Yr	0.040	41000.00	1142.00	1158.80	16.80	11.52	3558.47	0.58		0.040		
Grand Ave - Drop	441.6	100-Yr	0.050	41000.00	1142.00	1160.84	18.84	9.86	4157.12	0.47		0.050		
Grand Ave - Drop	435.37	100-Yr	0.055	41000.00	1138.00	1160.69	22.69	7.26	5688.25	0.30		0.055	0.045	0.045
Grand Ave - Drop	435.37	100-Yr	0.045	41000.00	1138.00	1159.06	21.06	8.01	5119.20	0.35		0.045		
Grand Ave - Drop	435.37	100-Yr	0.030	41000.00	1138.00	1156.46	18.46	9.50	4313.59	0.45		0.030		
Grand Ave - Drop	435.37	100-Yr	0.035	41000.00	1138.00	1157.29	19.29	8.97	4568.32	0.41		0.035		
Grand Ave - Drop	435.37	100-Yr	0.040	41000.00	1138.00	1158.18	20.18	8.47	4842.43	0.38		0.040		
Grand Ave - Drop	435.37	100-Yr	0.050	41000.00	1138.00	1159.90	21.90	7.61	5401.49	0.33		0.050	0.045	0.045
Grand Ave - Drop	429.37	100-Yr	0.055	41000.00	1139.00	1159.65	20.65	7.39	5568.81	0.31		0.055	0.045	0.045
Grand Ave - Drop	429.37	100-Yr	0.045	41000.00	1139.00	1158.11	19.11	8.13	5042.13	0.36		0.045		
Grand Ave - Drop	429.37	100-Yr	0.030	41000.00	1139.00	1155.79	16.79	9.51	4311.99	0.45		0.030		
Grand Ave - Drop	429.37	100-Yr	0.035	41000.00	1139.00	1156.49	17.49	9.05	4531.67	0.42		0.035		
Grand Ave - Drop	429.37	100-Yr	0.040	41000.00	1139.00	1157.29	18.29	8.57	4782.60	0.39		0.040		
Grand Ave - Drop	429.37	100-Yr	0.050	41000.00	1139.00	1158.90	19.90	7.74	5312.05	0.34		0.050	0.045	0.045
Grand Ave - Drop	424.17	100-Yr	0.055	41000.00	1138.00	1158.71	20.71	7.50	5510.47	0.32		0.055	0.045	0.045
Grand Ave - Drop	424.17	100-Yr	0.045	41000.00	1138.00	1157.26	19.26	8.20	5000.71	0.36		0.045		
Grand Ave - Drop	424.17	100-Yr	0.030	41000.00	1138.00	1155.24	17.24	9.37	4375.13	0.44		0.030		
Grand Ave - Drop	424.17	100-Yr	0.035	41000.00	1138.00	1155.82	17.82	9.01	4552.80	0.41		0.035		
Grand Ave - Drop	424.17	100-Yr	0.040	41000.00	1138.00	1156.52	18.52	8.60	4769.79	0.39		0.040		
Grand Ave - Drop	424.17	100-Yr	0.050	41000.00	1138.00	1158.00	20.00	7.83	5252.80	0.34		0.050	0.045	0.045
Grand Ave - Drop	418.97	100-Yr	0.055	41000.00	1138.00	1157.53	19.53	8.00	5146.40	0.35		0.055	0.045	0.045
Grand Ave - Drop	418.97	100-Yr	0.045	41000.00	1138.00	1156.16	18.16	8.76	4682.28	0.40		0.045		
Grand Ave - Drop	418.97	100-Yr	0.030	41000.00	1138.00	1154.45	16.45	9.91	4135.80	0.48		0.030		

HEC-RAS River: New River Reach: Grand Ave - Drop Profile: 100-Yr (Continued)

Reach	River Sta	Profile	Plan	Q Total	Min Ch El	W S Elev	Max Chl Dpth	Vel Chnl	Flow Area	Froude # Chl	Mann Comp	Mann Wtd Chnl	Mann Wtd Left	Mann Wtd Right
				(cfs)	(ft)	(ft)	(ft)	(ft/s)	(sq ft)					
Grand Ave - Drop	418.97	100-Yr	0.035	41000.00	1138.00	1154.88	16.88	9.59	4273.59	0.46		0.035		
Grand Ave - Drop	418.97	100-Yr	0.040	41000.00	1138.00	1155.49	17.49	9.18	4467.19	0.43		0.040		
Grand Ave - Drop	418.97	100-Yr	0.050	41000.00	1138.00	1156.85	18.85	8.36	4903.93	0.38		0.050		
Grand Ave - Drop	412.76	100-Yr	0.055	41000.00	1137.00	1155.91	18.91	8.27	4956.81	0.38		0.055		
Grand Ave - Drop	412.76	100-Yr	0.045	41000.00	1137.00	1154.76	17.76	8.96	4576.87	0.42		0.045		
Grand Ave - Drop	412.76	100-Yr	0.030	41000.00	1137.00	1153.67	16.67	9.71	4224.46	0.47		0.030		
Grand Ave - Drop	412.76	100-Yr	0.035	41000.00	1137.00	1153.85	16.85	9.58	4281.20	0.46		0.035		
Grand Ave - Drop	412.76	100-Yr	0.040	41000.00	1137.00	1154.24	17.24	9.30	4409.46	0.44		0.040		
Grand Ave - Drop	412.76	100-Yr	0.050	41000.00	1137.00	1155.32	18.32	8.61	4762.34	0.40		0.050		
Grand Ave - Drop	410.54	100-Yr	0.055	41000.00	1137.30	1154.06	16.76	11.37	3606.59	0.54		0.055		
Grand Ave - Drop	410.54	100-Yr	0.045	41000.00	1137.30	1152.72	15.42	12.57	3261.24	0.62		0.045		
Grand Ave - Drop	410.54	100-Yr	0.030	41000.00	1137.30	1151.69	14.39	13.65	3002.76	0.69		0.030		
Grand Ave - Drop	410.54	100-Yr	0.035	41000.00	1137.30	1151.69	14.39	13.65	3003.06	0.69		0.035		
Grand Ave - Drop	410.54	100-Yr	0.040	41000.00	1137.30	1152.11	14.81	13.20	3106.89	0.66		0.040		
Grand Ave - Drop	410.54	100-Yr	0.050	41000.00	1137.30	1153.39	16.08	11.95	3431.43	0.58		0.050		
Grand Ave - Drop	410.02			Bridge										
Grand Ave - Drop	409.5	100-Yr	0.055	41000.00	1136.97	1153.61	16.64	11.45	3581.36	0.54		0.055		
Grand Ave - Drop	409.5	100-Yr	0.045	41000.00	1136.97	1151.94	14.97	13.01	3151.12	0.65		0.045		
Grand Ave - Drop	409.5	100-Yr	0.030	41000.00	1136.97	1147.36	10.39	20.05	2044.78	1.19		0.030		
Grand Ave - Drop	409.5	100-Yr	0.035	41000.00	1136.97	1147.36	10.39	20.05	2045.23	1.19		0.035		
Grand Ave - Drop	409.5	100-Yr	0.040	41000.00	1136.97	1151.01	14.04	14.05	2918.33	0.72		0.040		
Grand Ave - Drop	409.5	100-Yr	0.050	41000.00	1136.97	1152.80	15.83	12.16	3371.77	0.59		0.050		
Grand Ave - Drop	406.5	100-Yr	0.055	41000.00	1136.00	1152.55	16.55	9.17	4470.78	0.44		0.055		
Grand Ave - Drop	406.5	100-Yr	0.045	41000.00	1136.00	1151.03	15.03	10.34	3966.63	0.52		0.045		
Grand Ave - Drop	406.5	100-Yr	0.030	41000.00	1136.00	1148.60	12.59	12.89	3179.74	0.72		0.030		
Grand Ave - Drop	406.5	100-Yr	0.035	41000.00	1136.00	1149.38	13.38	11.95	3429.73	0.65		0.035		
Grand Ave - Drop	406.5	100-Yr	0.040	41000.00	1136.00	1150.21	14.21	11.08	3698.78	0.58		0.040		
Grand Ave - Drop	406.5	100-Yr	0.050	41000.00	1136.00	1151.81	15.81	9.71	4224.47	0.48		0.050		
Grand Ave - Drop	402.5	100-Yr	0.055	41000.00	1136.00	1150.94	14.94	9.35	4399.99	0.46		0.055		0.045
Grand Ave - Drop	402.5	100-Yr	0.045	41000.00	1136.00	1149.37	13.37	10.65	3849.81	0.56		0.045		
Grand Ave - Drop	402.5	100-Yr	0.030	41000.00	1136.00	1146.52	10.52	14.12	2904.55	0.83		0.030		
Grand Ave - Drop	402.5	100-Yr	0.035	41000.00	1136.00	1147.55	11.55	12.65	3240.70	0.71		0.035		
Grand Ave - Drop	402.5	100-Yr	0.040	41000.00	1136.00	1148.49	12.49	11.53	3554.78	0.62		0.040		
Grand Ave - Drop	402.5	100-Yr	0.050	41000.00	1136.00	1150.18	14.18	9.94	4126.81	0.50		0.050		0.045
Grand Ave - Drop	395.5	100-Yr	0.055	41000.00	1133.00	1148.44	15.44	8.61	4760.40	0.42		0.055		
Grand Ave - Drop	395.5	100-Yr	0.045	41000.00	1133.00	1146.95	13.95	9.72	4219.58	0.50		0.045		
Grand Ave - Drop	395.5	100-Yr	0.030	41000.00	1133.00	1144.14	11.14	12.72	3222.01	0.74		0.030		
Grand Ave - Drop	395.5	100-Yr	0.035	41000.00	1133.00	1145.17	12.17	11.44	3582.42	0.63		0.035		
Grand Ave - Drop	395.5	100-Yr	0.040	41000.00	1133.00	1146.10	13.10	10.48	3913.00	0.56		0.040		
Grand Ave - Drop	395.5	100-Yr	0.050	41000.00	1133.00	1147.72	14.71	9.12	4496.54	0.46		0.050		
Grand Ave - Drop	392	100-Yr	0.055	41000.00	1131.00	1147.77	16.77	7.09	5812.23	0.34		0.055	0.045	
Grand Ave - Drop	392	100-Yr	0.045	41000.00	1131.00	1146.42	15.42	7.87	5215.79	0.39		0.045	0.045	
Grand Ave - Drop	392	100-Yr	0.030	41000.00	1131.00	1144.07	13.07	9.66	4244.15	0.53		0.030		
Grand Ave - Drop	392	100-Yr	0.035	41000.00	1131.00	1144.87	13.87	8.97	4570.01	0.47		0.035		
Grand Ave - Drop	392	100-Yr	0.040	41000.00	1131.00	1145.66	14.66	8.38	4893.54	0.43		0.040		
Grand Ave - Drop	392	100-Yr	0.050	41000.00	1131.00	1147.11	16.11	7.46	5518.57	0.36		0.050	0.045	
Grand Ave - Drop	388.5	100-Yr	0.055	41000.00	1131.00	1146.80	15.80	7.66	5385.45	0.38		0.055	0.045	0.045
Grand Ave - Drop	388.5	100-Yr	0.045	41000.00	1131.00	1145.43	14.43	8.58	4781.64	0.44		0.045		0.045
Grand Ave - Drop	388.5	100-Yr	0.030	41000.00	1131.00	1142.93	11.93	10.89	3766.10	0.63		0.030		
Grand Ave - Drop	388.5	100-Yr	0.035	41000.00	1131.00	1143.81	12.81	9.95	4120.78	0.55		0.035		
Grand Ave - Drop	388.5	100-Yr	0.040	41000.00	1131.00	1144.65	13.65	9.19	4460.60	0.49		0.040		
Grand Ave - Drop	388.5	100-Yr	0.050	41000.00	1131.00	1146.13	15.13	8.09	5086.61	0.41		0.050	0.045	0.045
Grand Ave - Drop	384.5	100-Yr	0.055	41000.00	1130.50	1145.65	15.15	7.73	5333.37	0.39		0.055	0.045	
Grand Ave - Drop	384.5	100-Yr	0.045	41000.00	1130.50	1144.30	13.80	8.68	4728.40	0.46		0.045	0.045	
Grand Ave - Drop	384.5	100-Yr	0.030	41000.00	1130.50	1141.69	11.19	11.30	3629.00	0.67		0.030		
Grand Ave - Drop	384.5	100-Yr	0.035	41000.00	1130.50	1142.65	12.15	10.19	4025.46	0.58		0.035		
Grand Ave - Drop	384.5	100-Yr	0.040	41000.00	1130.50	1143.51	13.01	9.35	4387.20	0.51		0.040		
Grand Ave - Drop	384.5	100-Yr	0.050	41000.00	1130.50	1144.99	14.49	8.17	5035.54	0.42		0.050	0.045	
Grand Ave - Drop	379.75	100-Yr	0.055	41000.00	1129.00	1144.67	15.67	6.81	6053.56	0.33		0.055	0.045	
Grand Ave - Drop	379.75	100-Yr	0.045	41000.00	1129.00	1143.46	14.46	7.49	5484.65	0.38		0.045	0.045	
Grand Ave - Drop	379.75	100-Yr	0.030	41000.00	1129.00	1141.20	12.20	9.14	4483.33	0.50		0.030		
Grand Ave - Drop	379.75	100-Yr	0.035	41000.00	1129.00	1141.99	12.99	8.49	4828.22	0.45		0.035		
Grand Ave - Drop	379.75	100-Yr	0.040	41000.00	1129.00	1142.75	13.75	7.95	5160.44	0.41		0.040		
Grand Ave - Drop	379.75	100-Yr	0.050	41000.00	1129.00	1144.07	15.07	7.13	5770.14	0.35		0.050	0.045	
Grand Ave - Drop	376.75	100-Yr	0.055	41000.00	1128.00	1143.96	15.96	7.07	5858.35	0.35		0.055	0.045	0.045
Grand Ave - Drop	376.75	100-Yr	0.045	41000.00	1128.00	1142.78	14.78	7.81	5252.68	0.40		0.045		
Grand Ave - Drop	376.75	100-Yr	0.030	41000.00	1128.00	1140.53	12.53	9.66	4244.99	0.55		0.030		
Grand Ave - Drop	376.75	100-Yr	0.035	41000.00	1128.00	1141.32	13.32	8.92	4596.23	0.49		0.035		
Grand Ave - Drop	376.75	100-Yr	0.040	41000.00	1128.00	1142.07	14.07	8.31	4933.47	0.44		0.040		
Grand Ave - Drop	376.75	100-Yr	0.050	41000.00	1128.00	1143.37	15.37	7.42	5545.63	0.38		0.050	0.045	0.045
Grand Ave - Drop	373.75	100-Yr	0.055	41000.00	1127.00	1143.53	16.53	6.00	6904.19	0.29		0.055	0.045	0.045
Grand Ave - Drop	373.75	100-Yr	0.045	41000.00	1127.00	1142.46	15.46	6.56	6253.90	0.33		0.045		
Grand Ave - Drop	373.75	100-Yr	0.030	41000.00	1127.00	1140.45	13.45	7.82	5240.85	0.43		0.030		
Grand Ave - Drop	373.75	100-Yr	0.035	41000.00	1127.00	1141.14	14.14	7.34	5585.61	0.39		0.035		
Grand Ave - Drop	373.75	100-Yr	0.040	41000.00	1127.00	1141.81	14.81	6.92	5926.42	0.36		0.040		
Grand Ave - Drop	373.75	100-Yr	0.050	41000.00	1127.00	1142.96	15.96	6.28	6569.30	0.31		0.050	0.045	0.045
Grand Ave - Drop	370.65	100-Yr	0.055	41000.00	1126.50	1142.87	16.37	6.49	6387.63	0.32		0.055	0.045	0.045
Grand Ave - Drop	370.65	100-Yr	0.045	41000.00	1126.50	1141.83	15.33	7.10	5776.41	0.37		0.045		
Grand Ave - Drop	370.65	100-Yr	0.030	41000.00	1126.50	1139.85	13.35	8.55	4795.90	0.48		0.030		
Grand Ave - Drop	370.65	100-Yr	0.035	41000.00	1126.50	1140.53	14.03	7.99	5130.35	0.44		0.035		
Grand Ave - Drop	370.65	100-Yr	0.040	41000.00	1126.50	1141.20	14.70	7.51	5460.75	0.40		0.040		
Grand Ave - Drop	370.65	100-Yr	0.050	41000.00	1126.50	1142.33	15.83	6.80	6059.72	0.35		0.050	0.045	0.045
Grand Ave - Drop	365.4	100-Yr	0.055	41000.00	1125.50	1141.21	15.71	7.90	5405.56	0.40		0.055	0.045	0.045
Grand Ave - Drop	365.4	100-Yr	0.045	41000.00	1125.50	1139.99	14.49	9.15	4482.71	0.49		0.045		
Grand Ave - Drop	365.4	100-Yr	0.030	41000.00	1125.50	1137.69	12.19	11.62	3528.44	0.70		0.030		
Grand Ave - Drop	365.4	100-Yr	0.035	41000.00	1125.50	1138.55	13.05	10.55	3884.48	0.61		0.035		

HEC-RAS River: New River Reach: Grand Ave - Drop Profile: 100-Yr (Continued)

Reach	River Sta	Profile	Plan	Q Total	Min Ch El	W.S. Elev	Max Chl Dpth	Vel Chnl	Flow Area	Froude # Chl	Mann Comp	Mann Wtd Chnl	Mann Wtd Left	Mann Wtd Right
				(cfs)	(ft)	(ft)	(ft)	(ft/s)	(sq ft)					
Grand Ave - Drop	365.4	100-Yr	0.040	41000.00	1125.50	1139.31	13.81	9.76	4199.68	0.54		0.040		
Grand Ave - Drop	365.4	100-Yr	0.050	41000.00	1125.50	1140.63	15.13	8.40	5068.86	0.44		0.050	0.045	0.045
Grand Ave - Drop	358.25	100-Yr	0.055	41000.00	1123.00	1138.44	15.44	8.90	4764.82	0.44		0.055	0.045	0.045
Grand Ave - Drop	358.25	100-Yr	0.045	41000.00	1123.00	1137.21	14.21	10.04	4183.71	0.53		0.045	0.045	0.045
Grand Ave - Drop	358.25	100-Yr	0.030	41000.00	1123.00	1134.98	11.98	12.59	3255.44	0.73		0.030		
Grand Ave - Drop	358.25	100-Yr	0.035	41000.00	1123.00	1135.80	12.80	11.56	3556.10	0.65		0.035		0.045
Grand Ave - Drop	358.25	100-Yr	0.040	41000.00	1123.00	1136.53	13.53	10.74	3867.98	0.58		0.040	0.045	0.045
Grand Ave - Drop	358.25	100-Yr	0.050	41000.00	1123.00	1137.85	14.85	9.43	4482.86	0.48		0.050	0.045	0.045
Grand Ave - Drop	352.4	100-Yr	0.055	41000.00	1122.00	1135.56	13.56	9.69	4300.25	0.50		0.055	0.045	0.045
Grand Ave - Drop	352.4	100-Yr	0.045	41000.00	1122.00	1134.38	12.38	10.83	3787.57	0.59		0.045		0.045
Grand Ave - Drop	352.4	100-Yr	0.030	41000.00	1122.00	1132.62	10.62	13.04	3144.64	0.78		0.030		
Grand Ave - Drop	352.4	100-Yr	0.035	41000.00	1122.00	1133.21	11.21	12.22	3355.86	0.71		0.035		
Grand Ave - Drop	352.4	100-Yr	0.040	41000.00	1122.00	1133.75	11.75	11.54	3553.16	0.65		0.040		
Grand Ave - Drop	352.4	100-Yr	0.050	41000.00	1122.00	1134.97	12.97	10.25	4007.80	0.55		0.050		0.045
Grand Ave - Drop	347.4	100-Yr	0.055	41000.00	1120.50	1132.90	12.40	9.82	4177.21	0.51		0.055	0.045	0.045
Grand Ave - Drop	347.4	100-Yr	0.045	41000.00	1120.50	1132.05	11.55	10.60	3868.14	0.57		0.045		
Grand Ave - Drop	347.4	100-Yr	0.030	41000.00	1120.50	1131.67	11.17	10.99	3731.79	0.60		0.030		
Grand Ave - Drop	347.4	100-Yr	0.035	41000.00	1120.50	1131.67	11.17	10.99	3732.10	0.60		0.035		
Grand Ave - Drop	347.4	100-Yr	0.040	41000.00	1120.50	1131.68	11.17	10.98	3732.46	0.60		0.040		
Grand Ave - Drop	347.4	100-Yr	0.050	41000.00	1120.50	1132.43	11.93	10.23	4007.02	0.54		0.050	0.000	0.000
Grand Ave - Drop	347.255			Bridge										
Grand Ave - Drop	347.1	100-Yr	0.055	41000.00	1120.40	1132.27	11.87	10.30	3982.44	0.55		0.055	0.000	0.000
Grand Ave - Drop	347.1	100-Yr	0.045	41000.00	1120.40	1131.13	10.73	11.48	3571.06	0.64		0.045		
Grand Ave - Drop	347.1	100-Yr	0.030	41000.00	1120.40	1126.80	6.40	19.88	2061.86	1.42		0.030		
Grand Ave - Drop	347.1	100-Yr	0.035	41000.00	1120.40	1126.81	6.40	19.87	2063.39	1.42		0.035		
Grand Ave - Drop	347.1	100-Yr	0.040	41000.00	1120.40	1126.81	6.41	19.85	2065.12	1.41		0.040		
Grand Ave - Drop	347.1	100-Yr	0.050	41000.00	1120.40	1131.68	11.28	10.88	3769.28	0.59		0.050		
Grand Ave - Drop	346.8	100-Yr	0.055	41000.00	1119.92	1132.10	12.18	10.35	3960.80	0.54		0.055		
Grand Ave - Drop	346.8	100-Yr	0.045	41000.00	1119.92	1131.00	11.08	11.47	3575.62	0.63		0.045		
Grand Ave - Drop	346.8	100-Yr	0.030	41000.00	1119.92	1130.38	10.46	12.19	3363.93	0.69		0.030		
Grand Ave - Drop	346.8	100-Yr	0.035	41000.00	1119.92	1130.42	10.50	12.14	3376.66	0.68		0.035		
Grand Ave - Drop	346.8	100-Yr	0.040	41000.00	1119.92	1130.47	10.54	12.09	3391.92	0.68		0.040		
Grand Ave - Drop	346.8	100-Yr	0.050	41000.00	1119.92	1131.53	11.61	10.91	3759.44	0.59		0.050		
Grand Ave - Drop	346.4	100-Yr	0.055	41000.00	1119.80	1132.01	12.21	10.12	4050.02	0.53		0.055	0.045	0.045
Grand Ave - Drop	346.4	100-Yr	0.045	41000.00	1119.80	1130.93	11.13	11.18	3665.81	0.61		0.045	0.000	0.000
Grand Ave - Drop	346.4	100-Yr	0.030	41000.00	1119.80	1130.42	10.62	11.77	3483.27	0.66		0.030		
Grand Ave - Drop	346.4	100-Yr	0.035	41000.00	1119.80	1130.42	10.62	11.77	3483.66	0.66		0.035		
Grand Ave - Drop	346.4	100-Yr	0.040	41000.00	1119.80	1130.42	10.62	11.77	3484.18	0.66		0.040		
Grand Ave - Drop	346.4	100-Yr	0.050	41000.00	1119.80	1131.44	11.64	10.65	3848.51	0.57		0.050	0.045	0.045
Grand Ave - Drop	345.95			Bridge										
Grand Ave - Drop	345.5	100-Yr	0.055	41000.00	1119.40	1131.54	12.14	10.21	4015.69	0.54		0.055	0.045	0.045
Grand Ave - Drop	345.5	100-Yr	0.045	41000.00	1119.40	1130.04	10.64	11.78	3481.73	0.66		0.045		
Grand Ave - Drop	345.5	100-Yr	0.030	41000.00	1119.40	1126.52	7.12	18.09	2266.67	1.23		0.030		
Grand Ave - Drop	345.5	100-Yr	0.035	41000.00	1119.40	1126.52	7.12	18.08	2267.33	1.23		0.035		
Grand Ave - Drop	345.5	100-Yr	0.040	41000.00	1119.40	1126.53	7.13	18.08	2267.94	1.23		0.040		
Grand Ave - Drop	345.5	100-Yr	0.050	41000.00	1119.40	1130.81	11.41	10.92	3755.73	0.59		0.050	0.000	0.000
Grand Ave - Drop	343.7	100-Yr	0.055	41000.00	1117.62	1130.64	13.02	9.60	4271.06	0.49		0.055		
Grand Ave - Drop	343.7	100-Yr	0.045	41000.00	1117.62	1129.16	11.54	10.94	3746.62	0.59		0.045		
Grand Ave - Drop	343.7	100-Yr	0.030	41000.00	1117.62	1126.55	8.93	14.44	2839.85	0.89		0.030		
Grand Ave - Drop	343.7	100-Yr	0.035	41000.00	1117.62	1127.50	9.88	12.95	3167.12	0.76		0.035		
Grand Ave - Drop	343.7	100-Yr	0.040	41000.00	1117.62	1128.35	10.73	11.83	3465.74	0.66		0.040		
Grand Ave - Drop	343.7	100-Yr	0.050	41000.00	1117.62	1129.91	12.29	10.21	4013.83	0.53		0.050		
Grand Ave - Drop	342	100-Yr	0.055	41000.00	1116.62	1129.95	13.32	9.08	4515.66	0.46		0.055		
Grand Ave - Drop	342	100-Yr	0.045	41000.00	1116.62	1128.49	11.87	10.31	3976.95	0.55		0.045		
Grand Ave - Drop	342	100-Yr	0.030	41000.00	1116.62	1126.04	9.42	13.32	3078.72	0.81		0.030		
Grand Ave - Drop	342	100-Yr	0.035	41000.00	1116.62	1126.90	10.28	12.08	3393.90	0.70		0.035		
Grand Ave - Drop	342	100-Yr	0.040	41000.00	1116.62	1127.72	11.09	11.11	3691.81	0.62		0.040		
Grand Ave - Drop	342	100-Yr	0.050	41000.00	1116.62	1129.23	12.61	9.65	4250.54	0.50		0.050		
Grand Ave - Drop	337	100-Yr	0.055	41000.00	1114.22	1127.76	13.54	9.21	4449.53	0.46		0.055		
Grand Ave - Drop	337	100-Yr	0.045	41000.00	1114.22	1126.29	12.07	10.45	3925.09	0.55		0.045		
Grand Ave - Drop	337	100-Yr	0.030	41000.00	1114.22	1123.81	9.59	13.44	3050.03	0.80		0.030		
Grand Ave - Drop	337	100-Yr	0.035	41000.00	1114.22	1124.69	10.47	12.21	3356.82	0.70		0.035		
Grand Ave - Drop	337	100-Yr	0.040	41000.00	1114.22	1125.51	11.29	11.24	3647.13	0.62		0.040		
Grand Ave - Drop	337	100-Yr	0.050	41000.00	1114.22	1127.04	12.82	9.78	4190.77	0.50		0.050		

Design N-Values

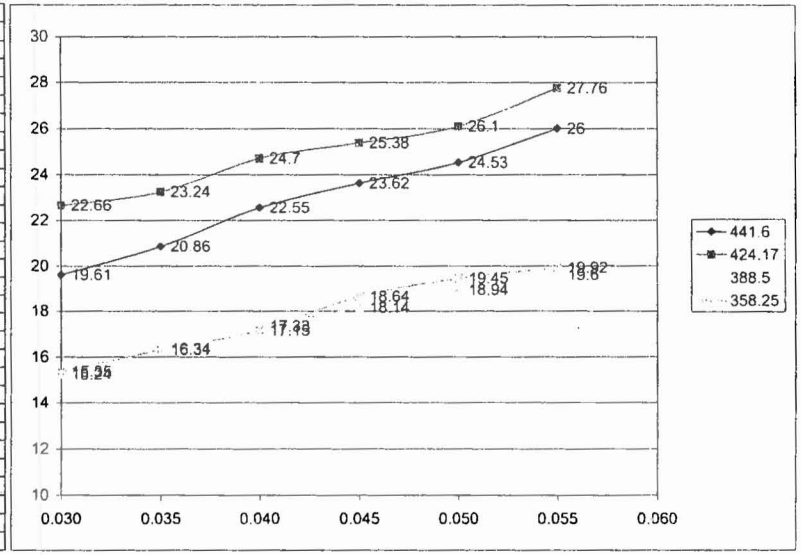
HEC-RAS Plan: Design N River: New River Reach: Grand Ave - Drop

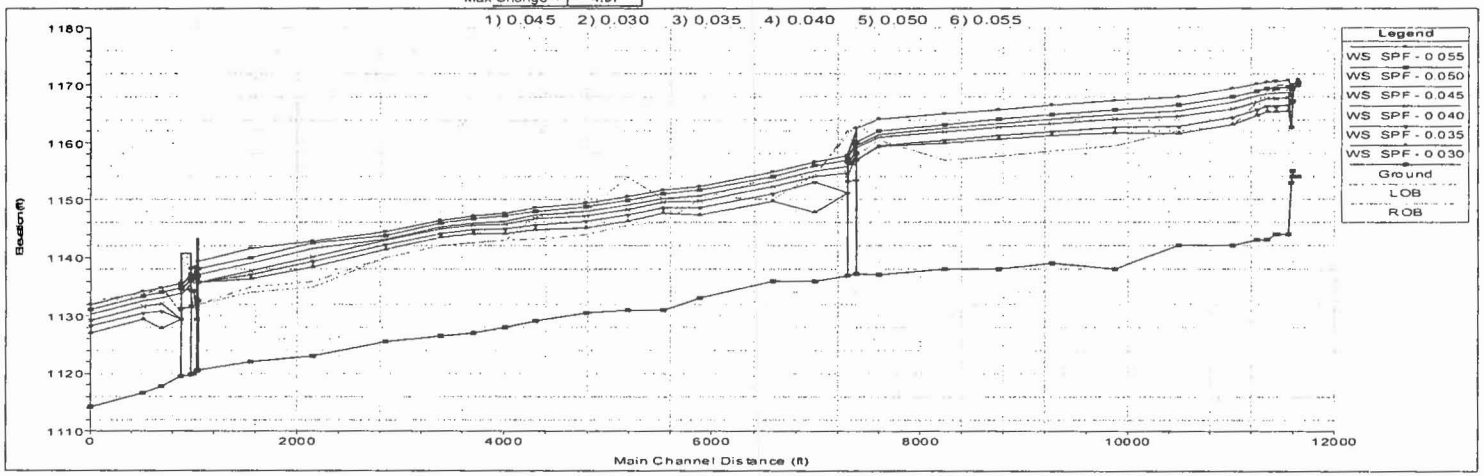
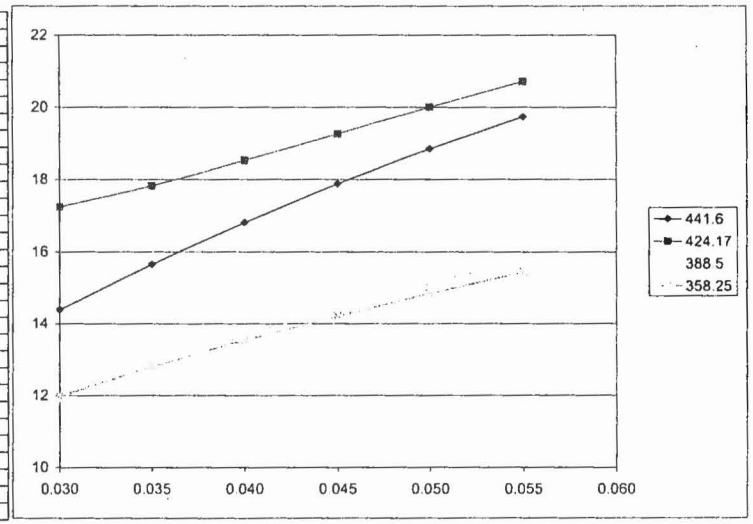
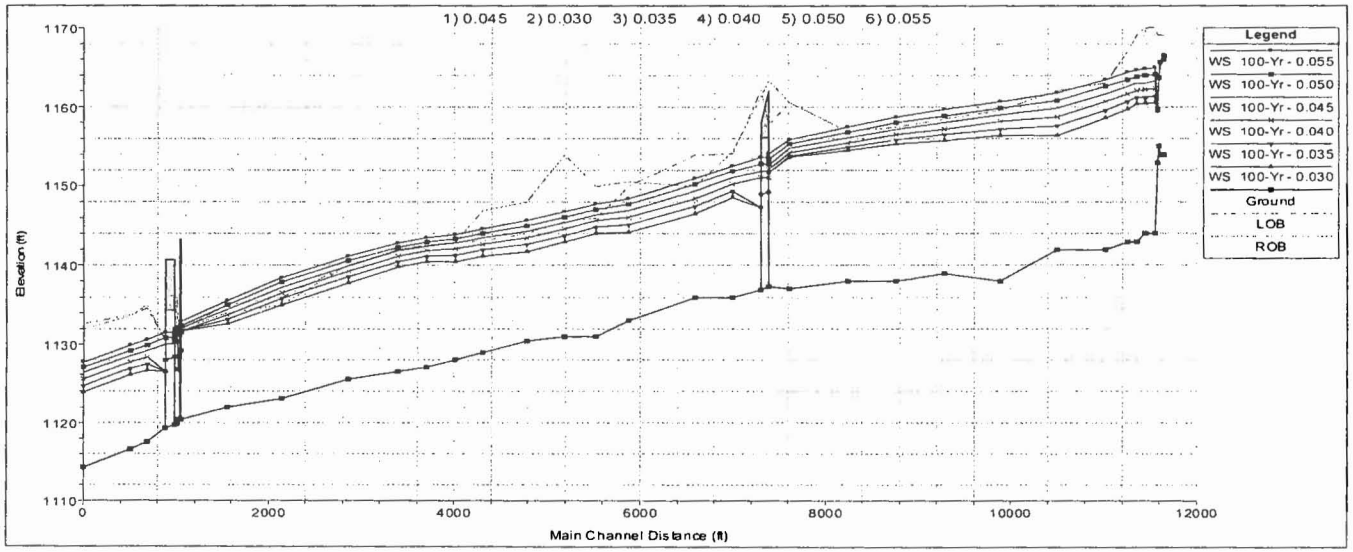
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Max Chl Dpth	Vel Chnl	Flow Area	Froude # Chl	Mann Comp	Mann Wtd Chnl	Mann Wtd Left	Mann Wtd Rght
			(cfs)	(ft)	(ft)	(ft)	(ft/s)	(sq ft)					
Grand Ave - Drop	453.23	10-Yr	10500	1154	1159.79	5.79	6.92	1517.71	0.53		0.03		
Grand Ave - Drop	453.23	100-Yr	41000	1154	1165.91	11.91	12.3	3332.69	0.66		0.03		
Grand Ave - Drop	453.23	SPF	68000	1154	1169.91	15.91	14.78	4624.05	0.69		0.03	0.045	0.045
Grand Ave - Drop	452.73	10-Yr	10500	1154	1159.56	5.56	7.39	1420.22	0.59		0.03		
Grand Ave - Drop	452.73	100-Yr	41000	1154	1165.51	11.51	12.9	3177.98	0.7		0.03		
Grand Ave - Drop	452.73	SPF	68000	1154	1169.41	15.41	15.47	4397.63	0.73		0.03	0.045	0.045
Grand Ave - Drop	452.65	10-Yr	10500	1155	1158.53	3.53	10.61	989.6	1		0.03		
Grand Ave - Drop	452.65	100-Yr	41000	1155	1163.68	8.68	16.47	2488.75	1		0.03		
Grand Ave - Drop	452.65	SPF	68000	1155	1167.11	12.11	19.3	3526.2	1		0.03	0.045	
Grand Ave - Drop	452.5	10-Yr	10500	1153	1155.26	2.26	17.02	617.07	2.01		0.03		
Grand Ave - Drop	452.5	100-Yr	41000	1153	1159.56	6.55	22.44	1827.03	1.57		0.03		
Grand Ave - Drop	452.5	SPF	68000	1153	1162.62	9.62	25.04	2715.9	1.45		0.03		
Grand Ave - Drop	452.23	10-Yr	10500	1144	1153.58	9.58	4.66	2252.54	0.28		0.03		
Grand Ave - Drop	452.23	100-Yr	41000	1144	1162.98	18.98	8.4	4879.07	0.36		0.03		
Grand Ave - Drop	452.23	SPF	68000	1144	1168.18	24.18	10.61	6411.25	0.4		0.03		
Grand Ave - Drop	451.23	10-Yr	10500	1144	1153.54	9.54	4.54	2313.03	0.27		0.03		
Grand Ave - Drop	451.23	100-Yr	41000	1144	1162.92	18.92	8.36	4904.95	0.36		0.03		
Grand Ave - Drop	451.23	SPF	68000	1144	1168.1	24.1	10.61	6413.99	0.4		0.03	0.045	
Grand Ave - Drop	451.05	10-Yr	10500	1144	1153.51	9.51	4.65	2259.38	0.28	0.043	0.043		
Grand Ave - Drop	451.05	100-Yr	41000	1144	1162.91	18.91	8.32	4928.71	0.36	0.042	0.042		
Grand Ave - Drop	451.05	SPF	68000	1144	1168.12	24.12	10.44	6515.62	0.4	0.041	0.041		
Grand Ave - Drop	450.23	10-Yr	10500	1143	1153.39	10.39	4.72	2223.66	0.28		0.049		
Grand Ave - Drop	450.23	100-Yr	41000	1143	1162.73	19.73	8.47	4837.98	0.37		0.05		
Grand Ave - Drop	450.23	SPF	68000	1143	1167.94	24.94	10.48	6488.98	0.42		0.05		0.045
Grand Ave - Drop	449.05	10-Yr	10500	1143	1153.11	10.11	5.39	1948.71	0.34		0.051		
Grand Ave - Drop	449.05	100-Yr	41000	1143	1162.25	19.25	9.26	4425.88	0.42		0.051		
Grand Ave - Drop	449.05	SPF	68000	1143	1167.38	24.38	11.25	6077.16	0.46		0.051	0.045	0.045
Grand Ave - Drop	446.87	10-Yr	10500	1142	1152.58	10.58	5.6	1875.31	0.35		0.05		
Grand Ave - Drop	446.87	100-Yr	41000	1142	1161.39	19.39	9.81	4177.76	0.45		0.051		
Grand Ave - Drop	446.87	SPF	68000	1142	1166.45	24.45	11.78	5898.32	0.48		0.051	0.045	0.045
Grand Ave - Drop	441.6	10-Yr	10500	1142	1150.13	8.13	7.71	1362.61	0.58	0.051	0.051		
Grand Ave - Drop	441.6	100-Yr	41000	1142	1159.03	17.03	10.68	3840.08	0.53	0.052	0.052		
Grand Ave - Drop	441.6	SPF	68000	1142	1164.32	22.32	12.22	5695.3	0.51	0.052	0.052	0.045	0.045
Grand Ave - Drop	435.37	10-Yr	10500	1138	1149.01	11.01	5.12	2052.49	0.32	0.039	0.039		
Grand Ave - Drop	435.37	100-Yr	41000	1138	1157.87	19.87	9.03	4539.06	0.41	0.038	0.038		
Grand Ave - Drop	435.37	SPF	68000	1138	1163.21	25.21	10.92	6444.67	0.43	0.038	0.038	0.045	0.045
Grand Ave - Drop	429.37	10-Yr	10500	1139	1148.29	9.29	5.15	2039.93	0.33	0.038	0.038		
Grand Ave - Drop	429.37	100-Yr	41000	1139	1157	18	8.97	4571.23	0.41	0.038	0.038		
Grand Ave - Drop	429.37	SPF	68000	1139	1162.37	23.37	10.79	6484.92	0.42	0.038	0.038	0.045	0.045
Grand Ave - Drop	424.17	10-Yr	10500	1138	1147.75	9.75	4.89	2146.01	0.31	0.037	0.037		
Grand Ave - Drop	424.17	100-Yr	41000	1138	1156.3	18.3	8.83	4641.5	0.4	0.037	0.037		
Grand Ave - Drop	424.17	SPF	68000	1138	1161.69	23.69	10.64	6565.44	0.42	0.037	0.037	0.045	0.045
Grand Ave - Drop	418.97	10-Yr	10500	1138	1146.91	8.91	5.83	1800.45	0.4	0.037	0.037		
Grand Ave - Drop	418.97	100-Yr	41000	1138	1155.22	17.22	9.7	4225.07	0.46	0.037	0.037		
Grand Ave - Drop	418.97	SPF	68000	1138	1160.68	22.68	11.33	6178.54	0.46	0.037	0.037	0.045	0.045
Grand Ave - Drop	412.76	10-Yr	10500	1137	1145.47	8.47	6.48	1621.62	0.46	0.038	0.038		
Grand Ave - Drop	412.76	100-Yr	41000	1137	1153.72	16.72	10.32	3971.66	0.5	0.038	0.038		
Grand Ave - Drop	412.76	SPF	68000	1137	1159.28	22.27	11.91	5710.19	0.5	0.038	0.038	0.045	0.035
Grand Ave - Drop	410.54	10-Yr	10500	1137.3	1144.46	7.16	7.98	1315.2	0.57		0.035		
Grand Ave - Drop	410.54	100-Yr	41000	1137.3	1151.69	14.39	13.65	3003.06	0.69		0.035		
Grand Ave - Drop	410.54	SPF	68000	1137.3	1157.01	19.71	15.48	4393.48	0.68		0.035		
Grand Ave - Drop	410.02		Bridge										
Grand Ave - Drop	409.5	10-Yr	10500	1136.97	1144.22	7.25	7.82	1343.04	0.55		0.035		
Grand Ave - Drop	409.5	100-Yr	41000	1136.97	1147.36	10.39	20.05	2045.23	1.19		0.035		
Grand Ave - Drop	409.5	SPF	68000	1136.97	1151.15	14.18	23.02	2954	1.18		0.035		
Grand Ave - Drop	406.5	10-Yr	10500	1136	1143.42	7.42	6.62	1585.52	0.51	0.037	0.037		
Grand Ave - Drop	406.5	100-Yr	41000	1136	1149.62	13.62	11.69	3508.46	0.62	0.037	0.037		
Grand Ave - Drop	406.5	SPF	68000	1136	1153.32	17.32	14.38	4729.26	0.68	0.037	0.037		
Grand Ave - Drop	402.5	10-Yr	10500	1136	1141.84	5.84	7.38	1422.73	0.6		0.036		
Grand Ave - Drop	402.5	100-Yr	41000	1136	1147.81	11.81	12.32	3327.53	0.69		0.037		
Grand Ave - Drop	402.5	SPF	68000	1136	1151.4	15.4	14.97	4567.27	0.72		0.037		0.045
Grand Ave - Drop	395.5	10-Yr	10500	1133	1139.34	6.34	6.6	1589.9	0.53	0.037	0.037		
Grand Ave - Drop	395.5	100-Yr	41000	1133	1145.42	12.42	11.17	3670.32	0.61	0.036	0.036		
Grand Ave - Drop	395.5	SPF	68000	1133	1148.96	15.96	13.73	4952.78	0.66	0.036	0.036		
Grand Ave - Drop	392	10-Yr	10500	1131	1138.82	7.82	4.92	2133.35	0.37		0.036		
Grand Ave - Drop	392	100-Yr	41000	1131	1145.03	14.03	8.93	4590.09	0.47		0.037		
Grand Ave - Drop	392	SPF	68000	1131	1148.74	17.74	11.07	6199.25	0.51		0.037	0.045	
Grand Ave - Drop	388.5	10-Yr	10500	1131	1138.06	7.06	5.64	1861.69	0.45	0.036	0.036		

Design N-Values.

HEC-RAS Plan: Design N River: New River Reach: Grand Ave - Drop													
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Max Chl Dpth	Vel Chnl	Flow Area	Froude # Chl	Mann Comp	Mann Wtd Chnl	Mann Wtd Left	Mann Wtd Rght
			(cfs)	(ft)	(ft)	(ft)	(ft/s)	(sq ft)					
Grand Ave - Drop	388.5	100-Yr	41000	1131	1143.98	12.98	9.78	4190.12	0.54	0.036	0.036		
Grand Ave - Drop	388.5	SPF	68000	1131	1147.55	16.55	11.99	5728.63	0.57	0.036	0.036	0.045	0.045
Grand Ave - Drop	384.5	10-Yr	10500	1130.5	1136.69	6.19	6.49	1616.67	0.56	0.036	0.036		
Grand Ave - Drop	384.5	100-Yr	41000	1130.5	1142.8	12.29	10.03	4089.38	0.56	0.036	0.036		
Grand Ave - Drop	384.5	SPF	68000	1130.5	1146.4	15.9	12.08	5678.19	0.59	0.036	0.036	0.045	
Grand Ave - Drop	379.75	10-Yr	10500	1129	1135.83	6.83	4.76	2206.55	0.36	0.037	0.037		
Grand Ave - Drop	379.75	100-Yr	41000	1129	1142.06	13.06	8.44	4858.16	0.45	0.037	0.037		
Grand Ave - Drop	379.75	SPF	68000	1129	1145.69	16.69	10.48	6542.97	0.49	0.037	0.037	0.045	
Grand Ave - Drop	376.75	10-Yr	10500	1128	1135.21	7.21	5.28	1989.15	0.42	0.037	0.037		
Grand Ave - Drop	376.75	100-Yr	41000	1128	1141.33	13.33	8.91	4599.54	0.49	0.037	0.037		
Grand Ave - Drop	376.75	SPF	68000	1128	1144.95	16.94	10.85	6388.66	0.52	0.037	0.037	0.045	0.045
Grand Ave - Drop	373.75	10-Yr	10500	1127	1134.91	7.91	4.12	2549.56	0.31		0.036		
Grand Ave - Drop	373.75	100-Yr	41000	1127	1141.11	14.11	7.36	5573.97	0.39		0.036		
Grand Ave - Drop	373.75	SPF	68000	1127	1144.83	17.83	9.04	7703.84	0.42		0.036	0.045	0.045
Grand Ave - Drop	370.65	10-Yr	10500	1126.5	1134.38	7.88	4.85	2165.42	0.4	0.036	0.036		
Grand Ave - Drop	370.65	100-Yr	41000	1126.5	1140.47	13.97	8.04	5098.63	0.44	0.036	0.036		
Grand Ave - Drop	370.65	SPF	68000	1126.5	1144.12	17.62	9.75	7164.15	0.46	0.036	0.036	0.045	0.045
Grand Ave - Drop	365.4	10-Yr	10500	1125.5	1132.46	6.96	7.32	1433.49	0.67		0.034		
Grand Ave - Drop	365.4	100-Yr	41000	1125.5	1138.36	12.86	10.77	3806.18	0.63		0.035		
Grand Ave - Drop	365.4	SPF	68000	1125.5	1142.1	16.6	12.25	5932.83	0.6		0.035	0.045	0.045
Grand Ave - Drop	358.25	10-Yr	10500	1123	1130.32	7.32	6.35	1652.77	0.51	0.034	0.034		
Grand Ave - Drop	358.25	100-Yr	41000	1123	1135.61	12.61	11.79	3485.59	0.66	0.034	0.034	0.045	0.045
Grand Ave - Drop	358.25	SPF	68000	1123	1139.02	16.02	14.26	5040.34	0.69	0.034	0.034	0.045	0.045
Grand Ave - Drop	352.4	10-Yr	10500	1122	1127.1	5.1	8.92	1177.47	0.86	0.034	0.034		
Grand Ave - Drop	352.4	100-Yr	41000	1122	1132.91	10.91	12.62	3249.41	0.74	0.034	0.034		
Grand Ave - Drop	352.4	SPF	68000	1122	1136.94	14.94	14.21	5005.97	0.7	0.034	0.034	0.045	0.03
Grand Ave - Drop	347.4	10-Yr	10500	1120.5	1125.27	4.77	7.08	1516.83	0.57		0.03	0.045	0.045
Grand Ave - Drop	347.4	100-Yr	41000	1120.5	1131.68	11.18	11.55	3734.35	0.61		0.03	0.045	0.045
Grand Ave - Drop	347.4	SPF	68000	1120.5	1135.72	15.22	13.89	5202.76	0.63		0.03	0.045	0.045
Grand Ave - Drop	347.255		Bridge										
Grand Ave - Drop	347.1	10-Yr	10500	1120.4	1122.94	2.54	13.4	793.25	1.48		0.03	0.045	0.045
Grand Ave - Drop	347.1	100-Yr	41000	1120.4	1126.87	6.46	20.27	2083.76	1.4		0.03	0.045	0.045
Grand Ave - Drop	347.1	SPF	68000	1120.4	1129.6	9.2	23.43	3025.99	1.36		0.03	0.045	0.045
Grand Ave - Drop	346.8	10-Yr	10500	1119.92	1124.3	4.38	7.84	1338.76	0.68		0.03		
Grand Ave - Drop	346.8	100-Yr	41000	1119.92	1130.61	10.69	11.91	3441.45	0.66		0.03		
Grand Ave - Drop	346.8	SPF	68000	1119.92	1134.66	14.74	13.97	4868.71	0.67		0.03		
Grand Ave - Drop	346.4	10-Yr	10500	1119.8	1124.23	4.43	7.77	1382	0.65		0.03	0.045	0.045
Grand Ave - Drop	346.4	100-Yr	41000	1119.8	1130.41	10.6	12.42	3477.53	0.67		0.03	0.045	0.045
Grand Ave - Drop	346.4	SPF	68000	1119.8	1134.31	14.51	14.85	4872	0.69		0.03	0.045	0.045
Grand Ave - Drop	345.95		Bridge										
Grand Ave - Drop	345.5	10-Yr	10500	1119.4	1122.29	2.89	11.99	888.79	1.24		0.03	0.045	0.045
Grand Ave - Drop	345.5	100-Yr	41000	1119.4	1126.63	7.23	18.46	2301.36	1.21		0.03	0.045	0.045
Grand Ave - Drop	345.5	SPF	68000	1119.4	1129.63	10.23	21.41	3337.05	1.18		0.03	0.045	0.045
Grand Ave - Drop	343.7	10-Yr	10500	1117.62	1121.92	4.3	8.31	1264.04	0.75		0.03		
Grand Ave - Drop	343.7	100-Yr	41000	1117.62	1126.91	9.29	13.84	2962.68	0.83		0.03		
Grand Ave - Drop	343.7	SPF	68000	1117.62	1127.44	9.82	21.6	3148.15	1.26		0.03		
Grand Ave - Drop	342	10-Yr	10500	1116.62	1121.21	4.59	7.76	1352.28	0.7		0.03		
Grand Ave - Drop	342	100-Yr	41000	1116.62	1126.56	9.94	12.54	3269.42	0.74		0.03		
Grand Ave - Drop	342	SPF	68000	1116.62	1130.04	13.42	14.94	4550.54	0.75		0.03		
Grand Ave - Drop	337	10-Yr	10500	1114.22	1119.17	4.95	7.22	1453.66	0.61		0.035		
Grand Ave - Drop	337	100-Yr	41000	1114.22	1124.69	10.47	12.21	3356.82	0.7		0.035		
Grand Ave - Drop	337	SPF	68000	1114.22	1128.18	13.96	14.78	4601.39	0.73		0.035		

Reach	River Sta	Profile	Plan	Min Ch El (ft)	W.S. Elev (ft)	Depth (ft)	Delta (ft)
Grand Ave - Drop	441.6	SPF	0.030	1142	1161.61	19.61	
Grand Ave - Drop	441.6	SPF	0.035	1142	1162.86	20.86	1.25
Grand Ave - Drop	441.6	SPF	0.040	1142	1164.55	22.55	1.69
Grand Ave - Drop	441.6	SPF	0.045	1142	1165.62	23.62	1.07
Grand Ave - Drop	441.6	SPF	0.050	1142	1166.53	24.53	0.91
Grand Ave - Drop	441.6	SPF	0.055	1142	1168	26	1.47
					Max Change=>	**6.39**	
Grand Ave - Drop	424.17	SPF	0.03	1138	1160.66	22.66	
Grand Ave - Drop	424.17	SPF	0.035	1138	1161.24	23.24	0.58
Grand Ave - Drop	424.17	SPF	0.04	1138	1162.7	24.7	1.46
Grand Ave - Drop	424.17	SPF	0.045	1138	1163.38	25.38	0.68
Grand Ave - Drop	424.17	SPF	0.05	1138	1164.1	26.1	0.72
Grand Ave - Drop	424.17	SPF	0.055	1138	1165.76	27.76	1.66
					Max Change=>	**5.1**	
Grand Ave - Drop	388.5	SPF	0.03	1131	1146.24	15.24	
Grand Ave - Drop	388.5	SPF	0.035	1131	1147.34	16.34	1.1
Grand Ave - Drop	388.5	SPF	0.04	1131	1148.33	17.33	0.99
Grand Ave - Drop	388.5	SPF	0.045	1131	1149.14	18.14	0.81
Grand Ave - Drop	388.5	SPF	0.05	1131	1149.94	18.94	0.8
Grand Ave - Drop	388.5	SPF	0.055	1131	1150.6	19.6	0.66
					Max Change=>	**4.36**	
Grand Ave - Drop	358.25	SPF	0.03	1123	1138.35	15.35	
Grand Ave - Drop	358.25	SPF	0.035	1123	1139.31	16.31	0.96
Grand Ave - Drop	358.25	SPF	0.04	1123	1140.15	17.15	0.84
Grand Ave - Drop	358.25	SPF	0.045	1123	1141.64	18.64	1.49
Grand Ave - Drop	358.25	SPF	0.05	1123	1142.45	19.45	0.81
Grand Ave - Drop	358.25	SPF	0.055	1123	1142.92	19.92	0.47
					Max Change=>	**4.57**	





Reach	River Sta	Profile	Plan	Min Ch El (ft)	W.S. Elev (ft)	Depth (ft)	Delta (ft)
Grand Ave - Drop	441.6	100-Yr	0.030	1142	1156.39	14.39	
Grand Ave - Drop	441.6	100-Yr	0.035	1142	1157.65	15.65	1.26
Grand Ave - Drop	441.6	100-Yr	0.040	1142	1158.8	16.8	1.15
Grand Ave - Drop	441.6	100-Yr	0.045	1142	1159.87	17.87	1.07
Grand Ave - Drop	441.6	100-Yr	0.050	1142	1160.84	18.84	0.97
Grand Ave - Drop	441.6	100-Yr	0.055	1142	1161.73	19.73	0.89
					Max Change=>	**5.34**	
Grand Ave - Drop	424.17	100-Yr	0.030	1138	1155.24	17.24	
Grand Ave - Drop	424.17	100-Yr	0.035	1138	1155.82	17.82	0.58
Grand Ave - Drop	424.17	100-Yr	0.040	1138	1156.52	18.52	0.7
Grand Ave - Drop	424.17	100-Yr	0.045	1138	1157.26	19.26	0.74
Grand Ave - Drop	424.17	100-Yr	0.050	1138	1158	20	0.74
Grand Ave - Drop	424.17	100-Yr	0.055	1138	1158.71	20.71	0.71
					Max Change=>	**3.47**	
Grand Ave - Drop	388.5	100-Yr	0.030	1131	1142.93	11.93	
Grand Ave - Drop	388.5	100-Yr	0.035	1131	1143.81	12.81	0.88
Grand Ave - Drop	388.5	100-Yr	0.040	1131	1144.65	13.65	0.84
Grand Ave - Drop	388.5	100-Yr	0.045	1131	1145.43	14.43	0.78
Grand Ave - Drop	388.5	100-Yr	0.050	1131	1146.13	15.13	0.7
Grand Ave - Drop	388.5	100-Yr	0.055	1131	1146.8	15.8	0.67
					Max Change=>	**3.87**	
Grand Ave - Drop	358.25	100-Yr	0.030	1123	1134.98	11.98	
Grand Ave - Drop	358.25	100-Yr	0.035	1123	1135.8	12.8	0.82
Grand Ave - Drop	358.25	100-Yr	0.040	1123	1136.53	13.53	0.73
Grand Ave - Drop	358.25	100-Yr	0.045	1123	1137.21	14.21	0.68
Grand Ave - Drop	358.25	100-Yr	0.050	1123	1137.85	14.85	0.64
Grand Ave - Drop	358.25	100-Yr	0.055	1123	1138.44	15.44	0.59
					Max Change=>	**3.46**