PRELIMINARY FINDINGS

Colville River Delta Two-Dimensional Surface Water Model

Nigliq Channel Bridge Project

Submitted to

ConocoPhillips

March 2004

By

Baker

Michael Baker Jr., Inc.
4601 Business Park Blvd., Suite 42
Anchorage, Alaska 99503
907-273-1600
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Executive Summary

Since 1997, two-dimensional surface water modeling has been used to predict water surface elevations and velocities in the Colville River delta. The model has proven to be a reliable tool and has been integral in the design of all existing Alpine facilities, pads, and pipelines.

The purpose of the 2004 modeling program was to evaluate potential hydrologic and hydraulic impacts of a road from the CD-2 pad into the National Petroleum Reserve Alaska (NPRA). The modeling focused on evaluation of three Nigliq Channel bridge lengths under varying hydrologic conditions and described how each of those bridge length options would affected the region's hydrology in general, as well as water surface elevation, velocity, and discharge at existing, planned, and proposed oilfield facilities.

Eleven final model runs were necessary to adequately model the 900-, 1,200-, and 1,500-foot Nigliq Channel bridge lengths during the 10-, 50-, and 200-year recurrence interval floods. Based on the 2004 modeling program, the following generalized conclusions can be made with regard to short- and long-term trends in water surface elevation, water velocity, and discharge:

Water Surface Elevation

- ◊ Water surface elevation increases at existing and planned facilities due to the presence of a bridge across the Nigliq Channel were generally considered to be negligible during both frequent and infrequent spring breakup flooding events.
- ◊ Higher water surface elevation increases relative to baseline conditions were expected during frequent flood events than were expected during infrequent flood events.

Water Velocity

- ◊ Water velocities typically increased as bridge length decreased during both frequent and infrequent flooding events. Increases in velocity were more pronounced at the Nigliq and Paleochannel bridges than at the CD-2 access road bridges.
- ◊ Significant velocity increases during frequent and infrequent floods were generally confined to the various channels under study; markedly increased overland flow velocities were typically not noted.
- ◊ Smaller velocity increases as compared to baseline were expected during frequent flooding events. Larger velocity increases were expected during infrequent flooding events.

Discharge

- ◊ Discharge decreased through the Nigliq and Paleochannel bridges and increased through the CD-2 access road bridges during the 200- and 50-year flood events compared to baseline conditions.
- ◊ As bridge length at the Nigliq crossing decreased, discharge at the Nigliq crossing decreased and discharge at the CD-2 access road bridges increased.

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Section 1.0 Introduction

ConocoPhillips Alaska, Inc. (CPAI) plans to develop two satellite sites in the Colville River Delta adjacent to the National Petroleum Reserve–Alaska (NPRA) and proposes three in the NPRA proper. A bridge across the Nigliq Channel near the CD-2 pad is proposed to accommodate road traffic and pipelines for the three NPRA facilities. The original Colville River Delta two-dimensional (2D) surface water model (Shannon & Wilson, 1997) was created to provide peak water surface elevations and velocity magnitudes for the design of the Alpine CD-1 and CD-2 facilities and pipeline. In addition to providing design values, the model was used to estimate the impact the facilities would have on the environment with respect to large spring floods.

This report presents an update of the Colville River Delta 2D surface water model with inclusion of planned and proposed facilities in support of the Alpine Satellites Development Project (ASDP). The proposed development includes a bridge across the Nigliq Channel and a gravel road connecting CD-2 with the three proposed ASDP facilities to the west. Also included in the model is the planned CD-4 (formerly CD-South) development, which is located approximately 3.5 miles south of Alpine. CD-4 consists of a typical satellite gravel drill pad with a conventional gravel access road. The second planned satellite development added within the model is CD-3 (formerly CD-North). It is located approximately 5 miles north of Alpine and is planned as a roadless development. CD-3 consists of a typical satellite gravel drill pad with a gravel airstrip and a short access road connecting the pad to the airstrip. The locations of the proposed developments and their locations with respect to Alpine are shown on Figure 1.

The updated model was used to estimate water surface elevations and velocity magnitudes for the 10-, 50-, and 200-year spring breakup floods. Model output from the 200-year flood was used in support of bridge design and will be used to set design criteria for the minimum elevation of the proposed gravel facilities and pipelines with respect to floodwaters. Discharge in cubic feet per second (cfs) at Monument 01 at the head of the delta for the 5-, 10-, 50, and 200-year recurrence interval spring breakup floods are shown in Table 1.

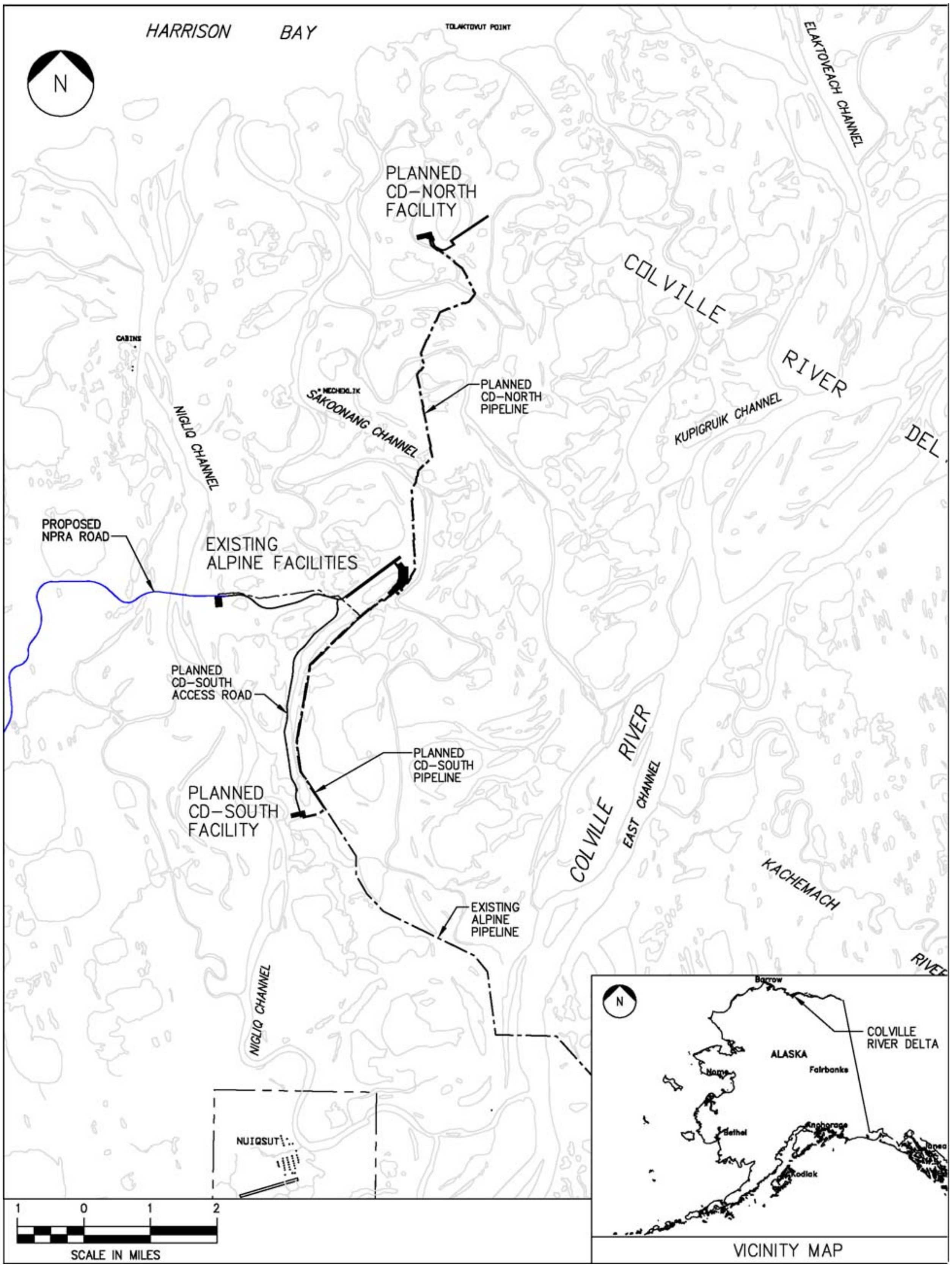

Figure 1 Vicinity Map

Table 1 Discharge at Monument 01
2-, 10-, 50-, and 200-Year Spring Breakup Flood Events

Recurrence Interval	Flood Peak Discharge (cfs)
2-year	240,000
10-year	470,000
50-year	730,000
200-year	1,000,000

Michael Baker Jr. Inc. and Hydroconsult, 2002

The intent of this report is to provide the reader with an understanding of how the model was updated as well as present and discuss the modeling results. Accordingly, a background discussion of the two dimensional model is provided in Section 2. Model updates and enhancements completed for the proposed projects are provided in Section 3. The numerous modeling scenarios run for each recurrence interval and bridge length are described in detail in Section 4, along with an overview of the results.

Model output has been compiled into tables and figures. Table 2 compares 10-, 50-, and 200-year baseline water surface elevation and velocity to those predicted with a 1,200-foot Nigliq bridge. Table 3 compares 200-year water surface elevations and velocities for a 1,500-foot, 1,200-foot, and 900-foot bridge. Pre-scour and post-scour data is provided for the 1,500- and 1,200-foot bridge scenarios. Both Tables 2 and 3 present point measurements of water surface elevations and depth averaged water velocities at 13 measurement locations near the proposed, planned, and existing facilities. Figure 2 identifies these 13 measurement locations. Model output figures show graphic representations of the water surface profiles and depth-averaged velocities for the modeled flood events. Model output figures are organized according to site and presented as Appendix A. An index of all figures is provided at the beginning of Appendix A.

All elevations presented in this report are in feet and are referenced to the British Petroleum Mean Sea Level (BPMSL).

Table 2 Water Surface Elevation and Velocity Magnitude Comparison, 1,200-Foot Bridge, 10-, 50-, and 200-Year Recurrence Intervals

	Water Surface Elevations 2002 Baseline(1)			Velocity Magnitude 2002 Baseline(2)			Water Surface Elevations 1200-FT Bridge Pre Scour			Velocity Magnitude 1200-FT Bridge Pre Scour		
	Q10	Q50	Q200	Q10	Q50	Q200	Q10	Q50	Q200	Q10	Q50	Q200
1 Nigliq Channel North *(approx 5,600-ft downstream of bridge)*	6.78	9.65	11.34	5.50	6.47	8.33	6.81	9.64	11.27	5.73	7.30	8.67
2 Facility Northwest *(approx 4,700-ft E of Pt 1)*	8.05	9.75	11.46	0.04	0.34	0.50	8.17	9.77	11.40	0.04	0.08	0.30
3 NPR-A Road 80-Foot Bridge												
West Abutment *(at centerline road)*	-		(3)	-	-	(3)	-	11.13	12.41	-	4.25	5.18
Channel *(bridge midspan)*	-		(3)	-	-	(3)	-	11.00	12.43	-	3.95	5.30
East Abutment *(at centerline road)*	-		(3)	-	-	(3)	-	10.86	12.45	-	3.32	4.78
4 Nigliq Bridge												
West Abutment *(location same for all models)*	-	10.65	12.63	-	3.92	4.58	7.61	10.13	11.14	1.43	2.41	2.93
Channel West *(always 300-ft from west abutment)*	7.40	10.60	12.58	6.30	5.93	6.50	7.70	10.59	12.37	5.31	7.09	9.21
Mid Channel *(always 600-ft from west abutment)*	7.39	10.57	12.55	4.76	5.09	6.27	7.67	10.57	12.37	5.50	7.33	9.40
Channel East *(always 900-ft from west abutment)*	7.35	10.54	12.51	4.06	4.83	5.57	7.64	10.49	12.26	4.82	7.00	9.12
East Abutment *(location same for 1200-ft bridge and baseline models, varies for others)*	7.37	10.56	12.53	3.96	4.49	5.01	7.10	9.21	10.20	1.53	2.16	2.89
5 CD-2 Pad *(SW corner of pad)*	8.90	11.49	13.32	0.17	1.58	2.35	9.20	11.83	14.08	0.03	1.17	1.57
6 CD-2 Road 62-Foot Bridge *(bridge midspan approx 40-ft upstream)*	8.38	10.63	12.31	1.46	3.58	4.50	8.57	10.74	12.37	1.66	3.93	5.50
7 CD-2 Road 452-Foot Bridge												
West Abutment *(at road centerline)*	7.99	9.57	10.99	1.25	2.87	3.61	8.11	9.58	10.80	1.39	3.15	4.43
Channel *(bridge midspan at road centerline)*	8.32	10.77	12.69	3.76	6.82	7.93	8.51	10.93	12.98	4.09	7.19	8.81
East Abutment *(at road centerline)*	8.23	9.99	11.40	1.68	3.54	4.19	8.39	10.04	11.29	1.88	3.81	4.89
8 Alpine Pad South *(southernmost pad corner)*	-	12.79	15.27	-	0.84	1.35	-	12.93	15.39	-	0.84	1.36
9 Alpine Pad East *(northeasternmost pad corner)*	-	-	14.04	-	-	1.54	-	-	14.14	-	-	1.61
10 Nigliq Channel South *(approx 6,200-ft upstream of bridge)*	8.36	11.53	13.66	3.77	3.81	4.19	8.70	11.88	14.28	3.46	3.44	3.40
11 Facility Southwest *(approx 3,400-ft E of Pt 10)*	8.97	11.94	13.98	0.18	1.07	1.78	9.23	12.20	14.49	0.19	1.19	1.81
12 Facility South *(approx 4,400-ft S of CD-2/CD-4 Rd Jctn)*	-	13.09	15.65	-	0.16	0.38	-	13.21	15.77	-	0.18	0.39
13 CD South Pad *(SW corner of pad)*	-	13.74	15.85	-	0.67	0.92	-	13.90	16.13	-	0.64	0.86

Notes:

1) Baseline conditions recorded from two dimensional model presented in *Colville River Delta Two-Dimensional Surface Water Model CD Satellite Project Update* , by Michael Baker Jr. Inc - May 2002, which includes CD-South and CD-North proposed facilities.
2) Baseline conditions recorded from the 2004 revised mesh indicating the Paleo Bluff, NPRA road, Nigliq Bridge and 80-foot NPRA road bridge. The model does not indicate road and bridge elevations. Baseline elevations still apply.
3) The mesh for the baseline conditions model was prepared prior to revised survey data near the NPRA 80-foot swale bridge.
4) Due to the fact that the mesh in each model differs slightly, water surface elevations and velocity magnitudes were not recorded at identical locations.

Table 3 Water Surface Elevation and Velocity Comparison, 1,500-, 1,200-, and 900-Foot Bridges, 200-Year Recurrence Interval

	Water Surface Elevation (ft BPMSL)								Velocity Magnitude (ft/sec)							
	2002	2004	1500-FT Bridge		1200-FT Bridge		900-FT Bridge		2002	2004	1500-FT Bridge		1200-FT Bridge		900-Ft Bridge	
	Baseline (1)	Baseline (2)	Pre Scour	Post Scour	Pre Scour	Post Scour	Pre Scour	Post Scour	Baseline (1)	Baseline (2)	Pre Scour	Post Scour	Pre Scour	Post Scour	Pre Scour	Post Scour
1 Nigliq Channel North *(approx 5,600-ft downstream of bridge)*	11.34	11.26	11.28	11.29	11.27	11.29	11.25		8.33	8.59	8.69	8.74	8.67	8.76	8.52	
2 Facility Northwest *(approx 4,700-ft E of Pt 1)*	11.46	11.48	11.42	11.44	11.40	11.44	11.36		0.50	0.54	0.52	0.45	0.30	0.44	0.12	
3 NPR-A Road 80-Foot Bridge																
West Abutment *(at centerline road)*	(3)	13.07	12.41	12.42	12.41	12.41	12.51		(3)	0.59	4.65	3.87	5.18	4.01	6.15	
Channel *(bridge midspan)*	(3)	13.05	12.45	12.46	12.43	12.45	12.49		(3)	1.11	4.74	3.92	5.30	4.07	6.80	
East Abutment *(at centerline road)*	(3)	13.03	12.48	12.51	12.45	12.49	12.47		(3)	1.36	4.24	3.48	4.78	3.64	6.06	
4 Nigliq Bridge																
West Abutment *(location same for all models)*			11.55	12.44	11.14	12.54	10.44		4.58	3.75	2.37	0.70	2.93	0.84	4.24	
Channel West *(always 300-ft from west abutment)*			12.49	12.57	12.37	12.55	12.47		6.50	5.88	8.12	6.75	9.21	5.47	10.48	
Mid Channel *(always 600-ft from west abutment)*			12.49	12.62	12.37	12.57	12.49		6.27	6.39	8.45	6.24	9.40	6.89	11.33	
Channel East *(always 900-ft from west abutment)*			12.48	12.64	12.26	12.59	12.08		5.57	5.35	7.59	5.40	9.12	6.34	11.43	
East Abutment *(location same for 1200-ft bridge and baseline models, varies for others)*			11.18	12.22	10.20	11.53	9.58		5.01	4.72	3.06	1.17	2.89	1.06	6.22	
5 CD-2 Pad *(SW corner of pad)*	13.32	13.31	13.92	13.66	14.08	13.67	14.68		2.35	2.18	1.60	1.66	1.57	1.66	1.41	
6 CD-2 Road 62-Foot Bridge *(bridge midspan approx 40-ft upstream)*	12.31	12.33	12.35	12.31	12.37	12.32	12.46		4.50	4.49	5.23	4.82	5.50	4.87	6.39	
7 CD-2 Road 452-Foot Bridge																
West Abutment *(at road centerline)*	10.99	11.01	10.85	10.91	10.80	10.90	10.68		3.61	3.61	4.20	3.87	4.43	3.91	5.16	
Channel *(bridge midspan at road centerline)*	12.69	12.70	12.89	12.76	12.98	12.78	13.32		7.93	7.93	8.58	8.22	8.81	8.27	9.52	
East Abutment *(at road centerline)*	11.40	11.42	11.32	11.35	11.29	11.35	11.22		4.19	4.19	4.70	4.41	4.89	4.45	5.49	
8 Alpine Pad South *(southernmost pad corner)*	15.27	15.27	15.35	15.30	15.39	15.31	15.52		1.35	1.35	1.36	1.35	1.36	1.35	1.42	
9 Alpine Pad East *(northeasternmost pad corner)*	14.04	14.05	14.11	14.07	14.14	14.07	14.26		1.54	1.55	1.59	1.56	1.61	1.57	1.68	
10 Nigliq Channel South *(approx 6,200-ft upstream of bridge)*	13.66	13.68	14.10	13.83	14.28	13.87	14.85		4.19	3.92	3.58	3.82	3.40	3.75	2.94	
11 Facility Southwest *(approx 3400-ft E of Pt 10)*	13.98	13.99	14.34	14.12	14.49	14.15	15.00		1.78	1.82	1.80	1.80	1.81	1.82	1.77	
12 Facility South *(approx 4,400-ft S of CD-2/CD-4 Rd Jctn)*	15.65	15.66	15.74	15.68	15.77	15.69	15.93		0.38	0.38	0.39	0.38	0.39	0.38	0.41	
13 CD South Pad *(SW corner of pad)*	15.85	15.86	16.05	15.93	16.13	15.94	16.42		0.92	0.91	0.88	0.90	0.86	0.90	0.81	

Notes:

1) Baseline conditions recorded from two dimensional model presented in *Colville River Delta Two-Dimensional Surface Water Model CD Satellite Project Update* , by Michael Baker Jr. Inc - May 2002, which includes CD-South and CD-North proposed facilities.
2) Baseline conditions recorded from the 2004 revised mesh indicating the Paleo Bluff, NPRA road, Nigliq Bridge and 80-foot NPRA road bridge. The model does not indicate road and bridge elevations. Baseline elevations still apply.
3) The mesh for the baseline conditions model was prepared prior to revised survey data near the NPRA 80-foot swale bridge.
4) Due to the fact that the mesh in each model differs slightly, water surface elevations and velocity magnitudes were not recorded at identical locations.

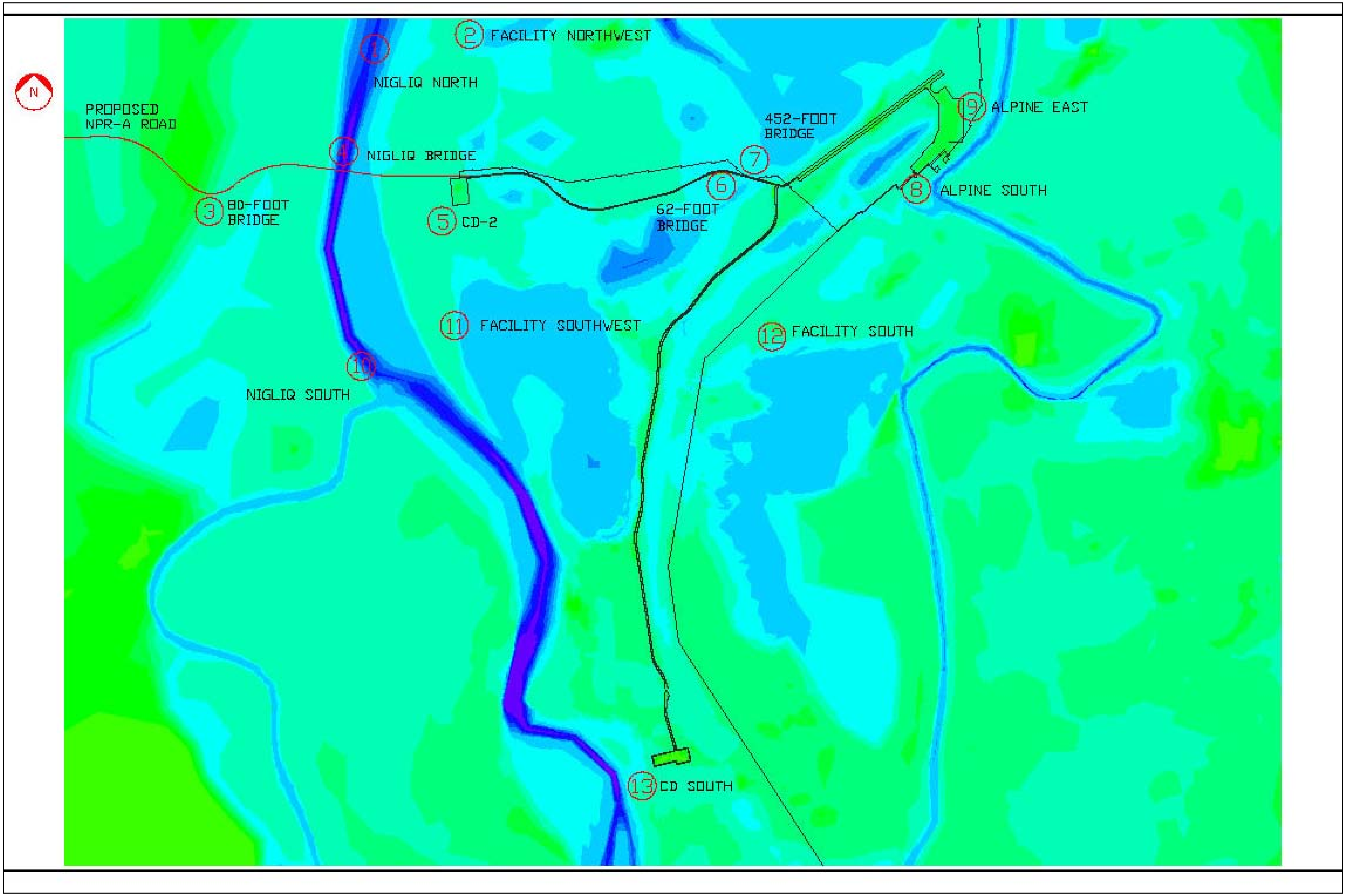

Figure 2 Water Surface elevation and Velocity Magnitude Comparison Locations

Section 2.0 Background

The original two-dimensional surface water model developed in 1997 was used to predict peak water surface elevations and velocity magnitudes for the 50-, 100-, and 200-year flood events as part of the original Alpine facilities design. In 1998, the ground surface elevations of the finite element mesh were improved based on a fall 1997 field survey. In addition, the finite element mesh along the then-proposed CD-2 road was updated to reflect the March 1998 proposed alignment. This included the addition of the proposed 440-foot bridge with spill-through abutments (only a single bridge was anticipated at that time). The model was rerun and the analysis presented in a project update report (Michael Baker Jr., Inc., 1998).

In the spring of 2001, model runs for the 2- and 10-year floods were completed (Michael Baker Jr., Inc., 2001). The purpose of this analysis was not for design, but rather to address permit stipulations required by the U.S. Army Corps of Engineers for floodwater monitoring in and around the Alpine facilities. The finite element mesh that was developed in 1998 was used to initiate modeling for the 2- and 10-year flood events. A two-stage approach was adopted for this modeling program. The first stage consisted of taking the finite element mesh generated in 1998 and running the 2- and 10-year peak discharges until the convergence tolerances of the model were satisfied. The second stage was to input the as-built swale bridge configurations at Alpine and rerun the simulations. Modifications made to the mesh included the addition of a second smaller bridge (which was added to the design after the original model was run) and the widening of the larger bridge to account for its vertical abutments.

In May of 2002, the model was again updated to incorporate the proposed CD-North and CD-South developments. The model was used to evaluate the impact of the proposed facilities on water surface elevations and velocity magnitudes. Model runs for 10-, 50-, and 200-year floods were completed (Michael Baker Jr., Inc., 2002). Modifications made to the mesh included the addition of the CD-3 and CD-4 developments.

Section 3.0 2004 Model Updates and Enhancements

3.1 Modeling Software

The two-dimensional surface water model is the product of two computer programs. The finite element mesh was developed using pre- and post-processing software titled *Surface Water Modeling System* (SMS) developed by Brigham Young University (Brigham Young, 1994). The original model was developed using version 4.1. Subsequent analyses were developed using versions 6.0 and 7.0. The current project update used version 7.0. SMS is used to not only create the finite element mesh, but also to analyze the modeling results and generate output graphics.

The computer program developed by the U.S. Geological Survey (Froehlich, 1996), *Finite Element Surface-Water Modeling System: Two-Dimensional Flow in a Horizontal Plane* (FESWMS), performs the numerical computation of the modeling system. FESWMS version 2 was used in the original analysis and subsequent analyses through April 2001. Version 3 of FESWMS was used for analysis in May 2002 and the current project update.

The following subsections outline the modifications made to the model for the 2004 modeling work.

3.2 Topographic Base Map

The topographic base map used for the development of the current project update was based on the finite element mesh developed as part of the 1998 project update (Michael Baker Jr., Inc., 1998). Enhancements to the floodplain topography were made in the areas of the CD-South and CD-North project development sites. Updated floodplain topography for the western Colville Delta was supplied by Peratrovich, Nottingham, & Drage, Inc. (PND) (2001a). This survey data was compiled by LCMF from a combination of 2-foot contour mapping developed from aerial photography collected in 1999 by Aeromap U.S., Inc., groundtruthing surveys conducted in 2000, and Western Geophysical Co. data collected in 1999. The data were provided in the vertical datum BPMSL and the NAD 83, Alaska State Plane, Zone 4 horizontal datum. The model is in the NAD 27, Alaska State Plane, Zone 4 horizontal datum, and the topography data were converted to this datum with the use of Tralaine Coordinate Conversion Software, version 3.23. The vertical datum was unchanged.

3.2.1 Topographic Base Map Verification CD-2 Vicinity

The finite element mesh was checked against recent ground survey data provided by LCMF. The survey data included several river profiles near the Nigliq Bridge site and topography of the tundra between CD-2 and the Paleochannels west of the Nigliq Channel. The scatter set of the finite element mesh was updated to reflect new survey data at the Paleochannels. Excluding the revised survey data at the Paleochannels, the finite element mesh was found to match the elevations of the LCMF survey data and was not modified as part of this effort.

3.3 Finite Element Mesh

The original two-dimensional surface water model (Shannon & Wilson, 1997), as well as the subsequent project updates (Michael Baker Jr., Inc., 1998 and 2002), was developed as part of the Alpine Development Project. Consequently, the modeling focused on the area around the Alpine Development. The entire Colville River Delta was represented in the original model runs; however, the finite element mesh is less dense in areas away from Alpine. The lower density mesh limited the number of elements which in turn made the model more manageable to use, i.e., simplifying calculations and keeping run times reasonable. With the current interest in the proposed Nigliq bridge site, it was decided to increase the level of detail of the finite element mesh and topography in this area.

3.3.1 Finite Element Mesh Enhancements at the Nigliq Bridge Site

The finite element mesh was enhanced to provide greater definition of the channel and floodplain in the project area. Elements along the proposed ASDP road corridor and at the bridge crossing contained within the enhanced topography were refined and relaxed (each selected element was split into smaller elements and the shape adjusted) using functions within the SMS program to optimize the mesh. Element material properties (hydraulic roughness and kinematic eddy viscosity) and material boundaries were not changed during the relaxing process; however, nodes were allowed to slide along material boundaries to optimize element shaping. In addition, minor modifications were made to better represent local topographical features.

3.4 Boundary Conditions

Downstream and upstream boundary conditions were unchanged for the current project update. The following sections summarize the boundary conditions.

3.4.1 Downstream Boundary

The downstream boundary condition was set at a constant water surface elevation of 3 feet BPMSL. The water surface elevation of 3 feet was based on conditions observed during the 1996, 2001, and 2002 breakup programs and is considered to be relatively conservative. Water and ice surface elevation measurements made near the coast since 1996 suggest that a downstream boundary of 3 feet is reasonable.

3.4.2 Upstream Boundary

The upstream boundary condition is based on a steady state discharge. Discharge values are based on design flood frequency estimates for the Colville River and are presented in the report *Colville River Flood Frequency Update, March 2002* (Michael Baker, Jr., Inc. and Hydroconsult, 2002). Discharge due to spring flooding is generally not a steady state condition as flood peaks are attenuated by natural features of the delta (i.e., temporary floodwater storage). Thus, the steady state conditions of the two-dimensional model are considered to be conservative.

3.5 Element Status

The tolerance limits set to define when an element turns “on” or “off’ was unchanged for the current project update. An element that is turned “on” is considered in the numerical computations while an element that is turned “off” is not. The tolerance limit remains set at one foot. Thus, if an element was already considered “on” it would be turned “off” when the water surface elevation fell one foot below the elevation of the highest node on that element. If an element were considered “off” it would be turned “on” when the water surface elevation was one foot higher than the highest node on that element. Elements that are turned “off” are generally those that are dry or only partially covered with water. In some cases, an element that is considered “off” may in fact be completely covered with water, however, the water surface elevation is below the depth tolerance to turn the element on.

Section 4.0 2004 Nigliq Channel Modeling, Results and Discussion

The purpose of the 2004 modeling program was to evaluate potential hydrologic and hydraulic impacts from the installation of a proposed bridge across the Nigliq Channel near the existing CD-2 pad and a smaller bridge across the Paleochannel just west of the Nigliq bridge site.

Baseline Conditions. Prior to modeling the Nigliq bridge, baseline modeling runs were completed. For the baseline conditions, it was assumed that in addition to existing facilities (CD-1 and CD-2) planned facilities at CD-3 and CD-4 were also in place. Thus, all modeling runs represent anticipated future conditions with respect to facilities in and around the Alpine vicinity. Facilities assumed to be in place at CD-3 include a production pad and gravel airstrip. Facilities assumed to be in place at CD-4 include a production pad and gravel road connecting the facility to CD-1.

In Table 3, two baseline values are shown. The 2002 Baseline represents the conditions prior to adjustment of the finite element mesh around the bridge location. The 2002 Baseline represents the baseline conditions against which all previous modeling has been compared. The 2004 Baseline represents conditions prior to bridge installation, but after modification of the finite element mesh. For purposes of consistency with past modeling, it was determined that the 2002 Baseline would be used for comparisons to the bridging options at the Nigliq Channel.

Modeling Variables. After the above baseline conditions were documented, numerous modeling runs were completed using different hydrologic and bridging variables. Spring breakup floods having recurrence intervals of 10, 50, and 200 years were examined. Within those three recurrence intervals, numerous iterations of the model were run under different bridging scenarios at the Nigliq Channel. A key objective of the modeling process was to provide analysis for various bridge lengths at the Nigliq Channel crossing. Accordingly, model runs were completed with Nigliq bridge lengths of 1,500 feet, 1,200 feet, and 900 feet for comparative purposes. All modeling runs were performed with an 80-foot bridge at the Paleochannel. Analyses were also performed using modeling runs to investigate how differing degrees of channel scour at the bridge location affected water surface elevations and velocities during the 200-year flood. PND and ConocoPhillips provided all bridge lengths, configurations and bridge piling and abutment locations. Scour depths for modeling purposes were also determined by PND and ConocoPhillips. All modeling runs were completed with bridging and hydrological variables adjusted as directed by PND and ConocoPhillips.

Modeling Results Output. Numerous preliminary model runs were required to calibrate and converge the model. Eleven final model runs were necessary to adequately model the different variations of the above modeling variables. Each of modeling runs resulted in graphical output that depicted water surface elevation in BPMSL and depth-averaged water velocity in feet per second. Model run outputs were plotted at three scales: delta-wide, Alpine-vicinity, and bridge-specific. The Alpine-vicinity scale includes the existing Alpine CD-1 and CD-2 pads and the planned CD-4 pad, and the Nigliq and Paleochannel crossing locations. Analysis of water surface elevation, velocity and discharge changes in the CD-3 pad vicinity was not performed.

All model output figures are shown in Appendix A. An index of figure numbers and a description of modeling parameters on those figures is provided as a cover sheet to Appendix A. The figures are organized in the following manner:

- Figures A1 through A14 – Water surface elevations under baseline and various bridge length and recurrence interval scenarios. Delta-wide scale.
- Figures A15 through A20 – Water surface elevations under baseline conditions during the 10-, 50-, and 200-year floods. Alpine-vicinity scale.
- Figures A21 through A26 – Water surface elevations and depth-averaged velocities with 1,500-foot bridge during the 10-, 50-, and 200-year floods. Alpine-vicinity scale.
- Figures A27 through A32 – Water surface elevations and depth-averaged velocities with 1,200-foot bridge during the 10-, 50-, and 200-year floods. Alpine-vicinity scale.
- Figures A33 through A38 – Water surface elevations and depth-averaged velocities with 900-foot bridge during the 10-, 50-, and 200-year floods. Alpine-vicinity scale.
- Figures A39 through A42 – Water surface elevations and depth-averaged velocities with 1,200 and 1,500-foot bridges during the 200-year flood with 15 and 10 feet of channel scour, respectively, at the bridge location. Alpine-vicinity scale.

- Figures A43 through A45 – Depth-averaged velocities with 1,500-foot bridge during the 10-, 50, and 200-year floods. Bridge-specific scale.
- Figures A46 through A48 – Depth-averaged velocities with 1,200-foot bridge during the 10-, 50-, and 200-year floods. Bridge-specific scale.
- Figures A49 through A51 – Depth-averaged velocities with 900-foot bridge during the 10-, 50-, and 200-year floods. Bridge-specific scale.
- Figures A52 and A53 – Depth-averaged velocities with 1,200 and 1,500-foot bridges during the 200-year flood with 15 and 10 feet of channel scour, respectively, at the bridge location. Bridge-specific scale.

Modeling Results Discussion. The following subsections provide a broad overview of the 10- and 50-year floods in terms of water surface elevation and velocity.

4.1 10-Year Flood

Water surface elevation increases associated with the bridge ranged from less than 0.05 feet to 0.30 feet and were generally considered to be negligible. During a 10-year flood, moderate velocity increases were noted at the Nigliq bridge location. Velocity increases immediately downstream of the bridge were minor. Water velocity comparisons at CD-1 pad, in the vicinity of the Alpine pipeline, and at the planned CD-4 pad were not made for the 10-year event.

4.2 50-Year Flood

Water surface elevation increases ranged from less than 0.05 feet to 0.35 feet and were generally considered to be negligible. Velocity increases of over 2.0 ft/s were noted at the Nigliq bridge location and moderate increases were seen immediately downstream of the bridge. Water velocity changes at CD-1 pad, in the vicinity of the Alpine pipeline, at the CD-2 access road bridges, and at the planned CD-4 pad were all negligible.

4.3 200-Year Flood

The following subsection provides a more in-depth discussion of the 200-year flood that includes water surface elevations, velocities and discharges under pre- and post-scour scenarios.

For purposes of the following discussion, water surface elevation changes of less than twenty five hundredths (0.25) of a foot are considered to be negligible, changes of between 0.25 and 0.50 feet are considered minor, changes between 0.50 and 1.0 feet are considered moderate, and changes over 1.0 feet are considered significant. Velocity changes less than 0.25 feet per second (ft/s) are considered negligible, changes between 0.25 and 0.50 ft/s are considered to be minor, changes between 0.50 and 1.25 ft/s are considered moderate, and changes over 1.25 ft/s are considered significant.

4.3.1 Nigliq Channel and Bridge Site – Pre-Scour

1,500-Foot Bridge

- Compared to baseline conditions, a 1,500-foot Nigliq bridge had little or no effect with respect to water surface elevation changes at the bridge and downstream of the crossing during the 200-year event; water surface elevation changes in those areas were typically negligible. Upstream of the crossing, water surface elevation changes were more pronounced but were still only considered to be minor.

- Water velocity increases associated with a 1,500-foot Nigliq bridge were typically minor or moderate except for east-, west-, and mid-channel flow at the bridge itself where significant increases up to 2.2 ft/s compared to baseline were noted. Baseline velocities were not completed for the Paleochannel bridge.

- Discharge estimates for the 1,500-foot bridge option show that, during a 200-year flood event, the flow through the Nigliq Channel and Paleochannel area decreases from about 197,800 cfs to 194,700 cfs, or approximately 1.6 percent, due to the addition of the bridge and road. As a result, discharge increases at the CD-2 access road bridges, to the east (Subsection 4.3 and 4.4).

1,200-Foot Bridge

- Compared to baseline conditions, a 1,200-foot Nigliq bridge had little or no effect with respect to water surface elevation changes at the bridge and downstream of the crossing during the 200-year event; water surface elevation changes in those areas were typically negligible. Upstream of the crossing, minor to moderate water surface elevation changes were noted.

- Velocity increases associated with a 1,200-foot Nigliq bridge were typically minor or moderate except for east-, west-, and mid-channel flow at the bridge itself where significant increases up to approximately 3.3 ft/s compared to baseline were noted. Velocity increases at the Paleochannel bridge were moderate (approximately 0.5 ft/s faster than velocities calculated for the 1,500-foot bridge).

- Discharge estimates with a 1,200-foot bridge suggest that Nigliq and Paleochannel flows decrease from about 197,800 cfs to 194,000 cfs, or over 1.9 percent.

900-Foot Bridge

- Compared to baseline conditions, a 900-foot bridge had little or no effect with respect to water surface elevation changes at the bridge and downstream of the crossing during the 200-year event; water surface elevation changes in those areas were typically negligible or minor. Upstream of the crossing, significant water surface elevation changes of up to approximately 1.2 feet were noted.

- Velocity increases associated with a 900-foot Nigliq bridge were typically minor or moderate except for east-, west-, and mid-channel flow at the bridge itself where significant increases up to approximately 5.1 ft/s compared to baseline were noted. Velocity increases at the Paleochannel bridge were significant (approximately 2.0 ft/s faster than velocities calculated for the 1,200-foot bridge).

- Pre-scour discharge comparisons were not calculated for the 900-foot bridge option. Based on trends noted with the 1,500- and 1,200-foot bridges, its likely that a 900-foot bridge would further constrict 200-year level flow through the Nigliq and Paleochannels and increase velocities at the Nigliq bridge and the flow towards the existing CD-2 bridges.

4.3.2 Nigliq Channel and Bridge Site – Post-Scour

1,500-Foot Bridge

- Ten feet of general scour was used for modeling purposes at the 1,500-foot bridge. Addition of the scour had little or no effect on water surface elevations as compared to water surface elevations calculated with no scour. Water velocity generally decreased moderately compared to pre-scour conditions. Post-scour discharge was not calculated.

1,200-Foot Bridge

- Fifteen feet of general scour was used for modeling purposes at the 1,200-foot bridge. Addition of the scour had little or no effect on water surface elevations as compared to pre-scour water surface elevation. Moderate to significant water velocity decreases were noted compared to pre-scour conditions. Post-scour discharge was not calculated.

900-Foot Bridge

- Post-scour modeling was not conducted for the 900-foot bridge scenario.

4.3.3 Existing & Planned Alpine Facilities – Pre-Scour

1,500-Foot Bridge

- Moderate 200-year water surface elevations increases were noted at the CD-2 pad only. Water surface elevation changes at the bridges on the CD-2 access road, at CD-1 pad, in the vicinity of the Alpine pipeline, and at the planned CD-4 pad were all negligible.

- Water velocities at the CD-2 pad decreased as a result of bridge construction. Moderate velocity increases of approximately 0.7 ft/s compared to baseline were noted at both CD-2 access road bridges. Water velocity changes at CD-1 pad, in the vicinity of the Alpine pipeline, and at the planned CD-4 pad were all negligible.

- A 1,500-foot bridge resulted in an increase in discharge at the CD-2 access road bridges from 27,200 cfs to 29,900 cfs, an almost 10 percent increase compared to baseline conditions.

1,200-Foot Bridge

- Moderate 200-year water surface elevations increases were noted at the CD-2 pad. Moderate increases were also noted at the CD-2 access road bridge (452-foot), and at the CD-4 pad location. Water surface elevation changes at CD-1 pad and in the vicinity of the Alpine pipeline were negligible.

- Water velocities at the CD-2 pad decreased as a result of bridge construction. Moderate velocity increases of 0.9 and 1.0 ft/s compared to baseline were noted at the CD-2 access road bridges. Water velocity changes at CD-1 pad, in the vicinity of the Alpine pipeline, and at the planned CD-4 pad were all negligible.

- A 1,200-foot bridge resulted in an increase in discharge at the CD-2 access road bridges from 27,200 cfs to 31,000 cfs, an approximately 12 percent increase compared to baseline conditions.

900-Foot Bridge

- Compared to baseline conditions, a 900-foot Nigliq bridge had a significant impact with respect to 200-year water surface elevation increases at the CD-2 pad. Predicted 200-year water surface elevations at CD-2 increased nearly 1.4 feet, an almost 10 percent increase over baseline conditions. Moderate increases were noted at the CD-2 access road bridge (452-foot), and at the CD-4 pad location. Minor increases were noted at locations south of CD-1 and in the vicinity of the Alpine pipeline.

- Water velocities at the CD-2 pad decreased as a result of bridge construction. Significant velocity increases of 1.6 and 1.9 ft/s compared to baseline were noted at the CD-2 access road bridges. Water velocity changes at CD-1 pad, in the vicinity of the Alpine pipeline, and at the planned CD-4 pad were all negligible.

- Pre-scour discharge comparisons were not calculated for the 900-foot bridge option. Based on trends noted with the 1,500- and 1,200-foot bridges, its likely that a 900-foot bridge would further constrict 200-year level flow through the Nigliq and Paleochannels and increase velocities at the Nigliq bridge and the flow towards the existing CD-2 bridges.

4.3.4 Existing & Planned Alpine Facilities – Post Scour

1,500-Foot Bridge

- Ten feet of channel scour was assumed for modeling purposes at the 1,500-foot bridge. Addition of the scour resulted in water surface elevation decrease compared to pre-scour conditions of about 0.25 feet at CD-2 pad and 0.10 feet at the 452-foot CD-2 access road bridge. Scour had little or no effect on water surface elevations as compared to water surface elevations calculated with no scour at other existing and planned Alpine facilities. Water velocity generally decreased negligibly compared to pre-scour conditions. Post-scour discharge was not calculated.

1,200-Foot Bridge

- Fifteen feet of channel scour was assumed for modeling purposes at the 1,200-foot bridge. Addition of the scour resulted in water surface elevation decrease compared to pre-scour conditions of about 0.40 feet at CD-2 pad and 0.20 feet at the 452-foot CD-2 access road bridge. Scour had little or no effect on water surface elevations as compared to water surface elevations calculated with no scour at other existing and planned Alpine facilities. Water velocity generally decreased negligibly compared to pre-scour conditions. Post-scour discharge was not calculated.

900-Foot Bridge

- Post-scour modeling was not conducted for the 900-foot bridge scenario.

Section 5.0 References

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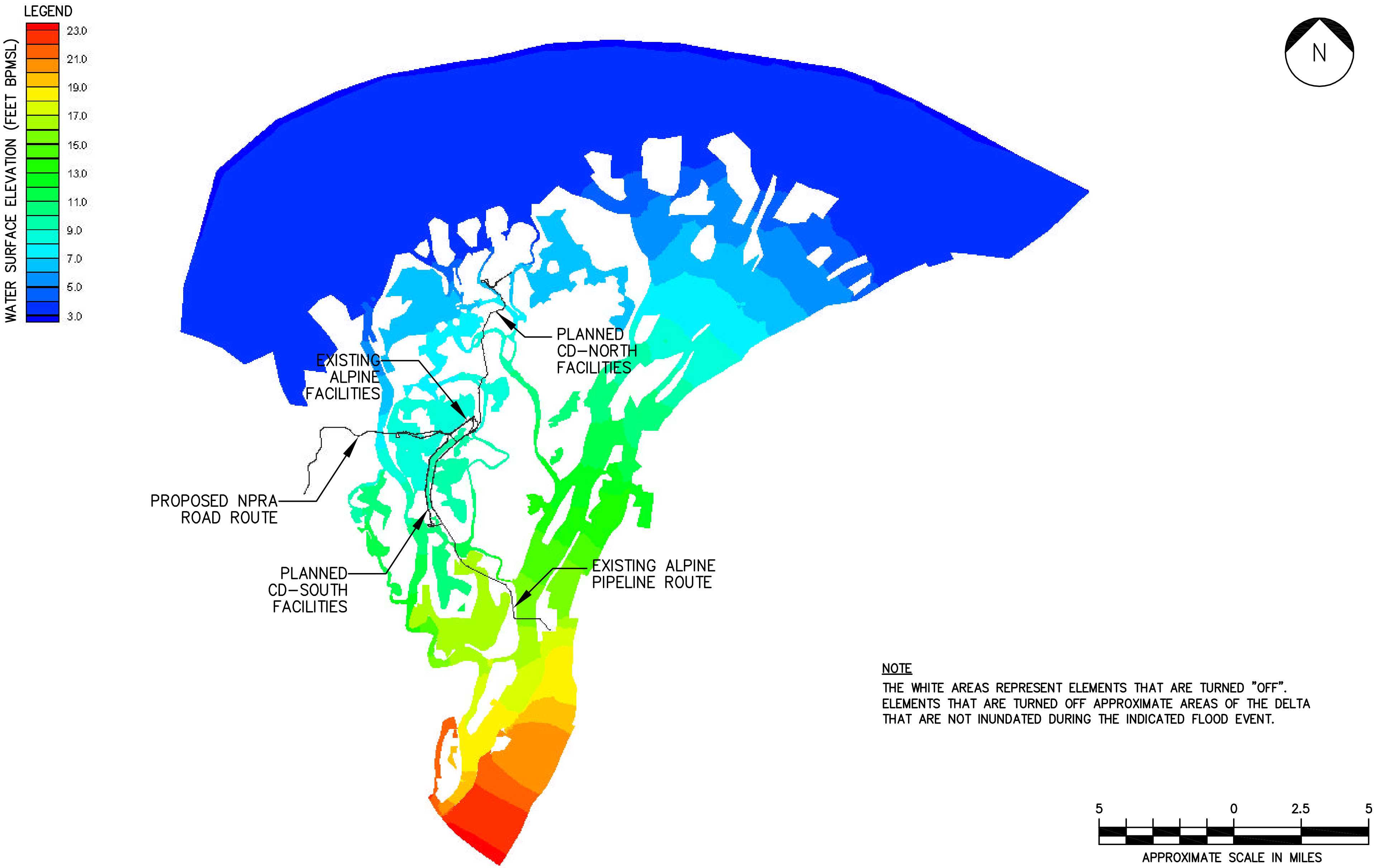
Appendix A Model Output Figures

Delta-Wide Scale

Alpine-Vicinity Scale

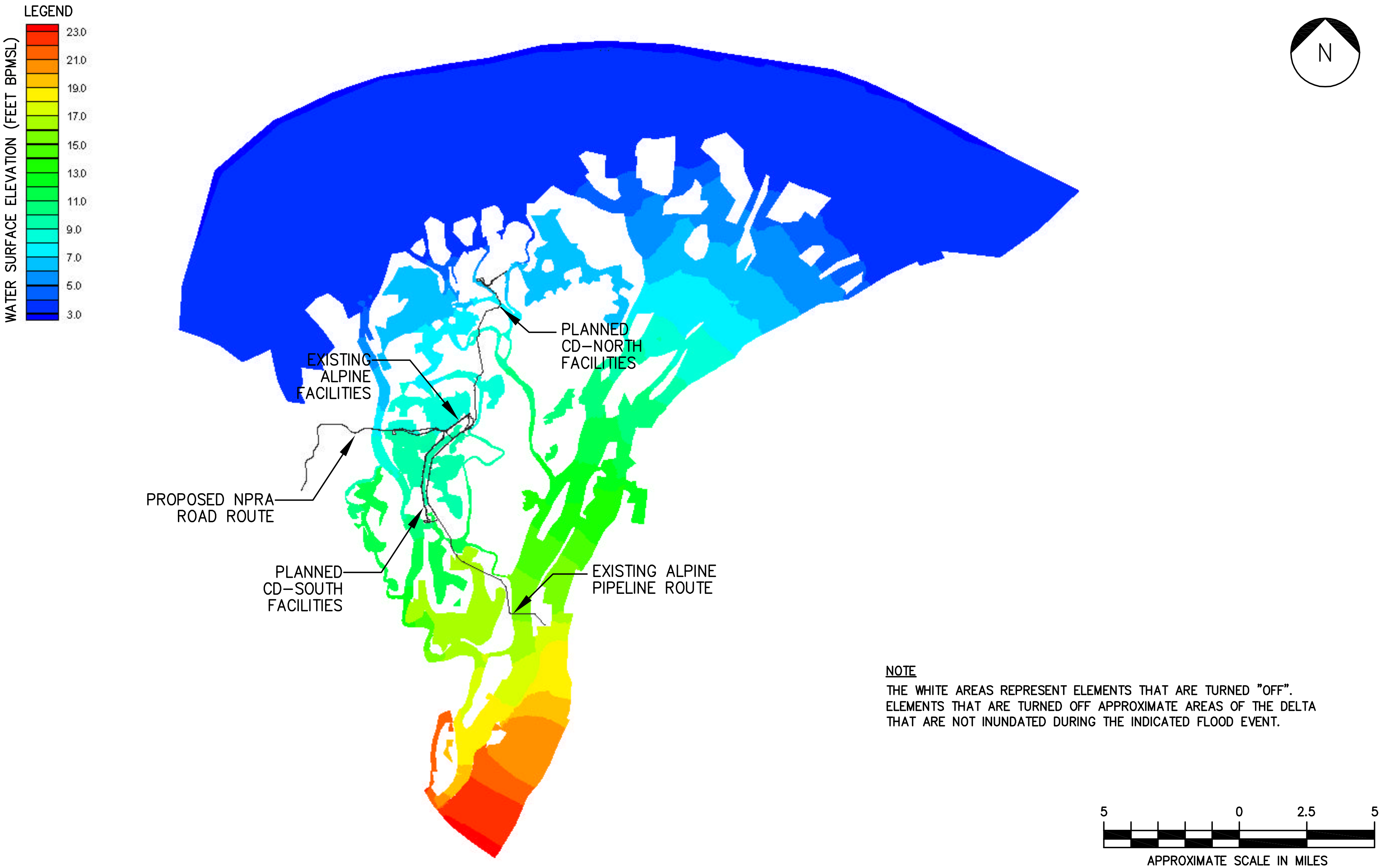
Bridge-Specific Scale



NOTE

THE WHITE AREAS REPRESENT ELEMENTS THAT ARE TURNED "OFF". ELEMENTS THAT ARE TURNED OFF APPROXIMATE AREAS OF THE DELTA THAT ARE NOT INUNDATED DURING THE INDICATED FLOOD EVENT.

Baker — Michael Baker Jr., Inc.	TITLE: 10–YEAR FLOOD, WATER SURFACE ELEVATIONS WITHOUT NPRA ROAD/NIGLIQ BRIDGE		
COLVILLE RIVER DELTA TWO–DIMENSIONAL SURFACE WATER MODEL NPRA ROAD/NIGLIQ BRIDGE UPDATE – FEB 2004	FILE NAME: 102579_A01	SCALE: AS SHOWN	FIGURE A1



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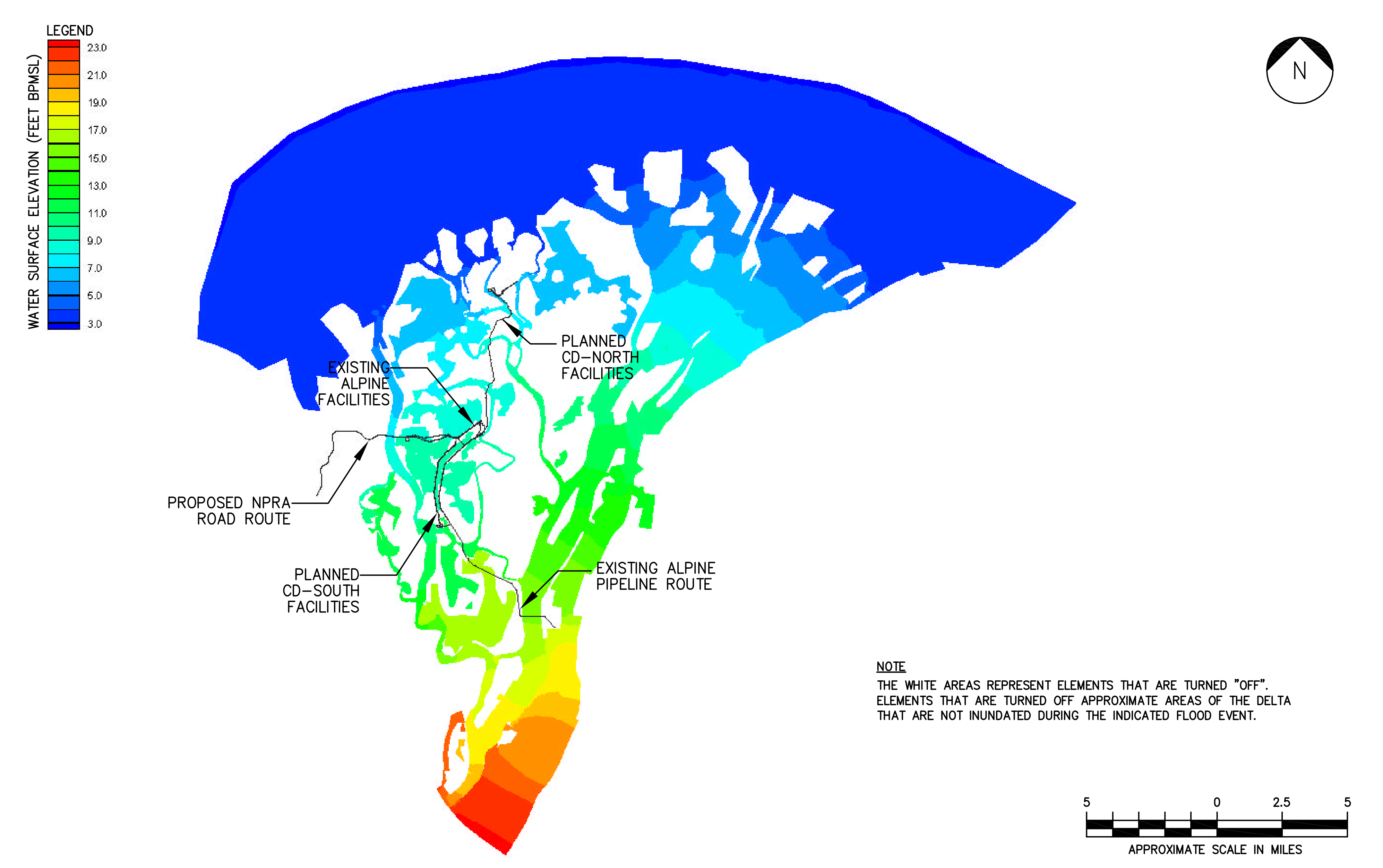
Michael Baker Jr., Inc.	TITLE: 10–YEAR FLOOD, WATER SURFACE ELEVATIONS WITH NPRA ROAD/1500–FT NIGLIQ BRIDGE		
COLVILLE RIVER DELTA TWO–DIMENSIONAL SURFACE WATER MODEL NPRA ROAD/NIGLIQ BRIDGE UPDATE – FEB 2004	FILE NAME: 102579_A02	SCALE: AS SHOWN	FIGURE A2



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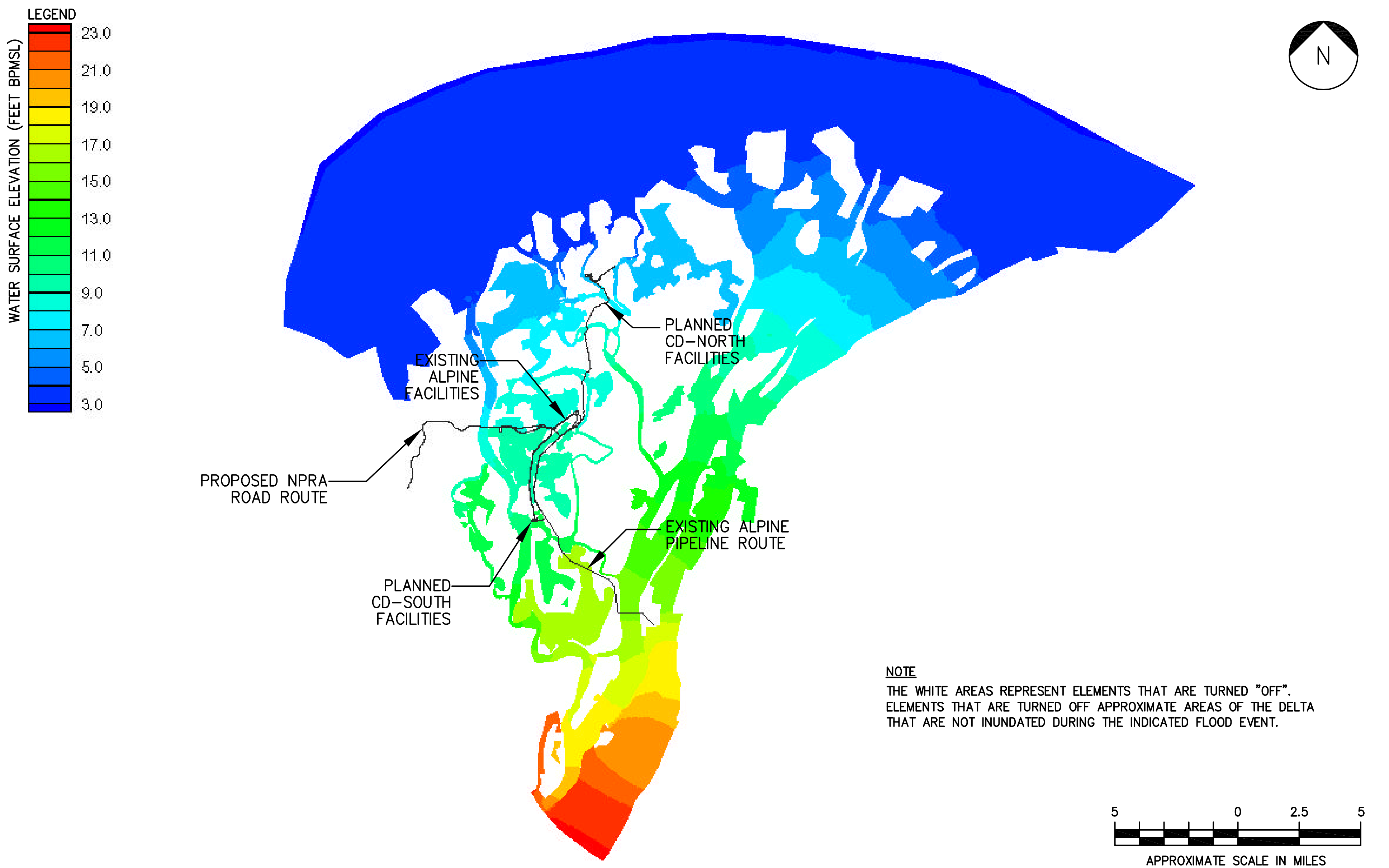
Baker Michael Baker Jr., Inc.	TITLE: 10–YEAR FLOOD, WATER SURFACE ELEVATIONS WITH NPRA ROAD/1200–FT NIGLIQ BRIDGE		
COLVILLE RIVER DELTA TWO–DIMENSIONAL SURFACE WATER MODEL NPRA ROAD/NIGLIQ BRIDGE UPDATE – FEB 2004	FILE NAME: 102579_A03	SCALE: AS SHOWN	FIGURE A3



Baker **Michael Baker Jr., Inc.**	TITLE: 10–YEAR FLOOD, WATER SURFACE ELEVATIONS WITH NPRA ROAD/1200–FT NIGLIQ BRIDGE		
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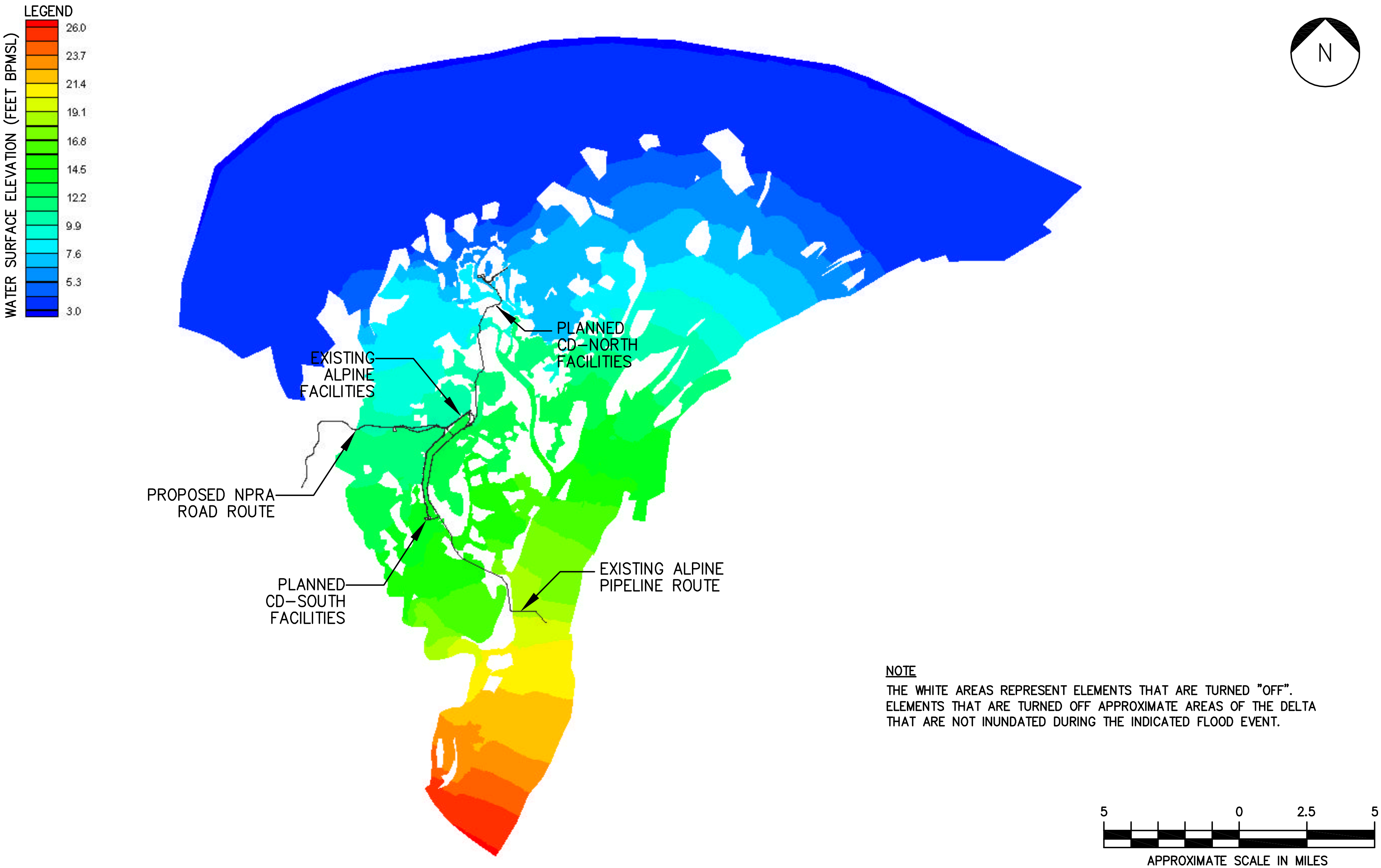

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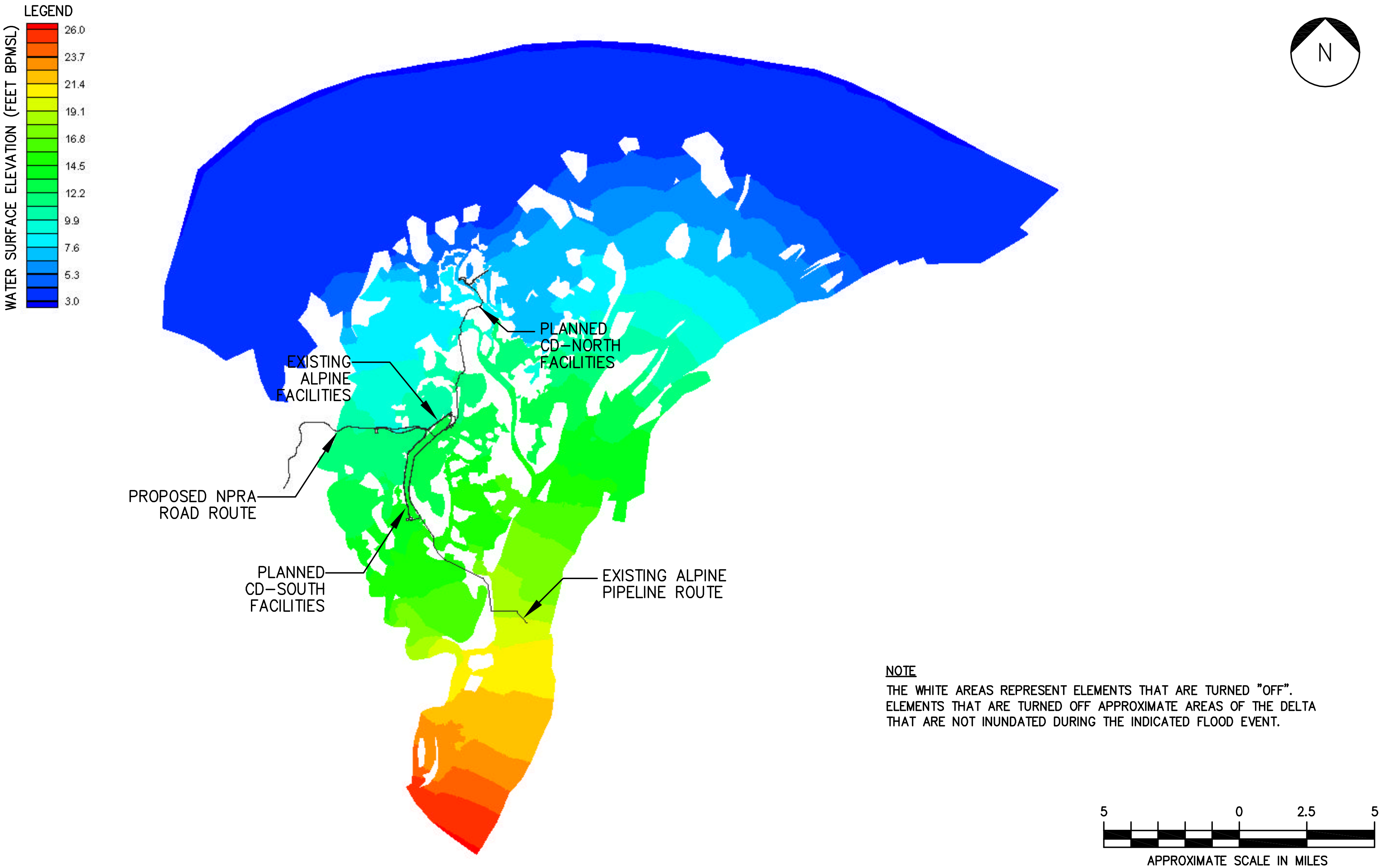
Baker — Michael Baker Jr., Inc.	TITLE: 50-YEAR FLOOD, WATER SURFACE ELEVATIONS WITHOUT NPRA ROAD/NIGLIQ BRIDGE		
COLVILLE RIVER DELTA TWO-DIMENSIONAL SURFACE WATER MODEL NPRA ROAD/NIGLIQ BRIDGE UPDATE – FEB 2004	FILE NAME: 102579_A05	SCALE: AS SHOWN	FIGURE A5



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Baker **Michael Baker Jr., Inc.**	TITLE: 50–YEAR FLOOD, WATER SURFACE ELEVATIONS WITH NPRA ROAD/1500–FT NIGLIQ BRIDGE		
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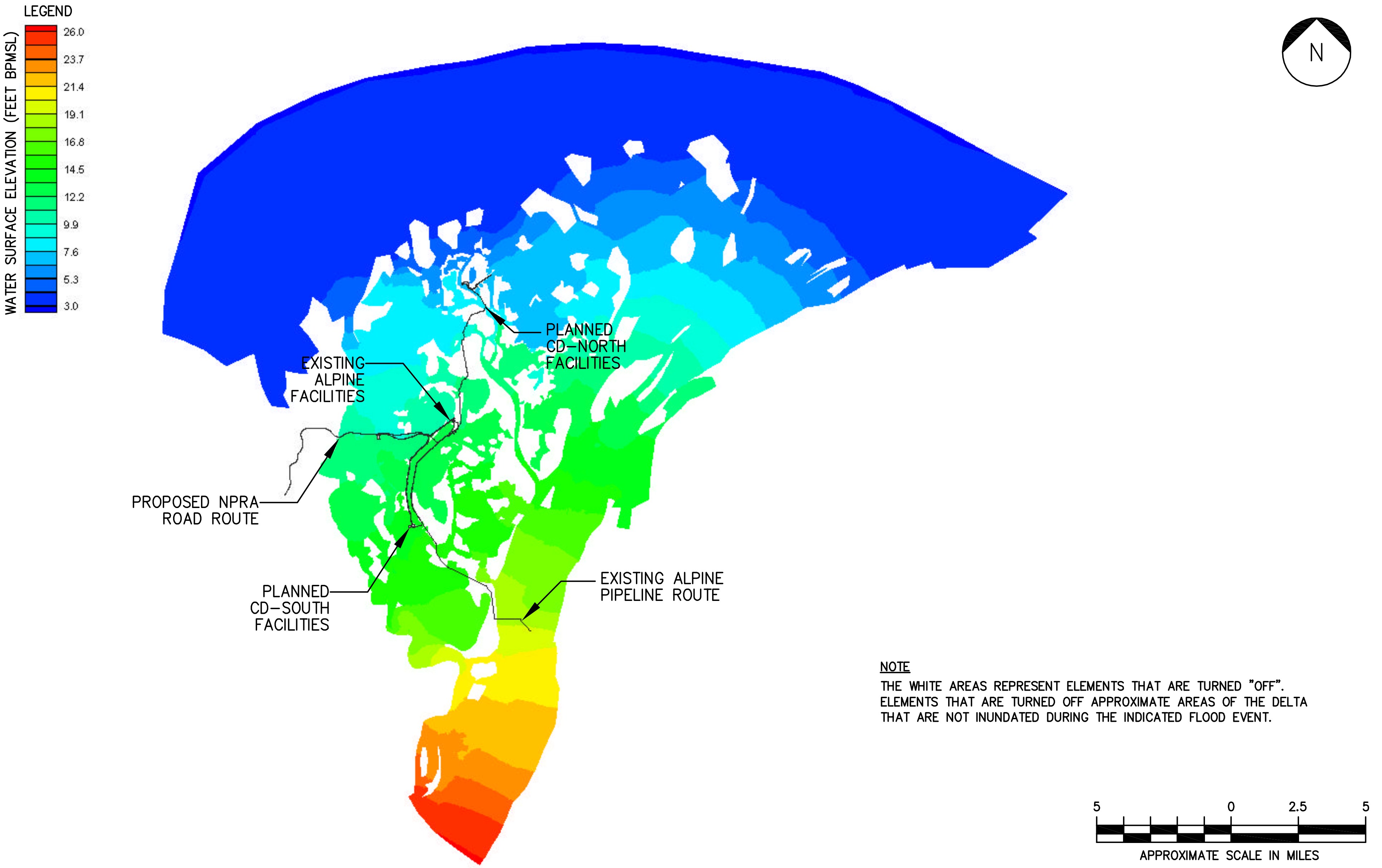

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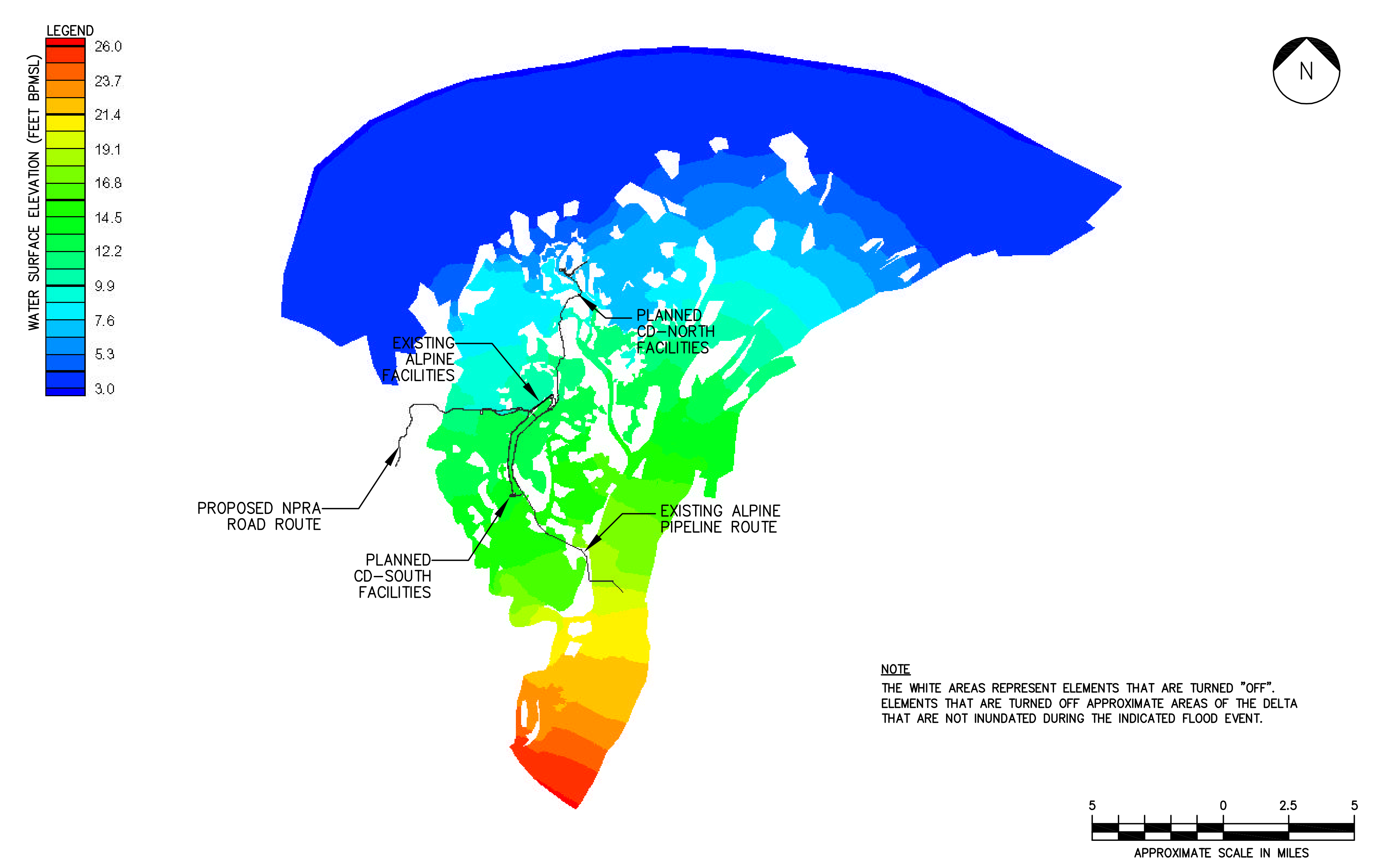
Baker Michael Baker Jr., Inc.	TITLE: 50–YEAR FLOOD, WATER SURFACE ELEVATIONS WITH NPRA ROAD/1200–FT NIGLIQ BRIDGE		
COLVILLE RIVER DELTA TWO–DIMENSIONAL SURFACE WATER MODEL NPRA ROAD/NIGLIQ BRIDGE UPDATE – FEB 2004	FILE NAME: 102579_A07	SCALE: AS SHOWN	FIGURE A7



Baker **Michael Baker Jr., Inc.**	TITLE: 50–YEAR FLOOD, WATER SURFACE ELEVATIONS WITH NPRA ROAD/900–FT NIGLIQ BRIDGE	
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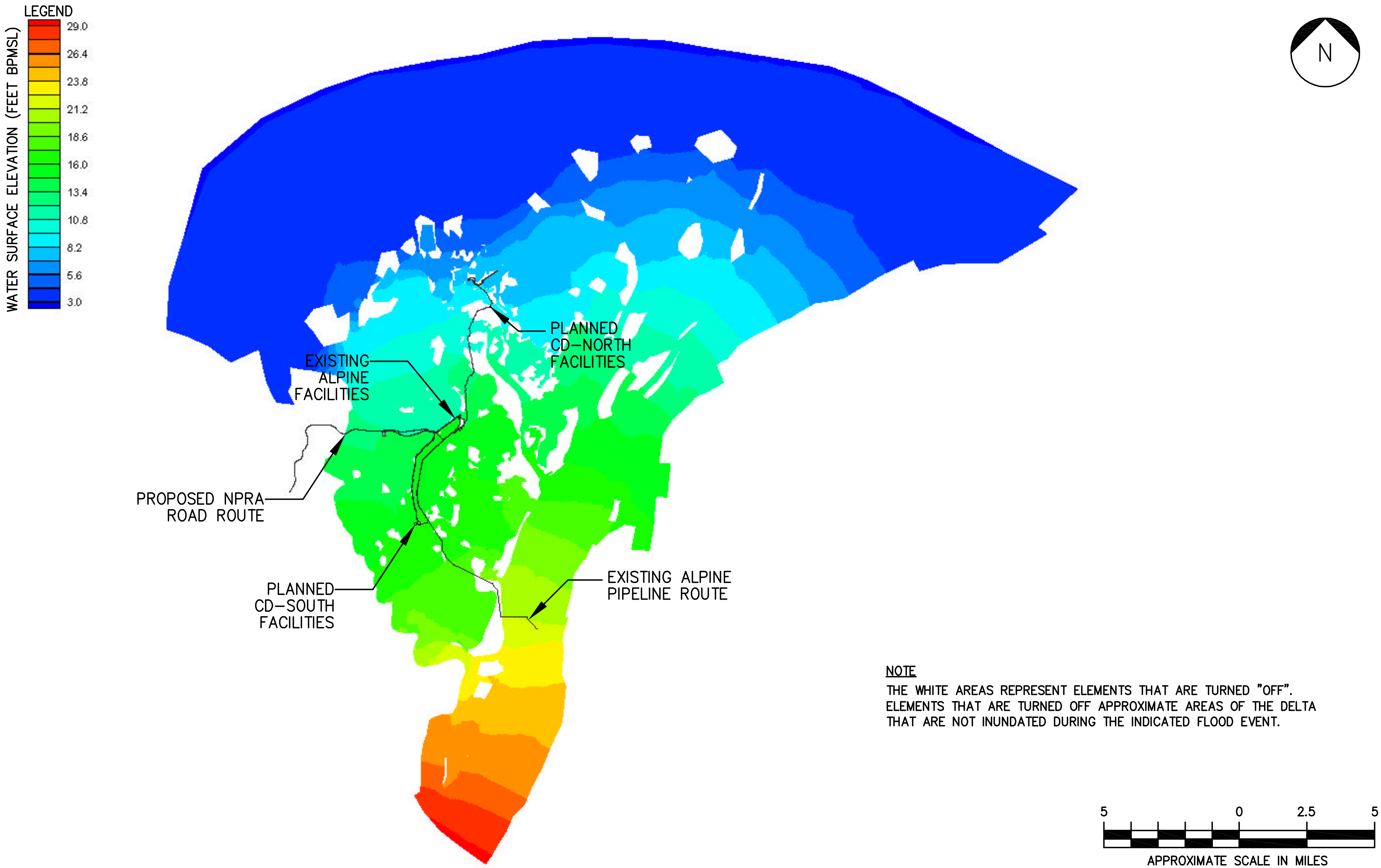
FIGURE A8



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Baker — Michael Baker Jr., Inc.	TITLE: 200–YEAR FLOOD, WATER SURFACE ELEVATIONS WITHOUT NPRA ROAD/NIGLIQ BRIDGE		
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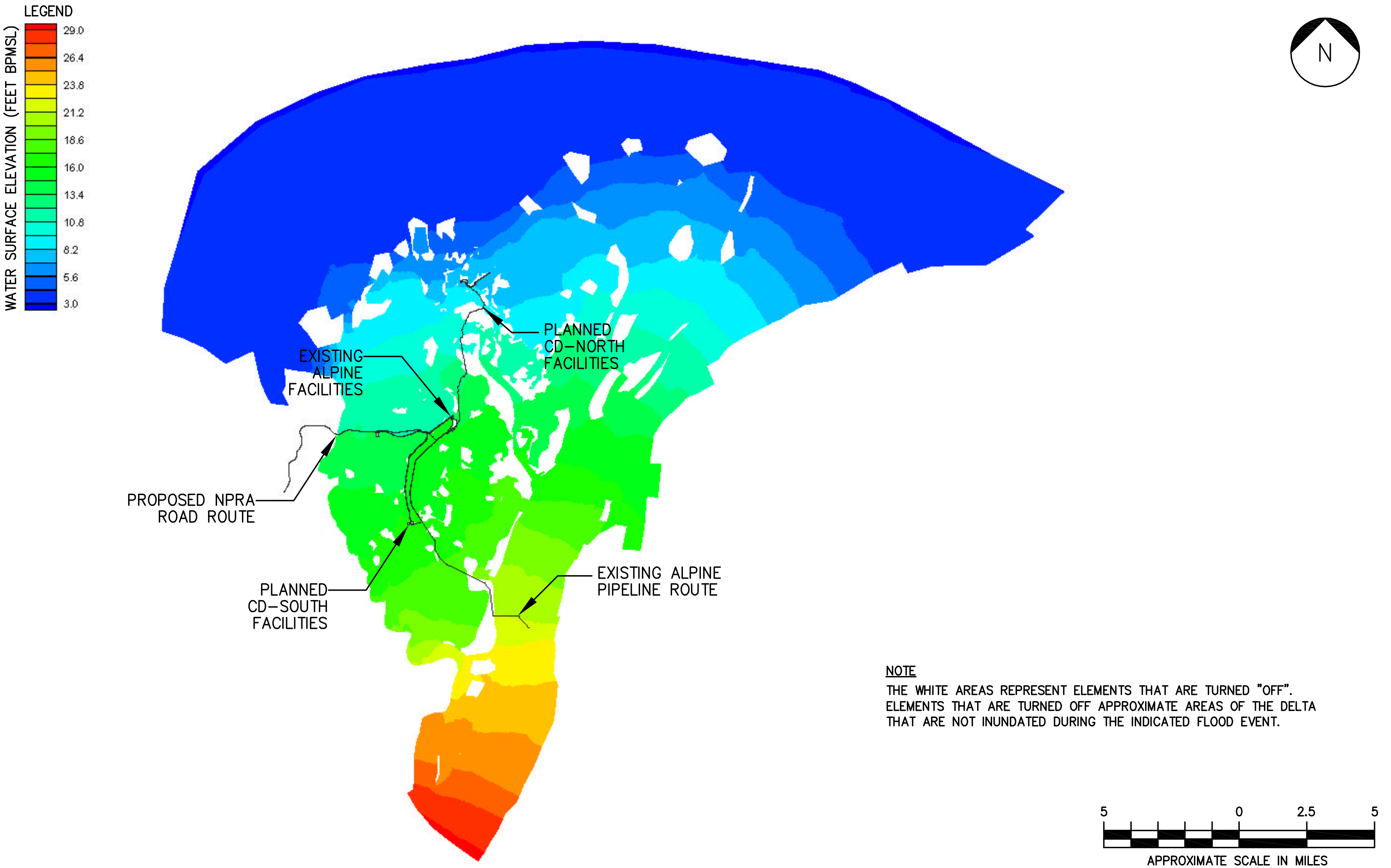

Baker **Michael Baker Jr., Inc.**	TITLE: 200-YEAR FLOOD, WATER SURFACE ELEVATIONS WITH NPRA ROAD/1500-FT NIGLIQ BRIDGE		
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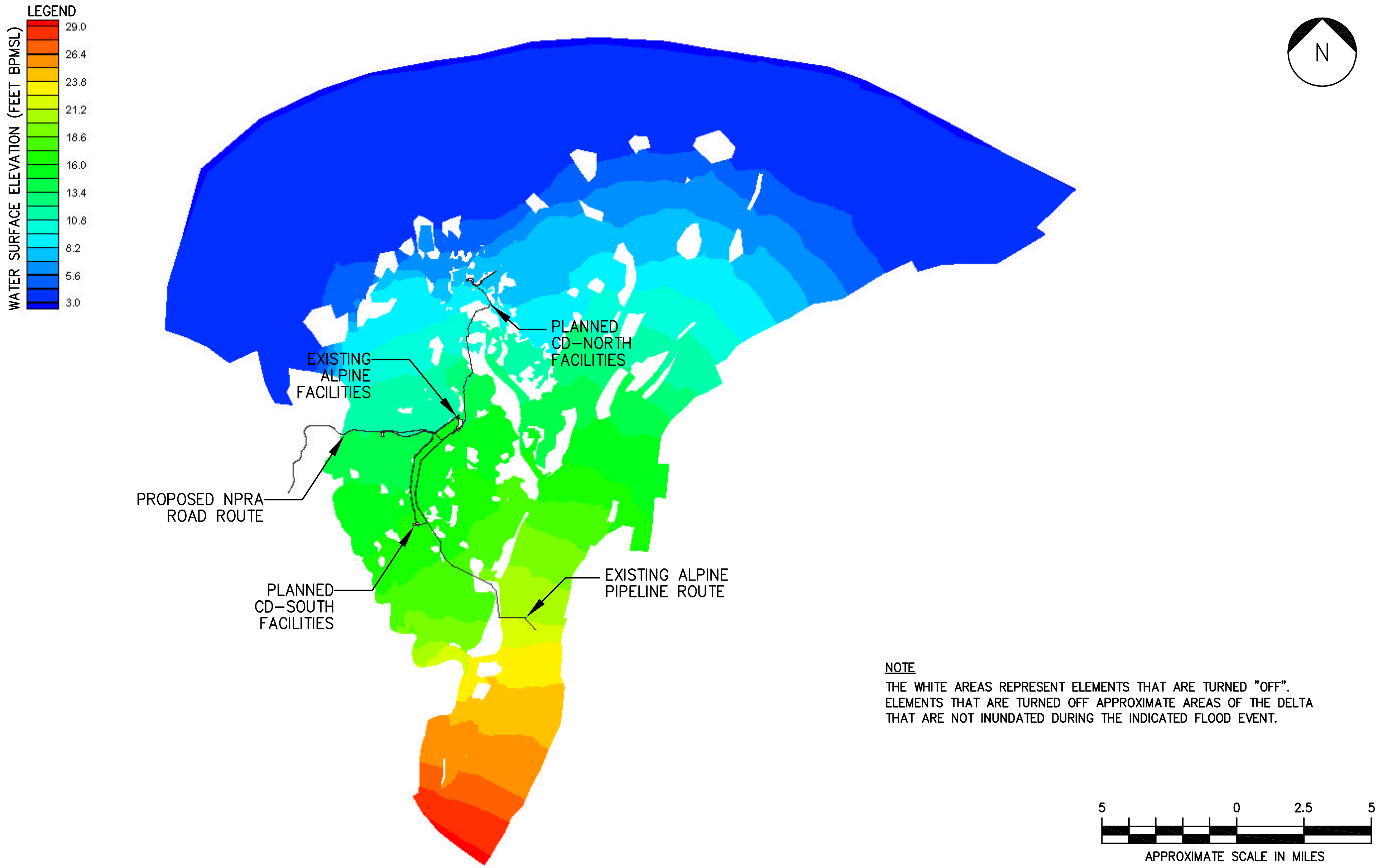

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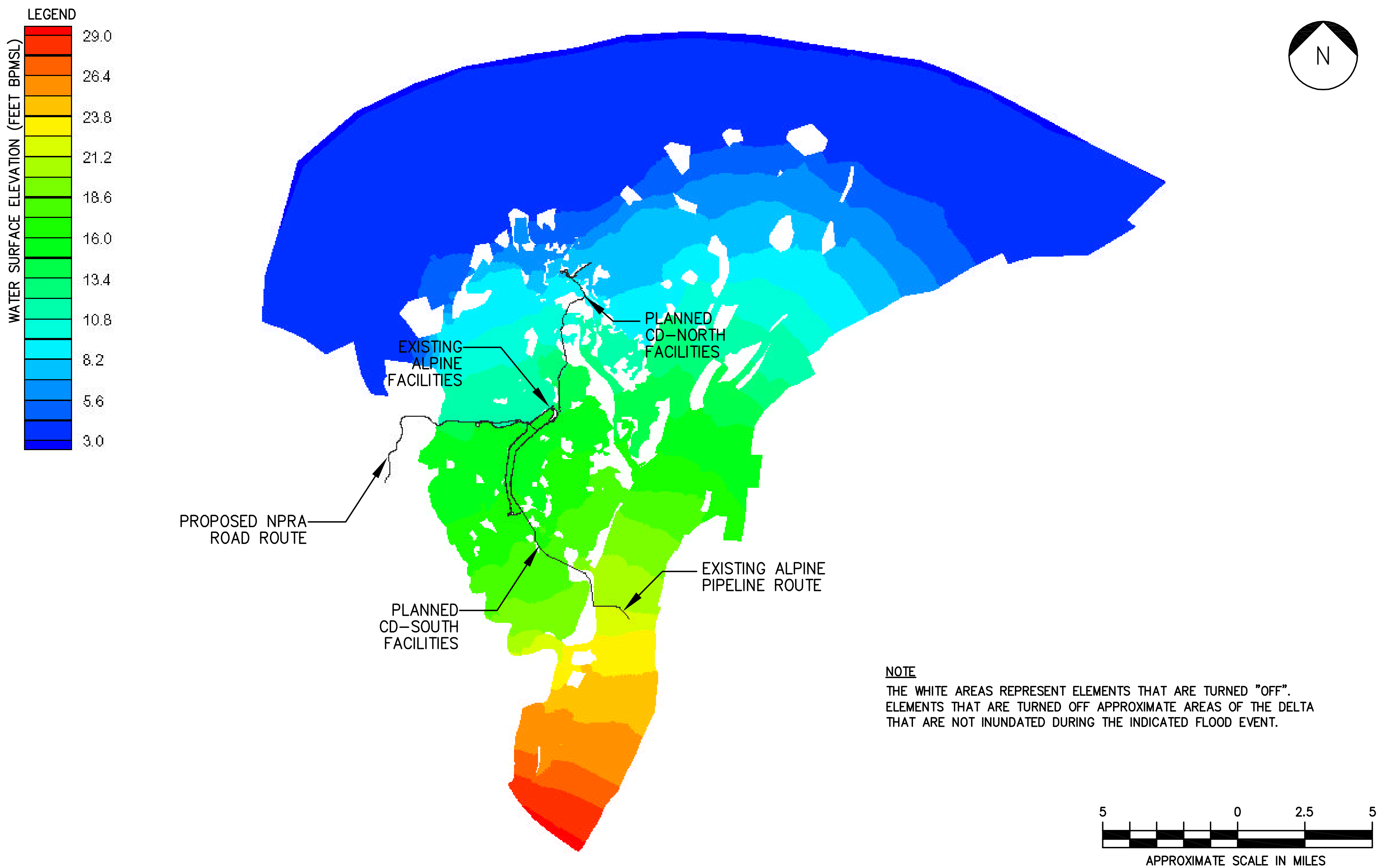
Baker — **Michael Baker Jr., Inc.**	TITLE: 200−YEAR FLOOD, WATER SURFACE ELEVATIONS WITH NPRA ROAD/1200−FT NIGLIQ BRIDGE		
COLVILLE RIVER DELTA TWO−DIMENSIONAL SURFACE WATER MODEL NPRA ROAD/NIGLIQ BRIDGE UPDATE − FEB 2004	FILE NAME: 102579_A11	SCALE: AS SHOWN	FIGURE A11



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Michael Baker Jr., Inc.

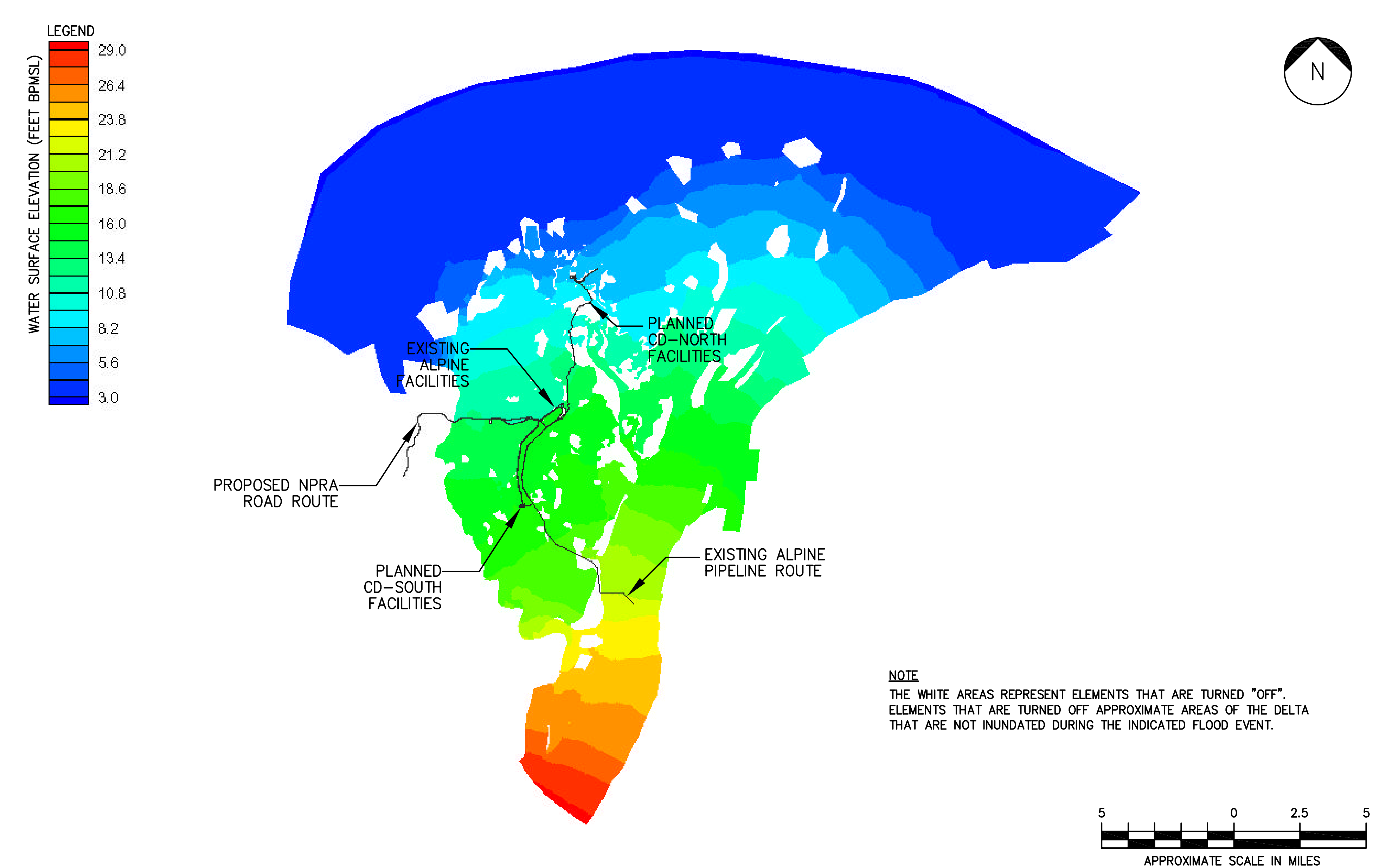
TITLE: 200-YEAR FLOOD, WATER SURFACE ELEVATIONS WITH NPRA ROAD/900-FT NIGLIQ BRIDGE

COLVILLE RIVER DELTA
TWO-DIMENSIONAL SURFACE WATER MODEL
NPRA ROAD/NIGLIQ BRIDGE UPDATE – FEB 2004

FILE NAME: 102579_A12

SCALE: AS SHOWN

FIGURE A12



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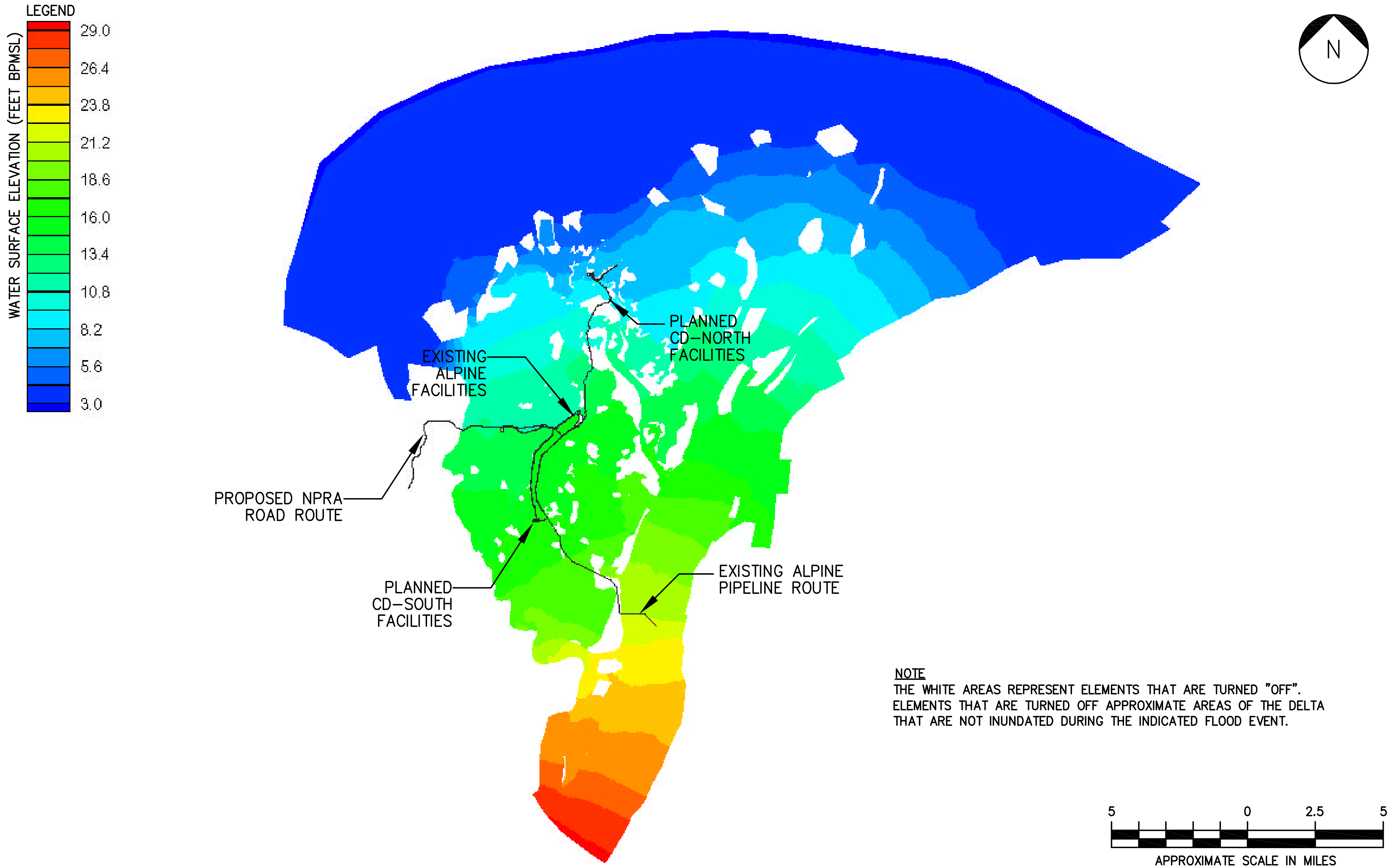
Baker Michael Baker Jr., Inc.	TITLE: 200–YEAR FLOOD, WATER SURFACE ELEVATIONS WITH NPRA ROAD/1500–FT NIGLIQ BRIDGE WITH SCOUR		
COLVILLE RIVER DELTA TWO–DIMENSIONAL SURFACE WATER MODEL NPRA ROAD/NIGLIQ BRIDGE UPDATE – FEB 2004	FILE NAME: 102579_A13	SCALE: AS SHOWN	FIGURE A13



Baker Michael Baker Jr., Inc.

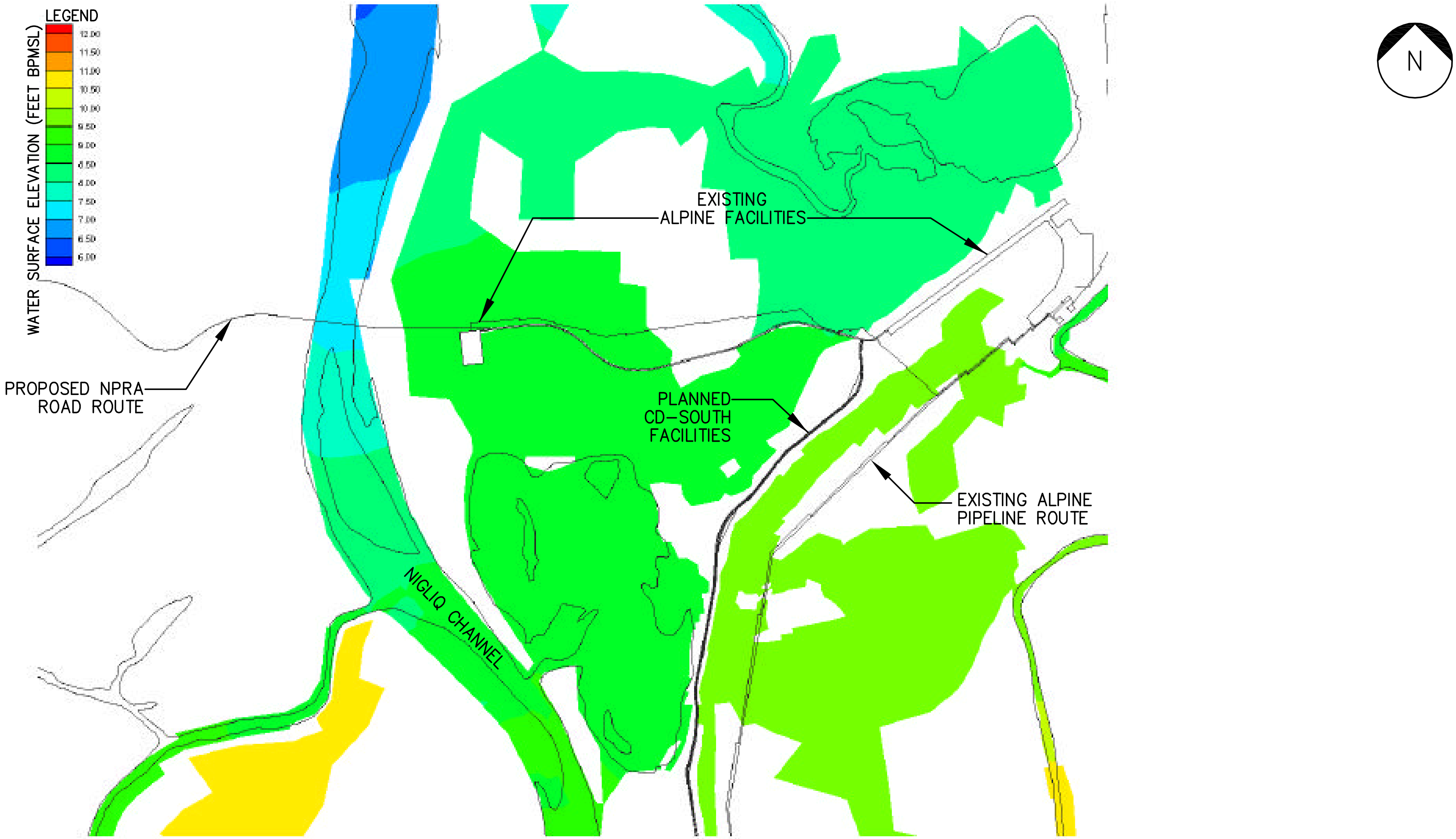
TITLE: 200-YEAR FLOOD, WATER SURFACE ELEVATIONS WITH NPRA ROAD/1200-FT NIGLIQ BRIDGE WITH SCOUR

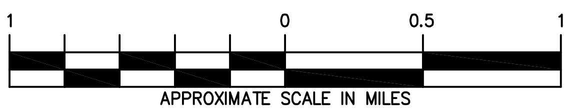
COLVILLE RIVER DELTA
TWO-DIMENSIONAL SURFACE WATER MODEL
NPRA ROAD/NIGLIQ BRIDGE UPDATE – FEB 2004

FILE NAME: 102579_A14

SCALE: AS SHOWN

FIGURE A14





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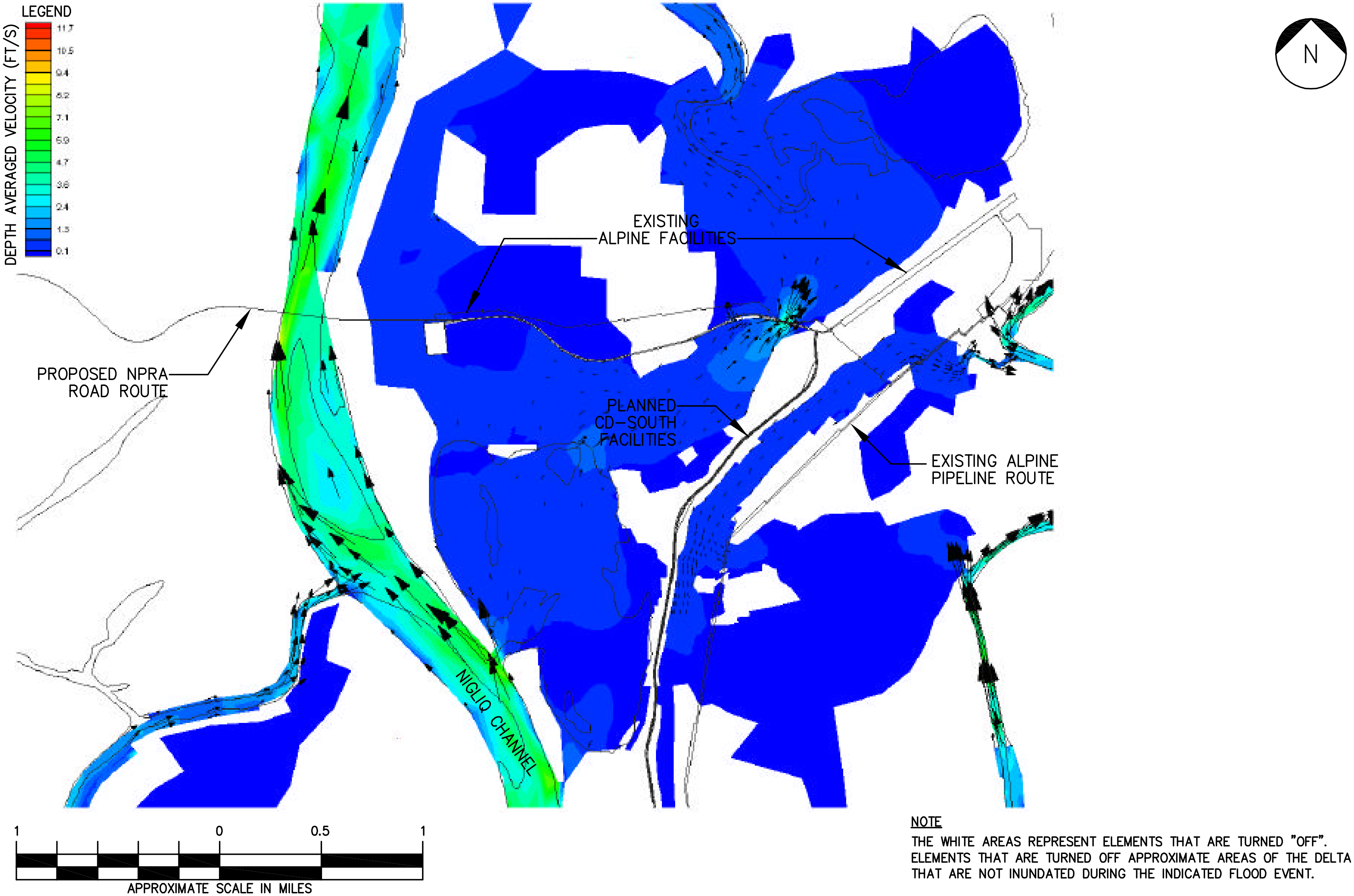
Baker **Michael Baker Jr., Inc.**	TITLE: 10–YEAR FLOOD, WATER SURFACE ELEVATIONS AT ALPINE WITHOUT NPRA ROAD/NIGLIQ BRIDGE		
COLVILLE RIVER DELTA TWO–DIMENSIONAL SURFACE WATER MODEL NPRA ROAD/NIGLIQ BRIDGE UPDATE – FEB 2004	FILE NAME: 102579_A15	SCALE: AS SHOWN	FIGURE A15



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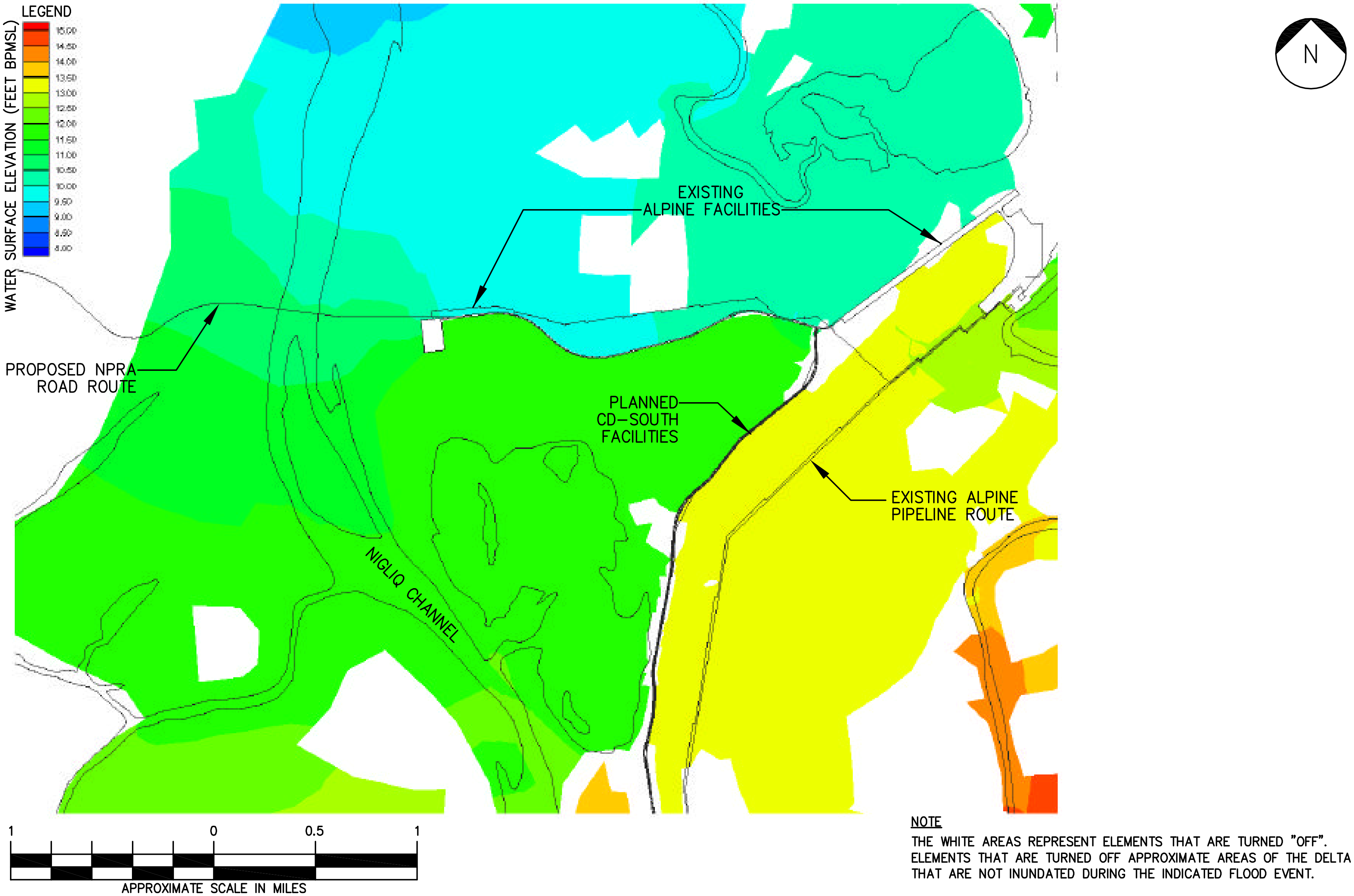
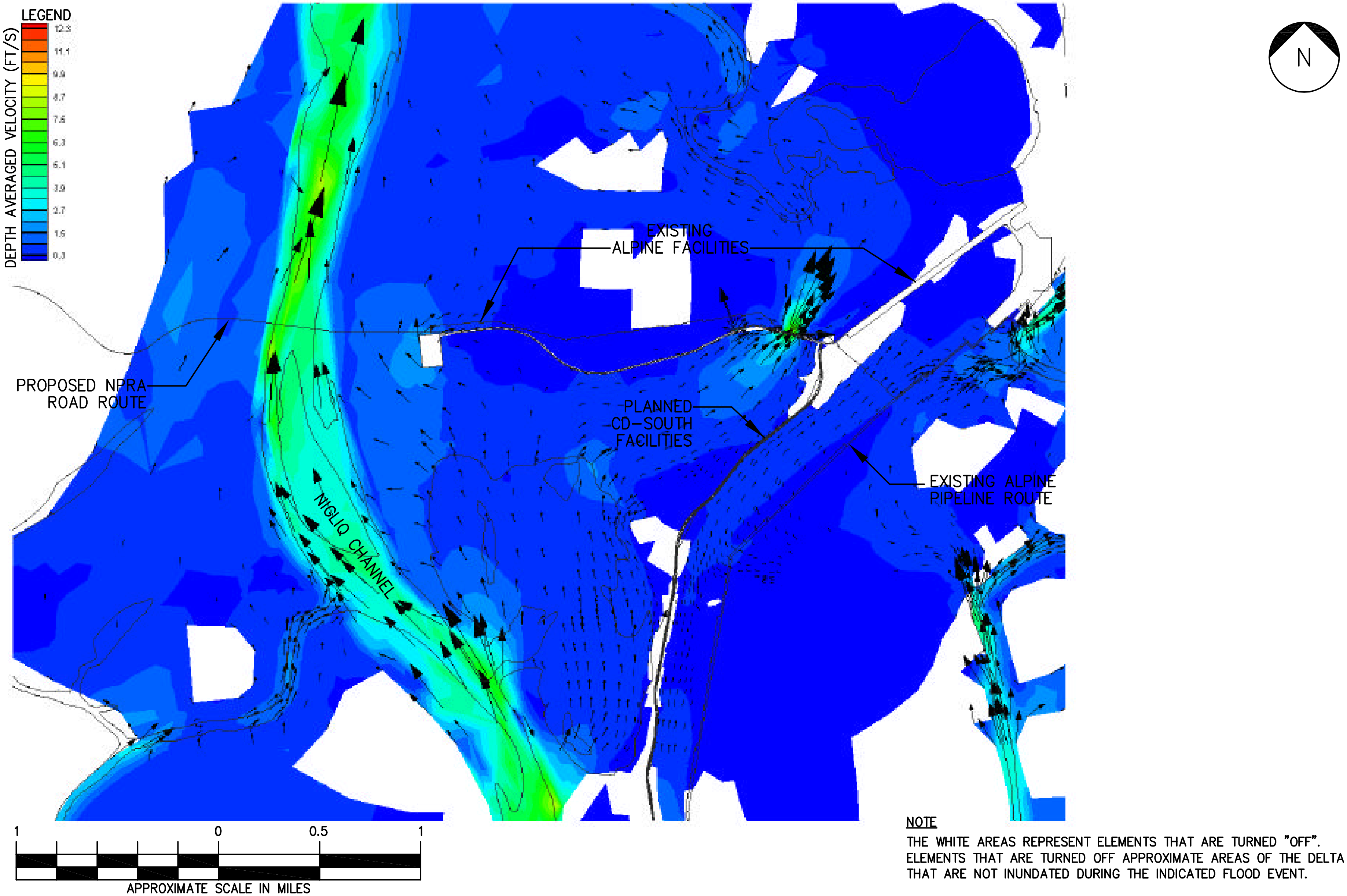
Baker Michael Baker Jr., Inc.	TITLE: 10–YEAR FLOOD, DEPTH AVERAGED VELOCITY AT ALPINE WITHOUT NPRA ROAD/NIGLIQ BRIDGE		
COLVILLE RIVER DELTA TWO–DIMENSIONAL SURFACE WATER MODEL NPRA ROAD/NIGLIQ BRIDGE UPDATE – FEB 2004	FILE NAME: 102579_A16	SCALE: AS SHOWN	FIGURE A16



Baker **Michael Baker Jr., Inc.**	TITLE: 50–YEAR FLOOD, WATER SURFACE ELEVATIONS AT ALPINE WITHOUT NPRA ROAD/NIGLIQ BRIDGE

COLVILLE RIVER DELTA TWO–DIMENSIONAL SURFACE WATER MODEL NPRA ROAD/NIGLIQ BRIDGE UPDATE – FEB 2004	FILE NAME: 102579_A17	SCALE: AS SHOWN	FIGURE A17



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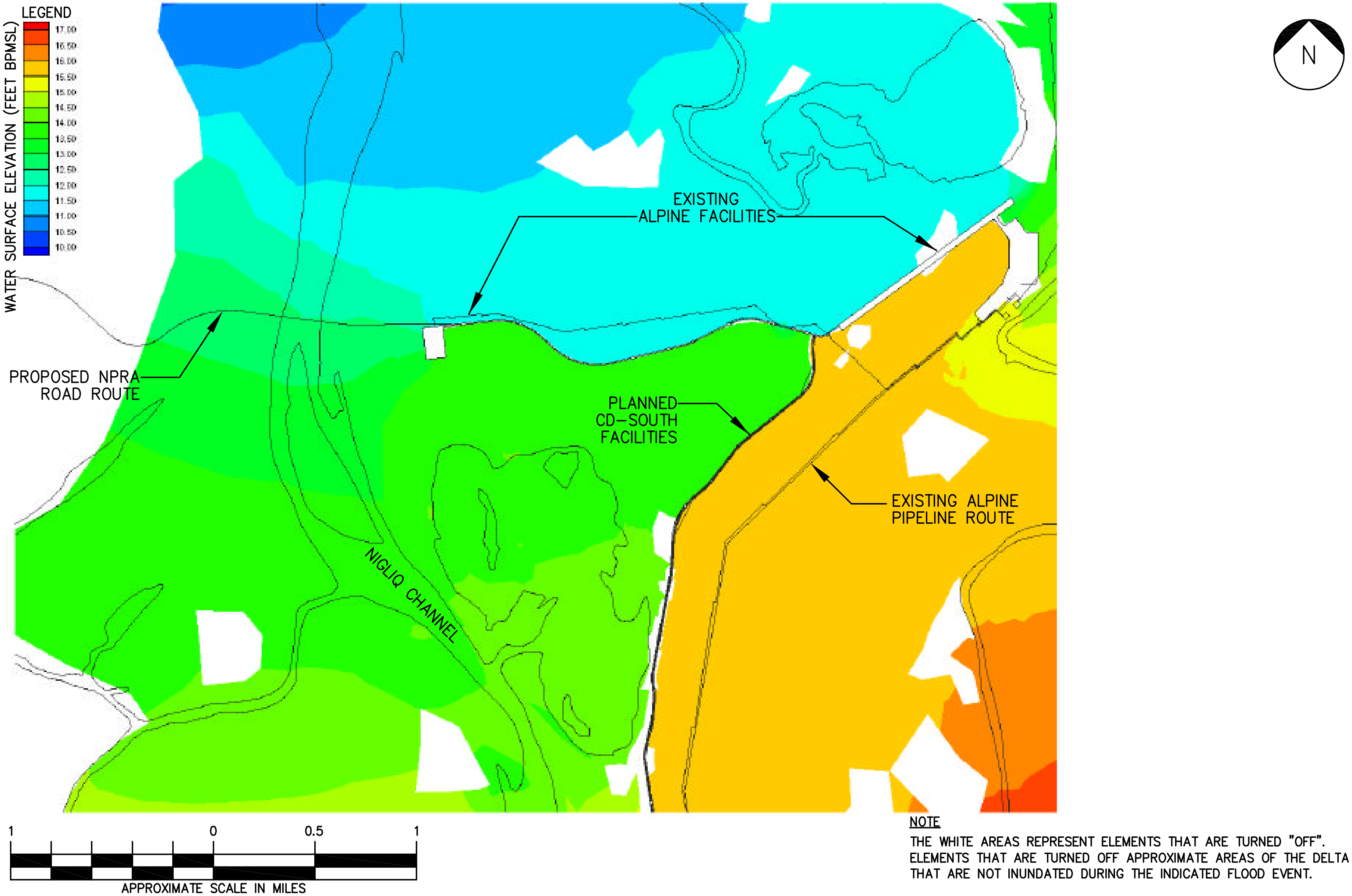
Baker **Michael Baker Jr., Inc.**	TITLE: 50-YEAR FLOOD, DEPTH AVERAGED VELOCITY AT ALPINE WITHOUT NPRA ROAD/NIGLIQ BRIDGE
COLVILLE RIVER DELTA TWO-DIMENSIONAL SURFACE WATER MODEL NPRA ROAD/NIGLIQ BRIDGE UPDATE – FEB 2004	FILE NAME: 102579_A18 | SCALE: AS SHOWN | FIGURE A18



NOTE

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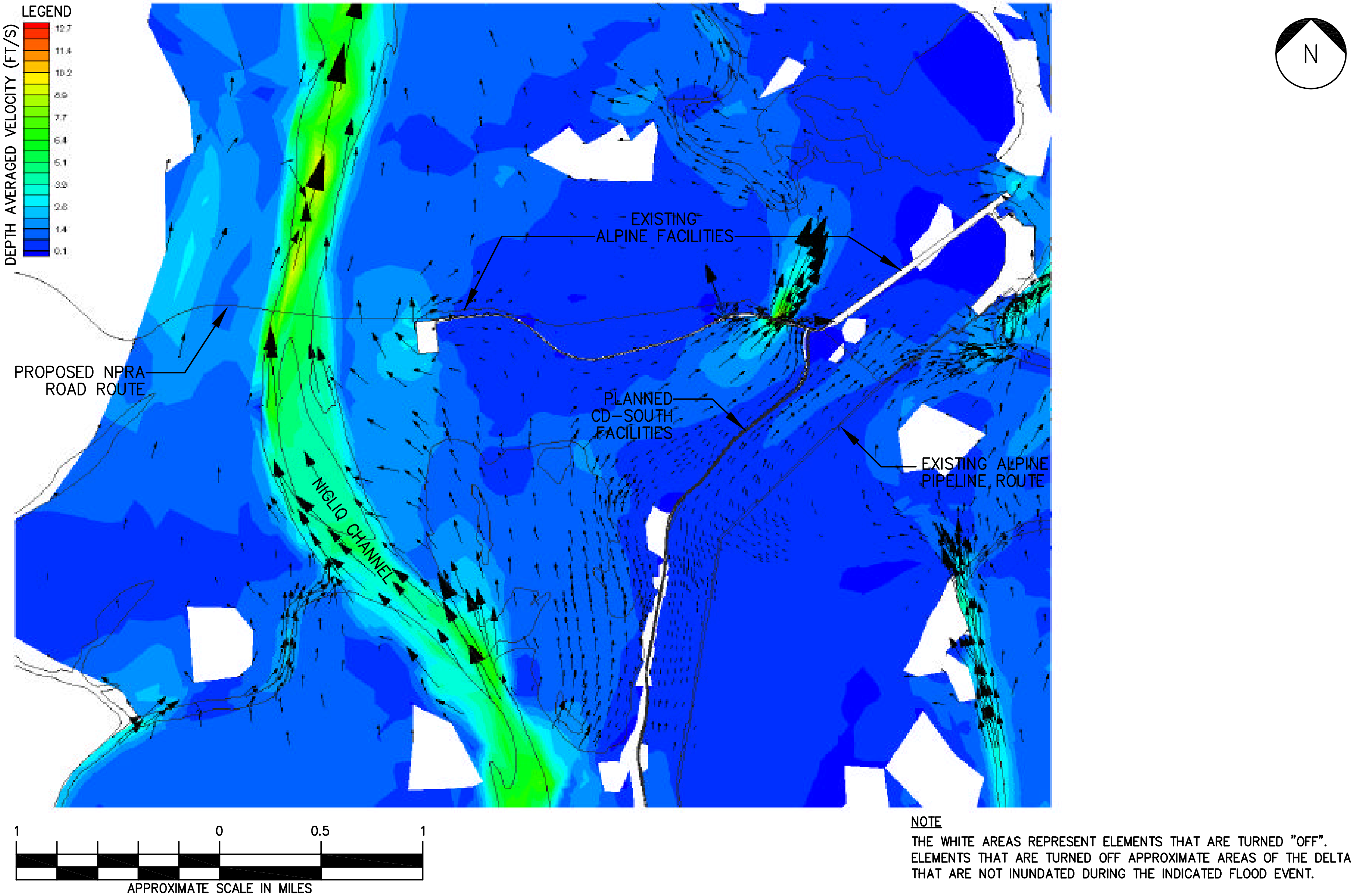
Baker Michael Baker Jr., Inc.	TITLE: 200–YEAR FLOOD, WATER SURFACE ELEVATIONS AT ALPINE WITHOUT NPRA ROAD/NIGLIQ BRIDGE	
COLVILLE RIVER DELTA TWO–DIMENSIONAL SURFACE WATER MODEL NPRA ROAD/NIGLIQ BRIDGE UPDATE – FEB 2004	FILE NAME: 102579_A19	SCALE: AS SHOWN
		FIGURE A19



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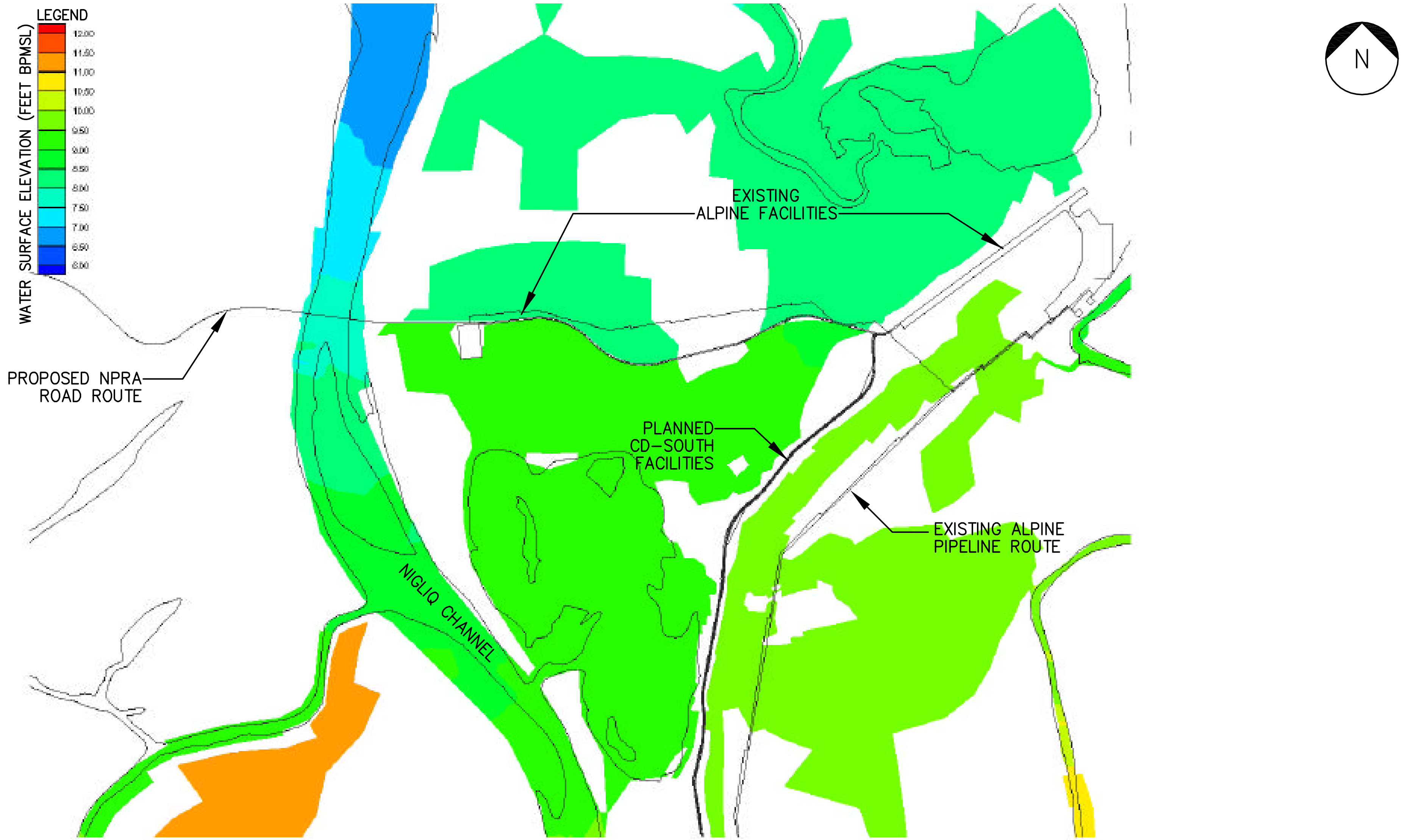
Baker **Michael Baker Jr., Inc.**	TITLE: 200-YEAR FLOOD, DEPTH AVERAGED VELOCITY AT ALPINE WITHOUT NPRA ROAD/NIGLIQ BRIDGE		
COLVILLE RIVER DELTA TWO-DIMENSIONAL SURFACE WATER MODEL NPRA ROAD/NIGLIQ BRIDGE UPDATE – FEB 2004	FILE NAME: 102579_A20	SCALE: AS SHOWN	FIGURE A20



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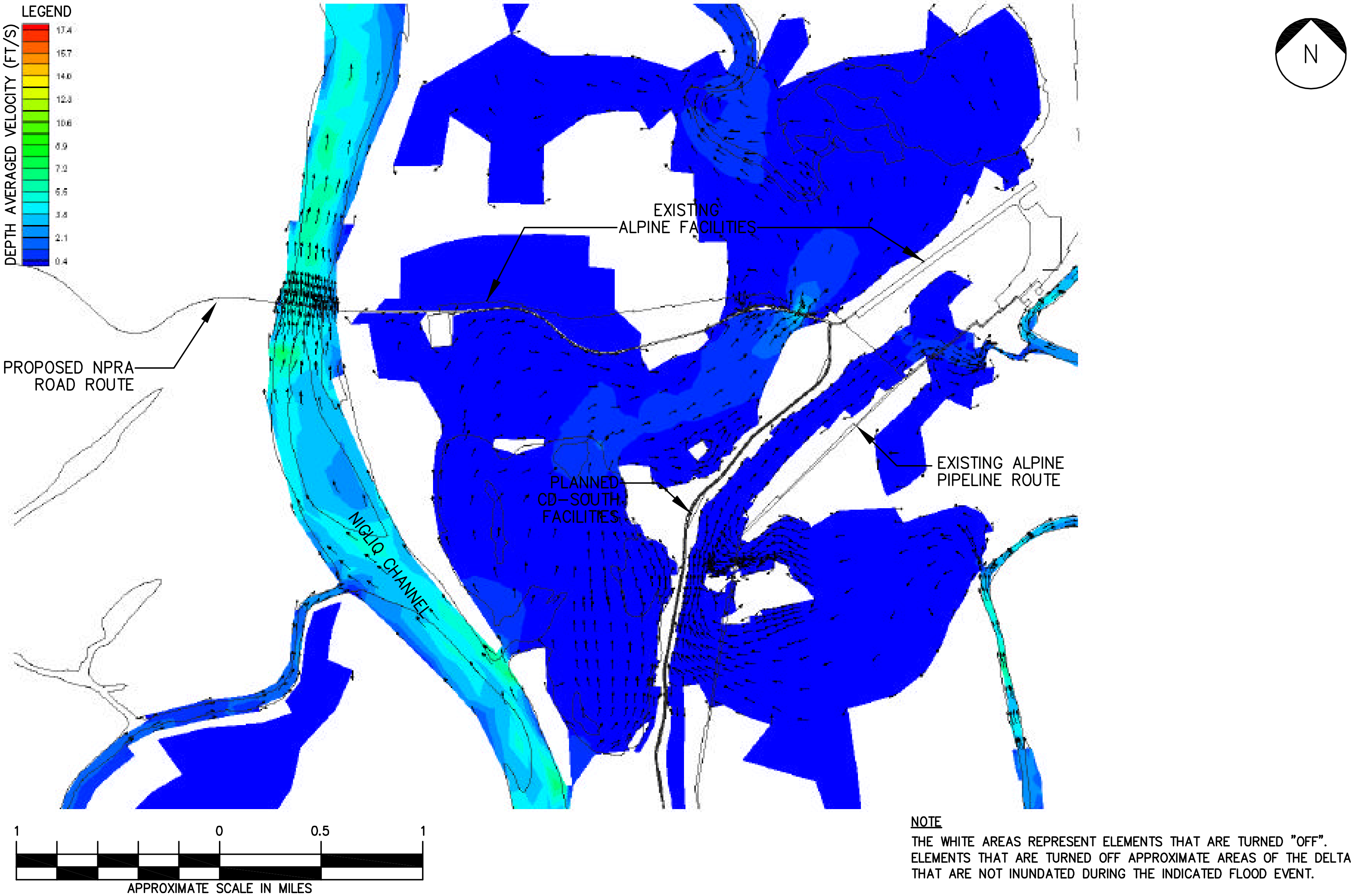
Baker Michael Baker Jr., Inc.	TITLE: 10-YEAR FLOOD, WATER SURFACE ELEVATIONS AT ALPINE WITH NPRA ROAD/1500-FT NIGLIQ BRIDGE		
COLVILLE RIVER DELTA TWO-DIMENSIONAL SURFACE WATER MODEL NPRA ROAD/NIGLIQ BRIDGE UPDATE – FEB 2004	FILE NAME: 102579_A21	SCALE: AS SHOWN	FIGURE A21



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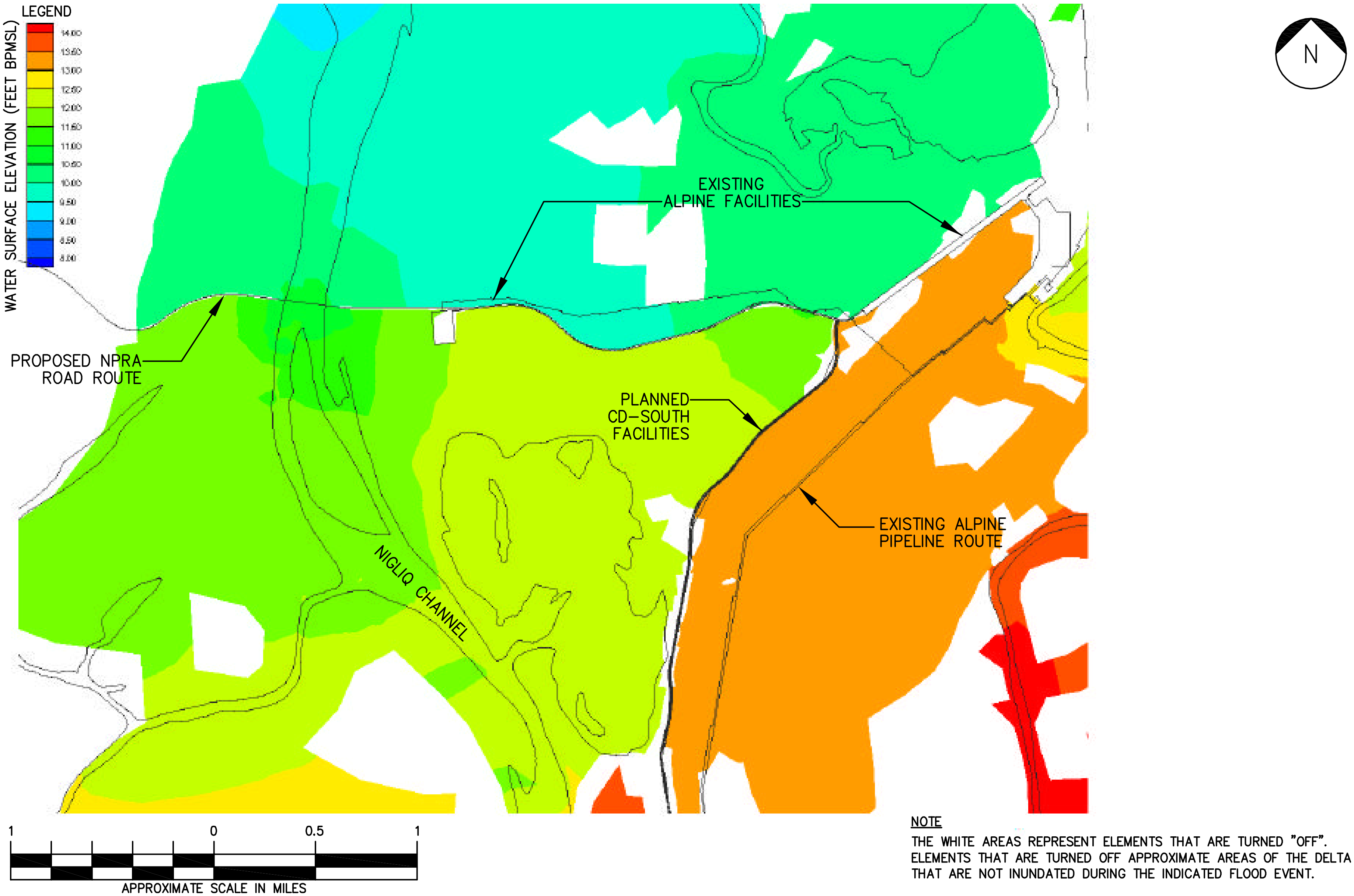
Baker Michael Baker Jr., Inc.	TITLE: 10-YEAR FLOOD, DEPTH AVERAGED VELOCITY AT ALPINE WITH NPRA ROAD/1500-FT NIGLIQ BRIDGE

COLVILLE RIVER DELTA TWO-DIMENSIONAL SURFACE WATER MODEL NPRA ROAD/NIGLIQ BRIDGE UPDATE – FEB 2004	FILE NAME: 102579_A22	SCALE: AS SHOWN	FIGURE A22



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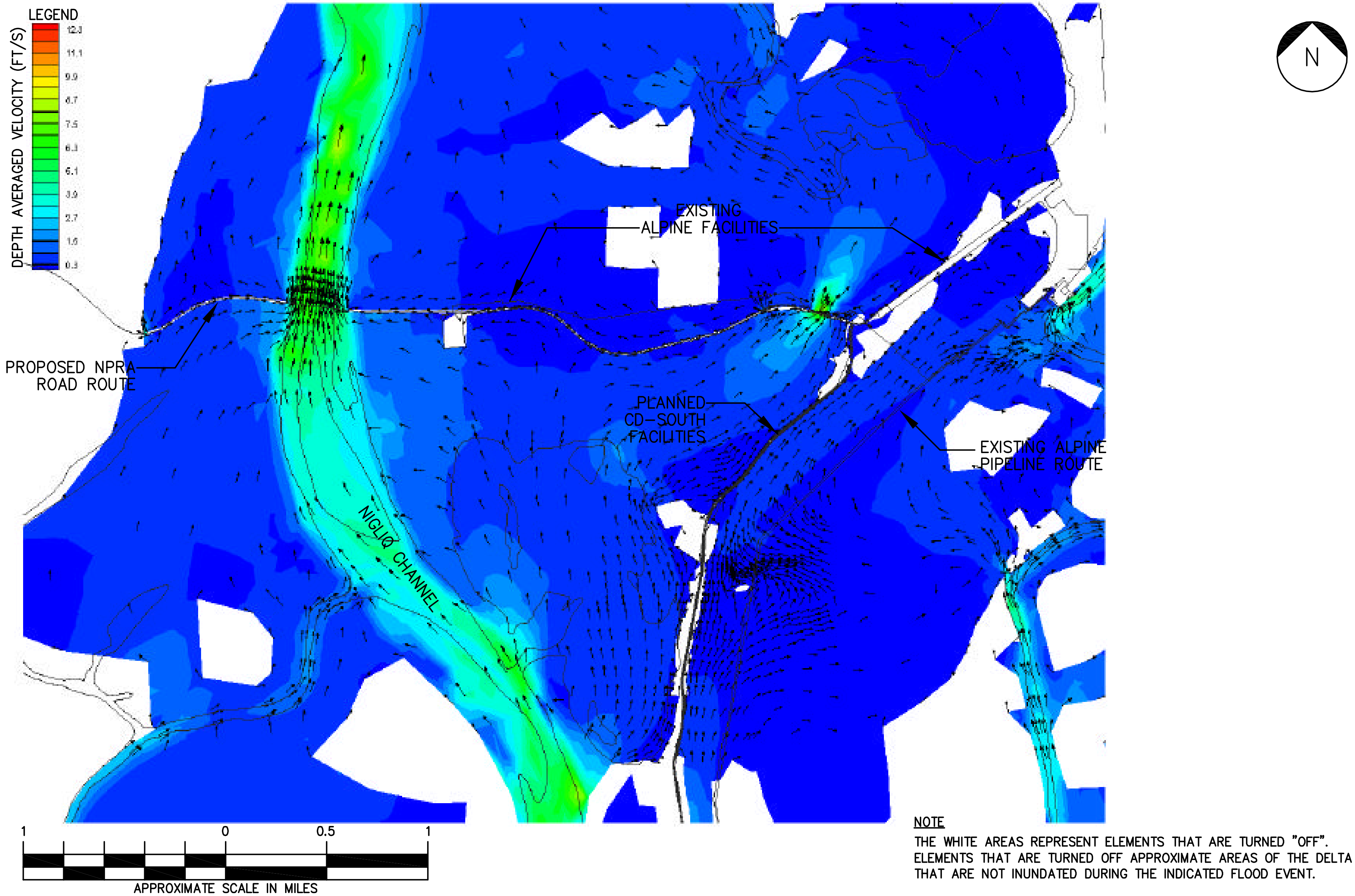
Baker — Michael Baker Jr., Inc.	TITLE: 50–YEAR FLOOD, WATER SURFACE ELEVATIONS AT ALPINE WITH NPRA ROAD/1500–FT NIGLIQ BRIDGE		
COLVILLE RIVER DELTA TWO–DIMENSIONAL SURFACE WATER MODEL NPRA ROAD/NIGLIQ BRIDGE UPDATE – FEB 2004	FILE NAME: 102579_A23	SCALE: AS SHOWN	FIGURE A23



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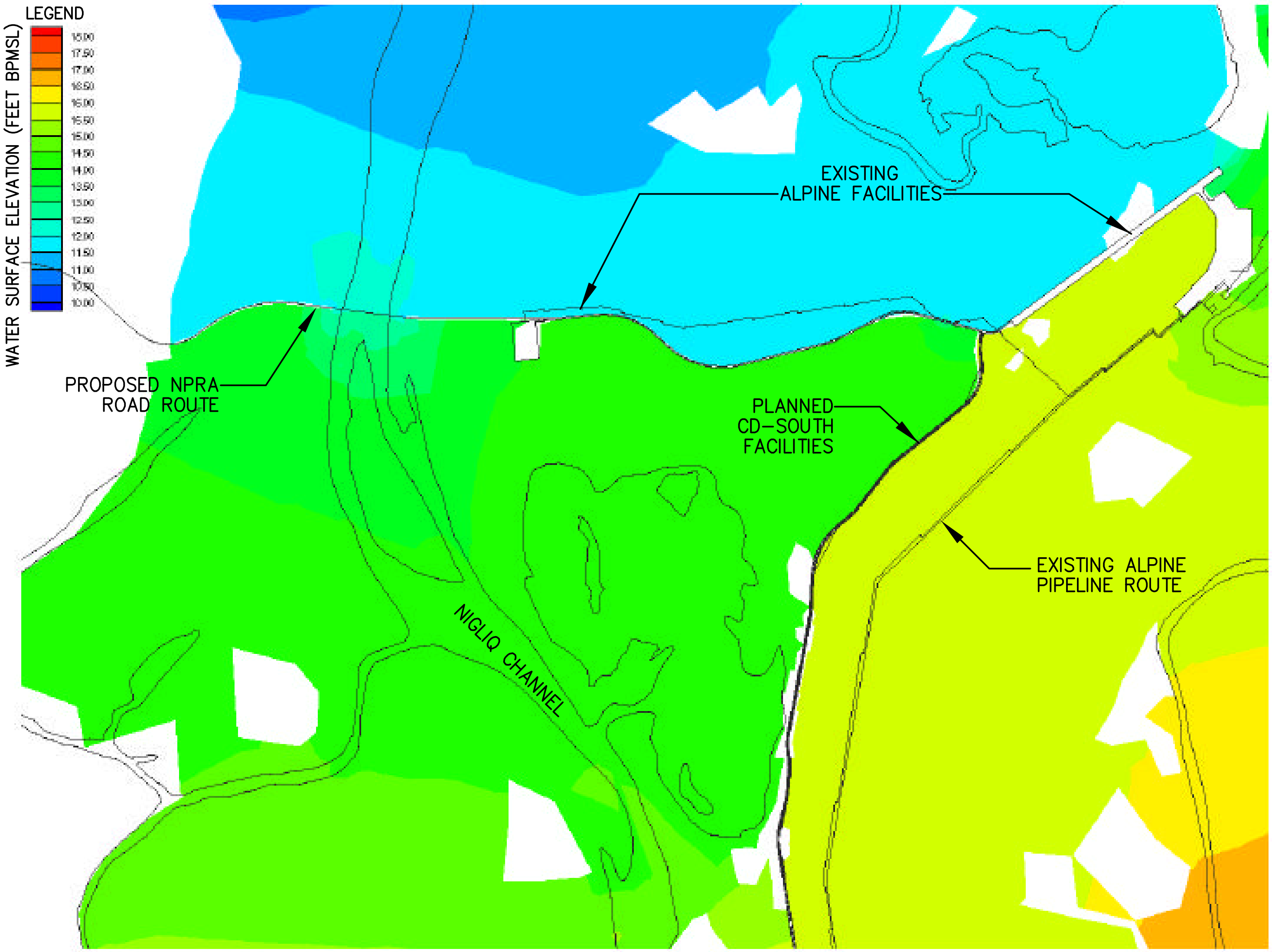
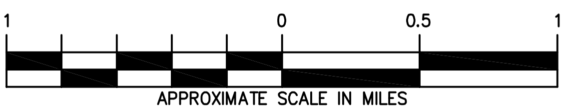
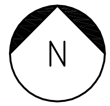
Baker Michael Baker Jr., Inc.	TITLE: 50-YEAR FLOOD, DEPTH AVERAGED VELOCITY AT ALPINE WITH NPRA ROAD/1500-FT NIGLIQ BRIDGE		
COLVILLE RIVER DELTA TWO-DIMENSIONAL SURFACE WATER MODEL NPRA ROAD/NIGLIQ BRIDGE UPDATE – FEB 2004	FILE NAME: 102579_A24	SCALE: AS SHOWN	FIGURE A24







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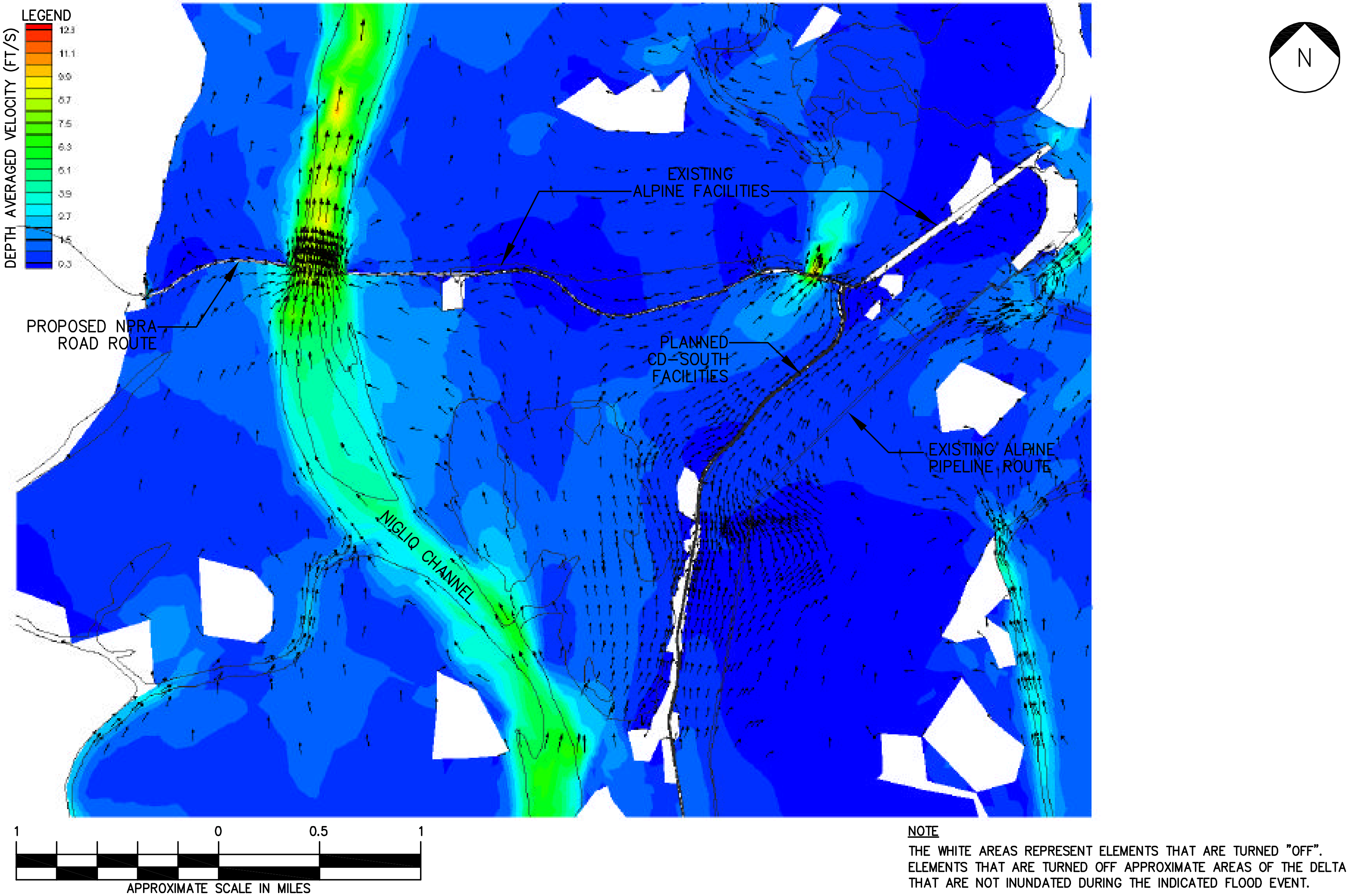
Baker Michael Baker Jr., Inc.	TITLE: 200–YEAR FLOOD, WATER SURFACE ELEVATIONS AT ALPINE WITH NPRA ROAD/1500–FT NIGLIQ BRIDGE

COLVILLE RIVER DELTA TWO–DIMENSIONAL SURFACE WATER MODEL NPRA ROAD/NIGLIQ BRIDGE UPDATE – FEB 2004	FILE NAME: 102579_A25	SCALE: AS SHOWN	FIGURE A25



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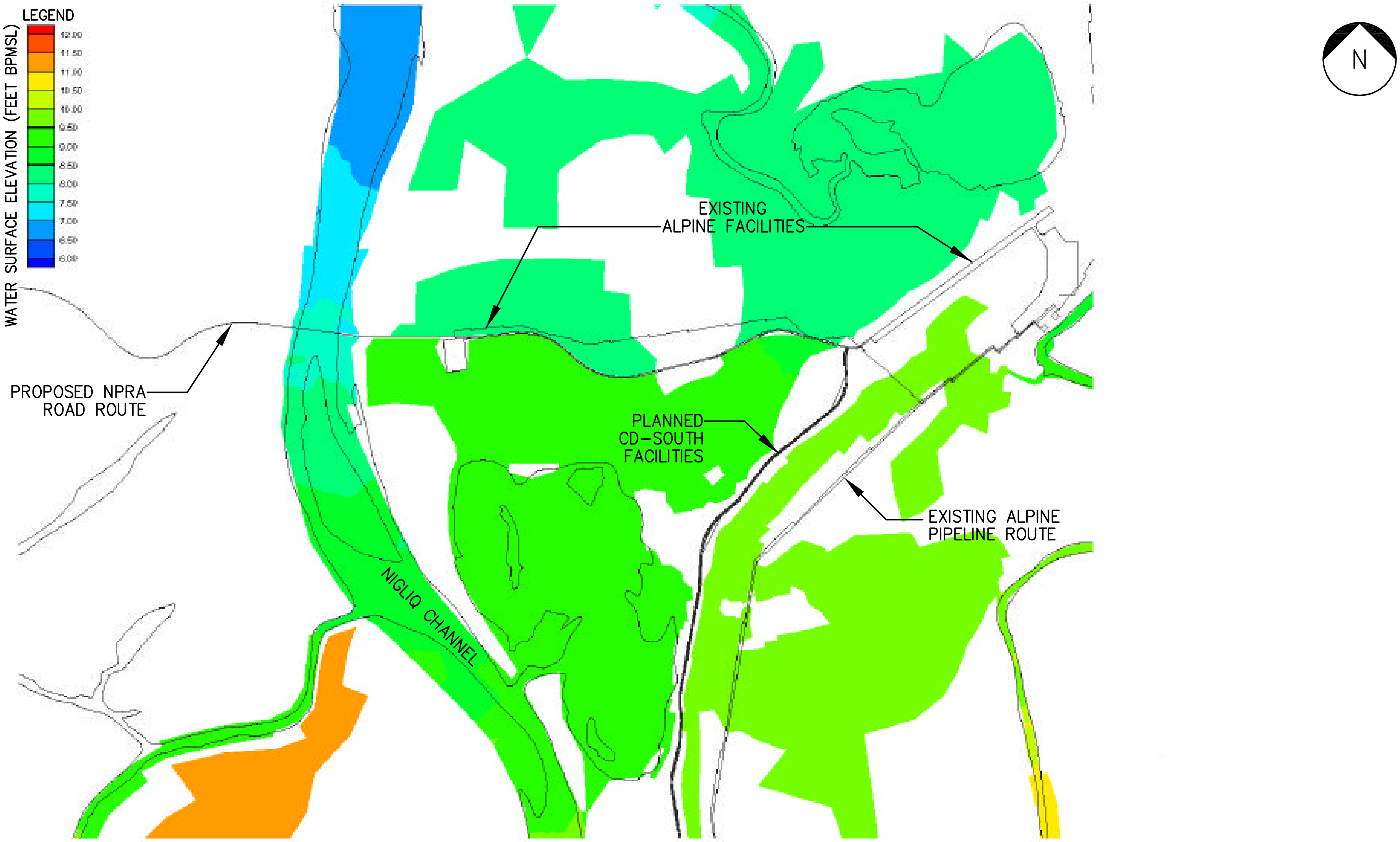
Baker Michael Baker Jr., Inc.	TITLE: 200-YEAR FLOOD, DEPTH AVERAGED VELOCITY AT ALPINE WITH NPRA ROAD/1500-FT NIGLIQ BRIDGE		
COLVILLE RIVER DELTA TWO-DIMENSIONAL SURFACE WATER MODEL NPRA ROAD/NIGLIQ BRIDGE UPDATE - FEB 2004	FILE NAME: 102579_A26	SCALE: AS SHOWN	FIGURE A26



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APPROXIMATE SCALE IN MILES

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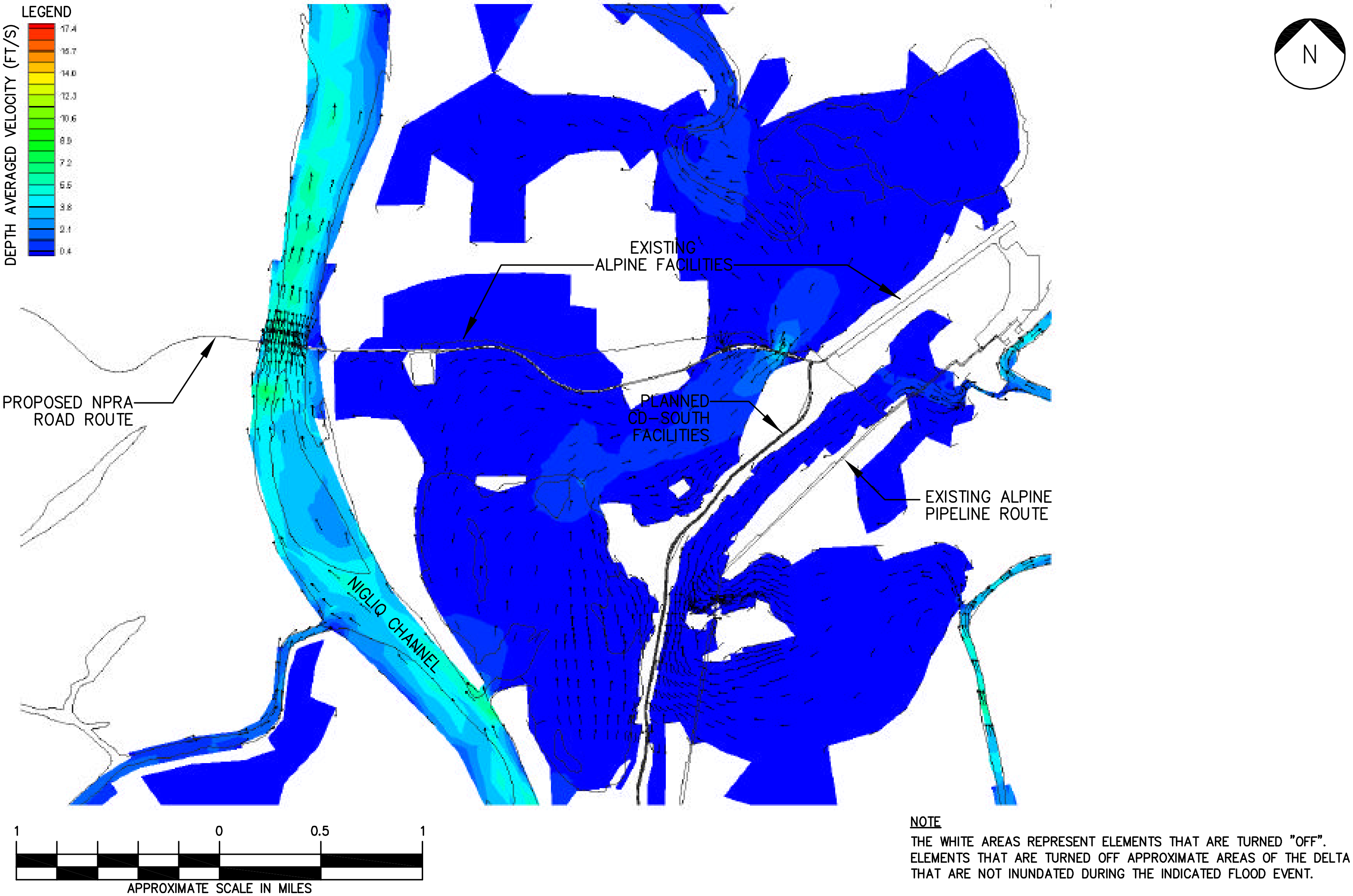
Baker	Michael Baker Jr., Inc.	TITLE: 10–YEAR FLOOD, WATER SURFACE ELEVATIONS AT ALPINE WITH NPRA ROAD/1200–FT NIGLIQ BRIDGE	
COLVILLE RIVER DELTA TWO–DIMENSIONAL SURFACE WATER MODEL NPRA ROAD/NIGLIQ BRIDGE UPDATE – FEB 2004	FILE NAME: 102579_A27	SCALE: AS SHOWN	FIGURE A27



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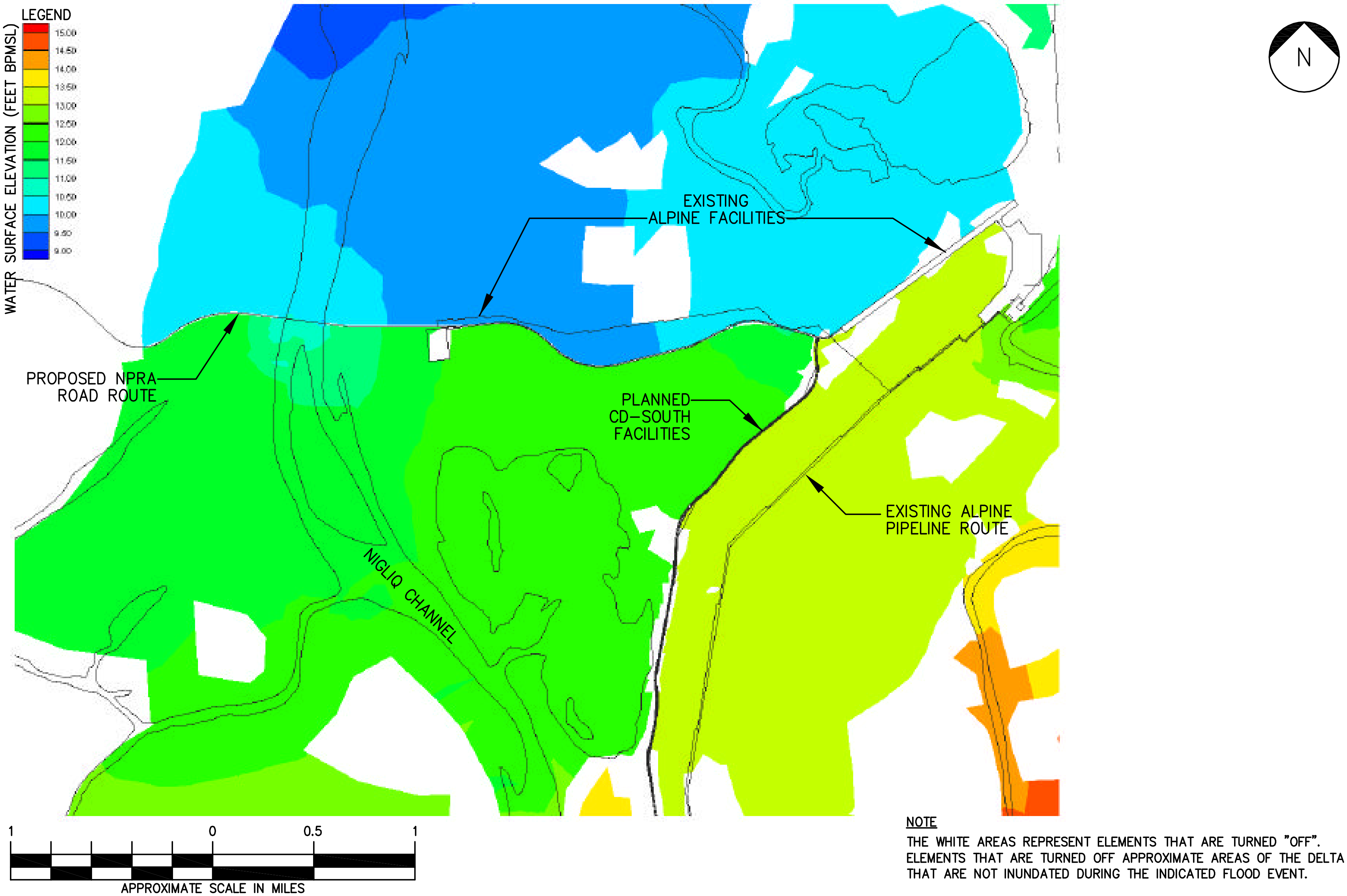
Baker — Michael Baker Jr., Inc.	TITLE: 10-YEAR FLOOD, DEPTH AVERAGED VELOCITY AT ALPINE WITH NPRA ROAD/1200-FT NIGLIQ BRIDGE		
COLVILLE RIVER DELTA TWO-DIMENSIONAL SURFACE WATER MODEL NPRA ROAD/NIGLIQ BRIDGE UPDATE - FEB 2004	FILE NAME: 102579_A28	SCALE: AS SHOWN	FIGURE A28



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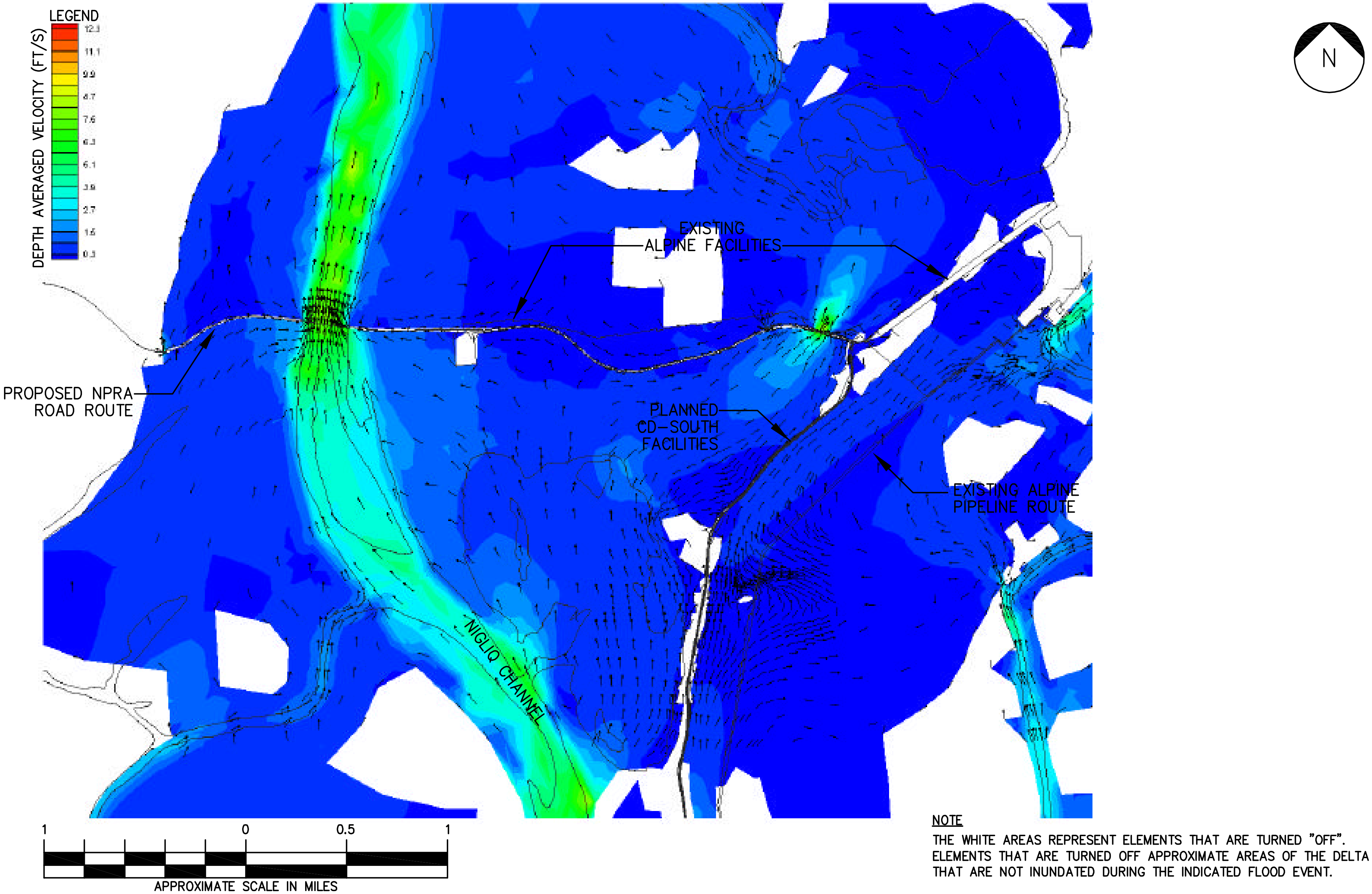
Baker Michael Baker Jr., Inc.	TITLE: 50-YEAR FLOOD, WATER SURFACE ELEVATIONS AT ALPINE WITH NPRA ROAD/1200-FT NIGLIQ BRIDGE
COLVILLE RIVER DELTA TWO-DIMENSIONAL SURFACE WATER MODEL NPRA ROAD/NIGLIQ BRIDGE UPDATE - FEB 2004	FILE NAME: 102579_A29
SCALE: AS SHOWN	FIGURE A29



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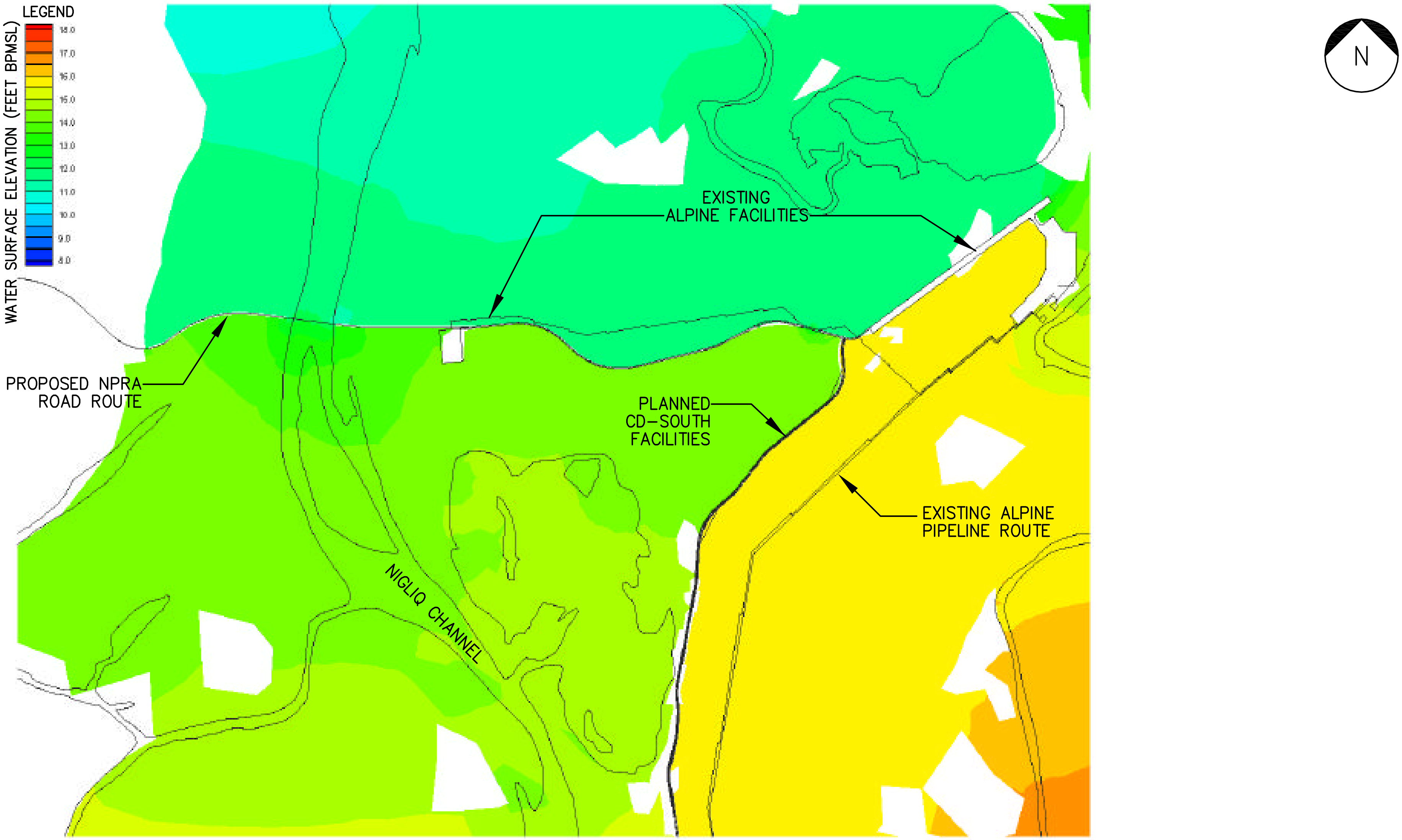
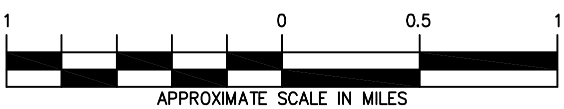
Baker **Michael Baker Jr., Inc.**	TITLE: 50-YEAR FLOOD, DEPTH AVERAGED VELOCITY AT ALPINE WITH NPRA ROAD/1200-FT NIGLIQ BRIDGE		
COLVILLE RIVER DELTA TWO-DIMENSIONAL SURFACE WATER MODEL NPRA ROAD/NIGLIQ BRIDGE UPDATE - FEB 2004	FILE NAME: 102579_A30	SCALE: AS SHOWN	FIGURE A30





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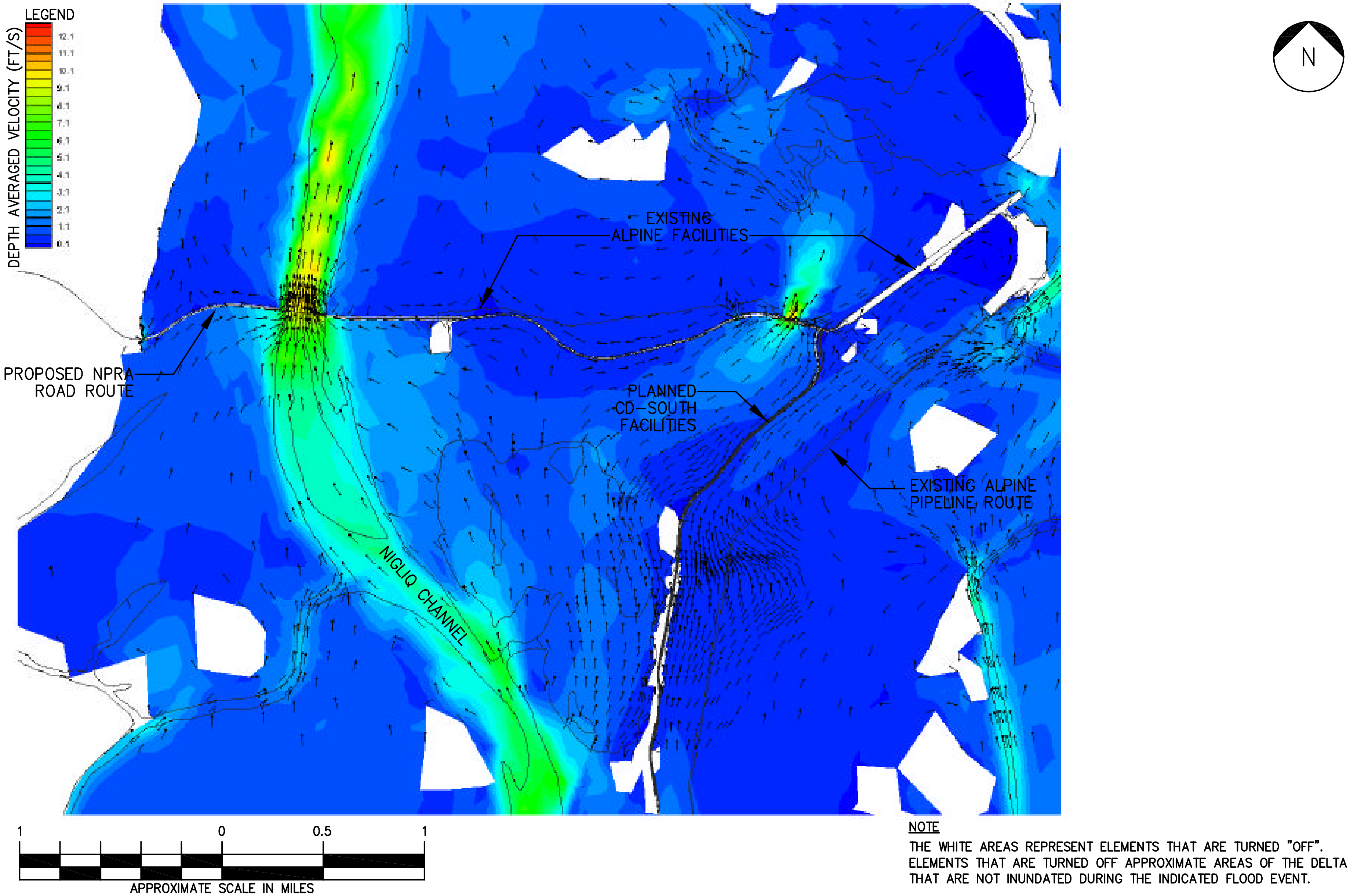
Baker Michael Baker Jr., Inc.	TITLE: 200-YEAR FLOOD, WATER SURFACE ELEVATIONS AT ALPINE WITH NPRA ROAD/1200-FT NIGLIQ BRIDGE		
COLVILLE RIVER DELTA TWO-DIMENSIONAL SURFACE WATER MODEL NPRA ROAD/NIGLIQ BRIDGE UPDATE - FEB 2004	FILE NAME: 102579_A31	SCALE: AS SHOWN	FIGURE A31



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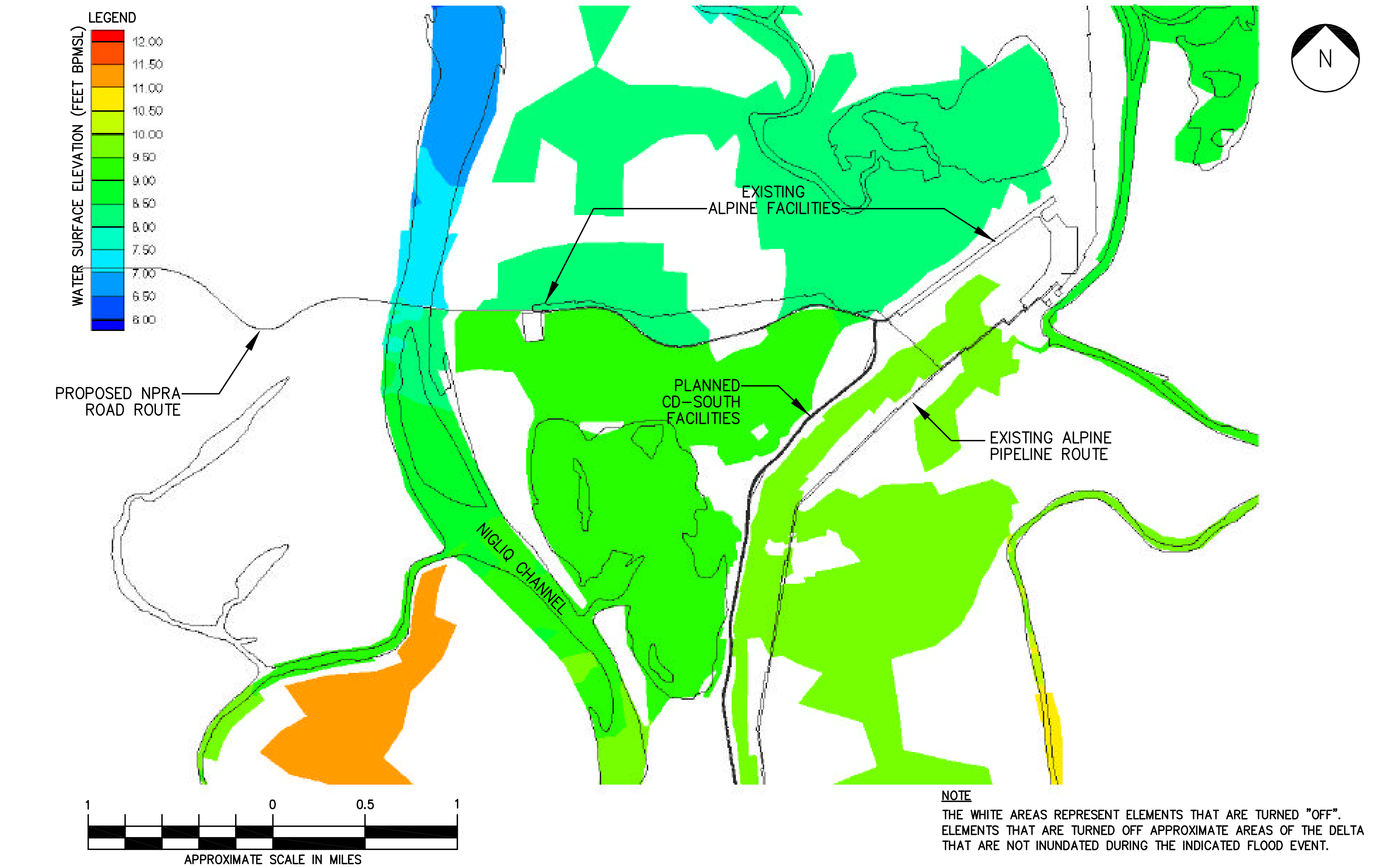
Baker **Michael Baker Jr., Inc.**	TITLE: 200–YEAR FLOOD, DEPTH AVERAGED VELOCITY AT ALPINE WITH NPRA ROAD/1200–FT NIGLIQ BRIDGE		
COLVILLE RIVER DELTA TWO–DIMENSIONAL SURFACE WATER MODEL NPRA ROAD/NIGLIQ BRIDGE UPDATE – FEB 2004	FILE NAME: 102579_A32	SCALE: AS SHOWN	FIGURE A32



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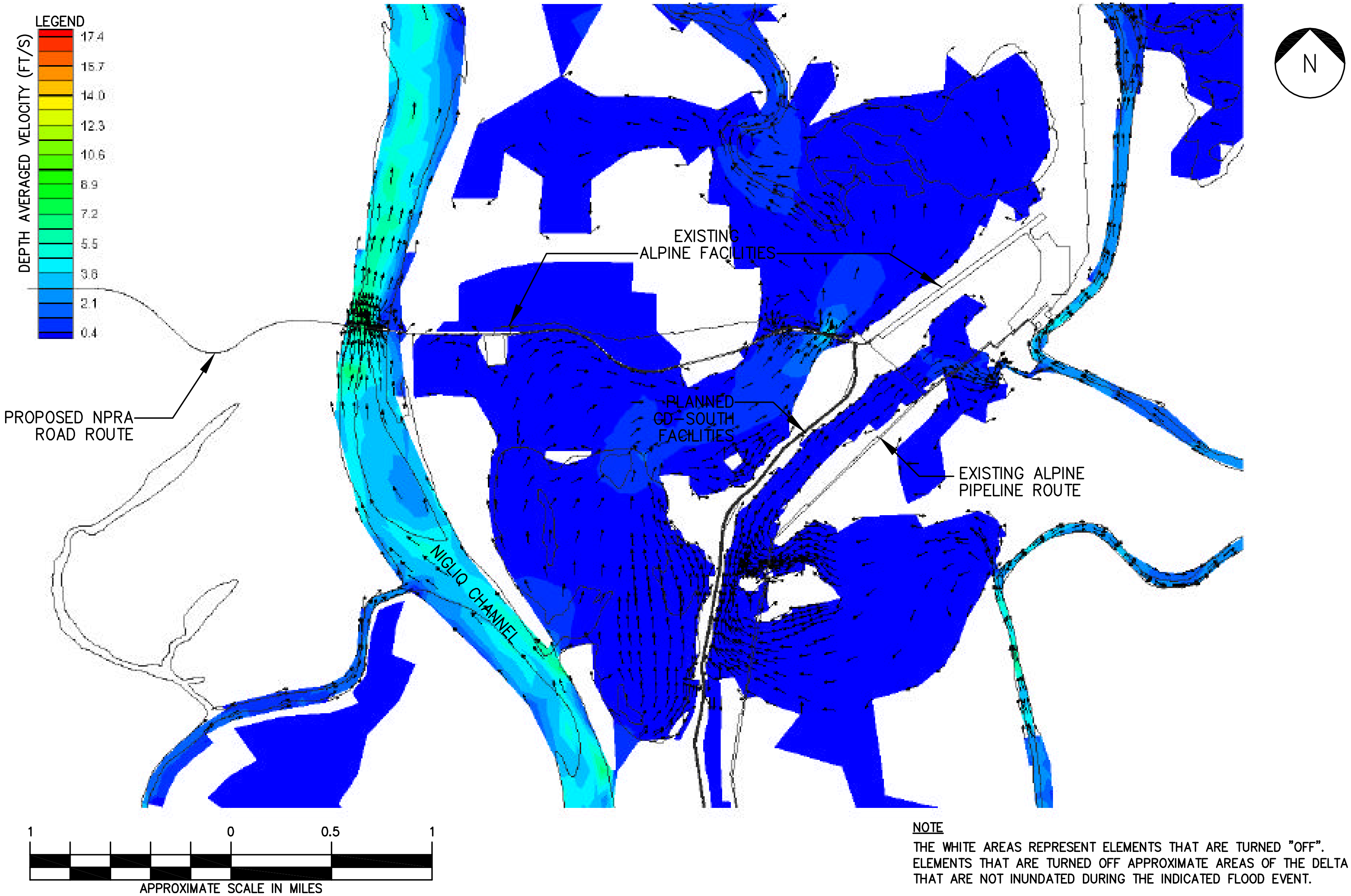
Baker Michael Baker Jr., Inc.	TITLE: 10–YEAR FLOOD, WATER SURFACE ELEVATIONS AT ALPINE WITH NPRA ROAD/900–FT NIGLIQ BRIDGE		
COLVILLE RIVER DELTA TWO–DIMENSIONAL SURFACE WATER MODEL NPRA ROAD/NIGLIQ BRIDGE UPDATE – FEB 2004	FILE NAME: 102579_A33	SCALE: AS SHOWN	FIGURE A33



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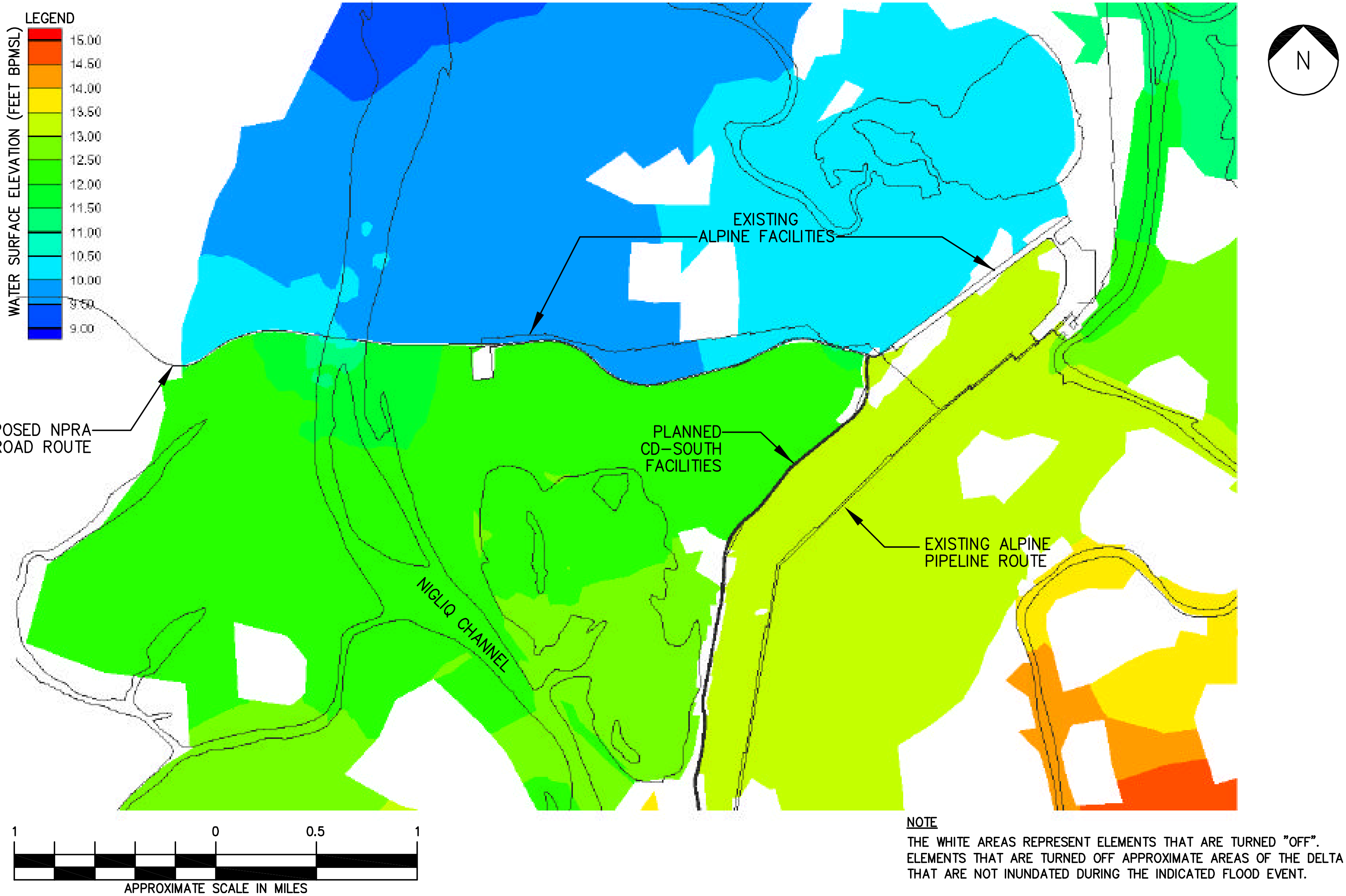
Baker Michael Baker Jr., Inc.	TITLE: 10–YEAR FLOOD, DEPTH AVERAGED VELOCITY AT ALPINE WITH NPRA ROAD/900–FT NIGLIQ BRIDGE
COLVILLE RIVER DELTA TWO–DIMENSIONAL SURFACE WATER MODEL NPRA ROAD/NIGLIQ BRIDGE UPDATE – FEB 2004	FILE NAME: 102579_A34 / SCALE: AS SHOWN / FIGURE A34



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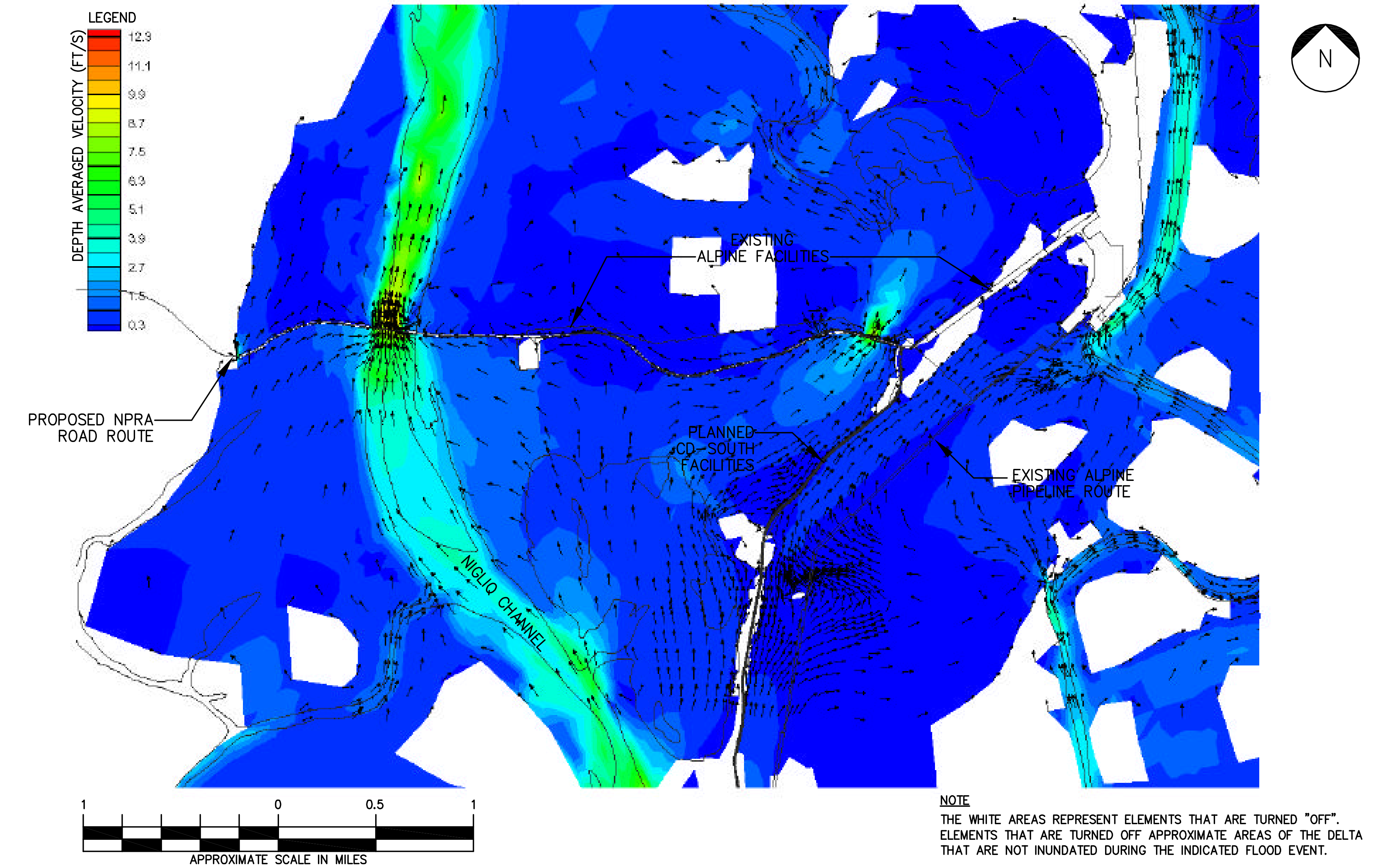
Michael Baker Jr., Inc.	TITLE: 50-YEAR FLOOD, WATER SURFACE ELEVATIONS AT ALPINE WITH NPRA ROAD/900-FT NIGLIQ BRIDGE	
COLVILLE RIVER DELTA TWO-DIMENSIONAL SURFACE WATER MODEL NPRA ROAD/NIGLIQ BRIDGE UPDATE – FEB 2004	FILE NAME: 102579_A35	SCALE: AS SHOWN

FIGURE A35



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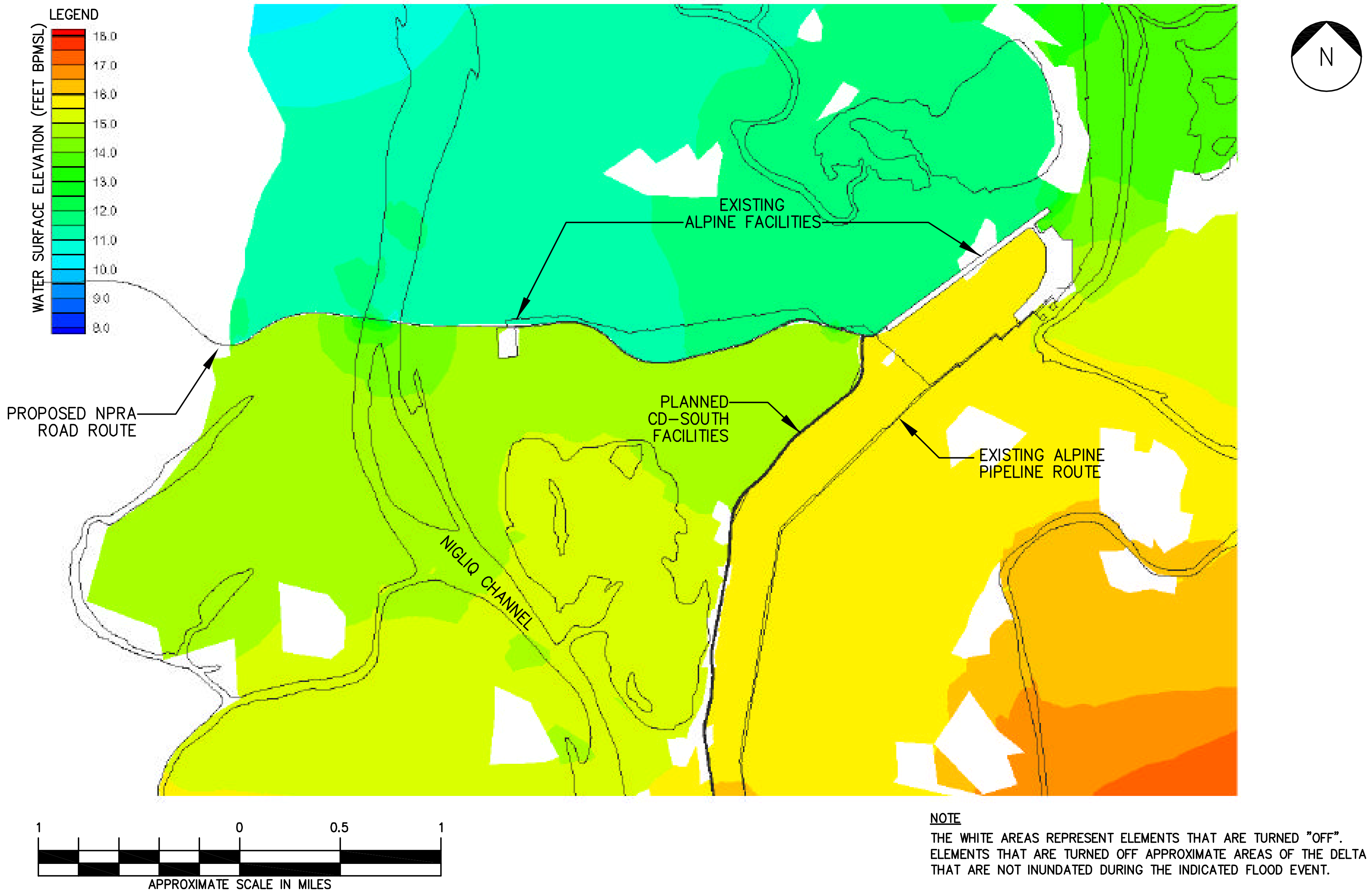
Baker Michael Baker Jr., Inc.	TITLE: 50-YEAR FLOOD, DEPTH AVERAGED VELOCITY AT ALPINE WITH NPRA ROAD/900-FT NIGLIQ BRIDGE		
COLVILLE RIVER DELTA TWO-DIMENSIONAL SURFACE WATER MODEL NPRA ROAD/NIGLIQ BRIDGE UPDATE - FEB 2004	FILE NAME: 102579_A36	SCALE: AS SHOWN	FIGURE A36



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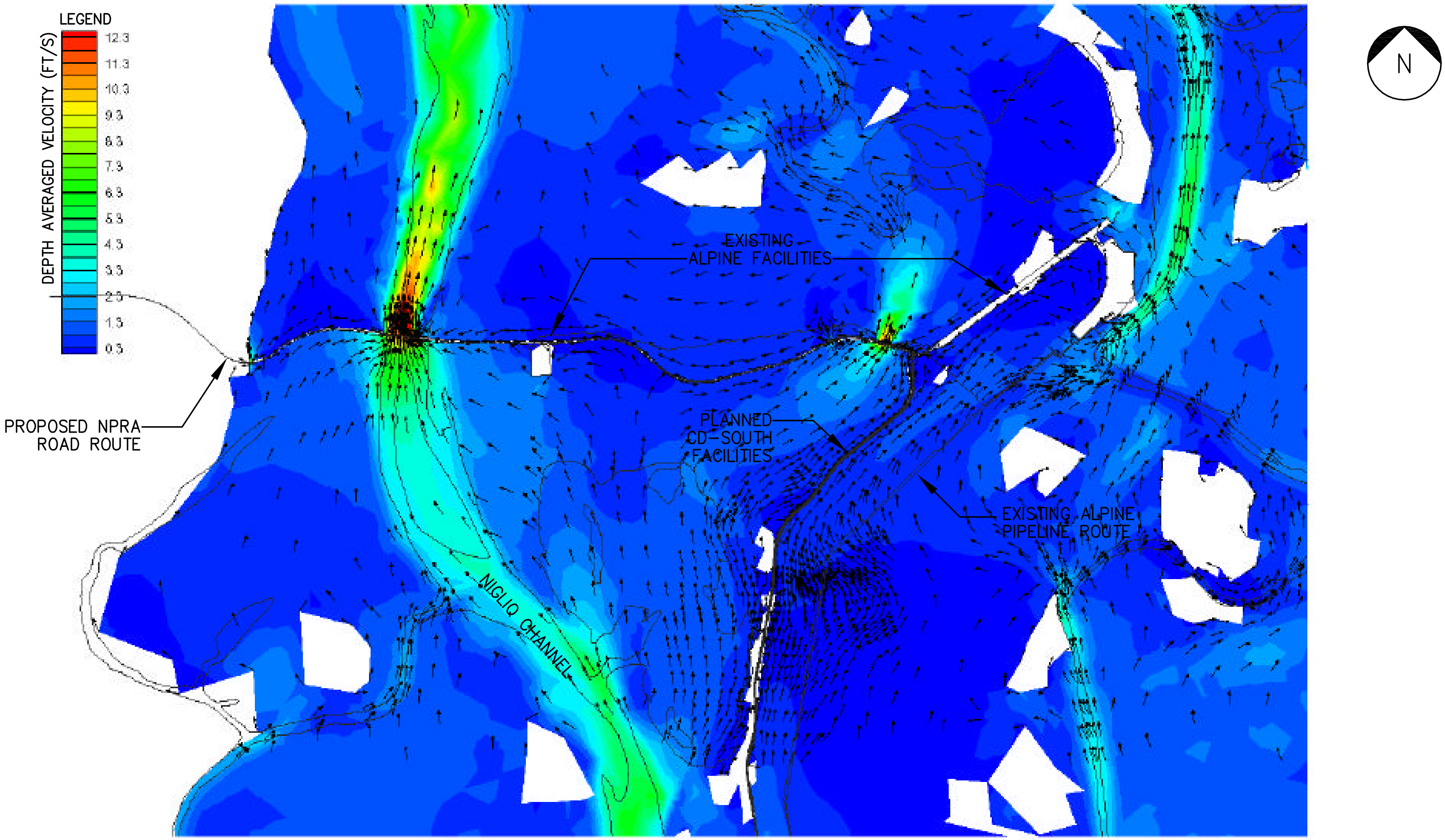
Baker Michael Baker Jr., Inc.	TITLE: 200–YEAR FLOOD, WATER SURFACE ELEVATIONS AT ALPINE WITH NPRA ROAD/900–FT NIGLIQ BRIDGE		
COLVILLE RIVER DELTA TWO–DIMENSIONAL SURFACE WATER MODEL NPRA ROAD/NIGLIQ BRIDGE UPDATE – FEB 2004	FILE NAME: 102579_A37	SCALE: AS SHOWN	FIGURE A37



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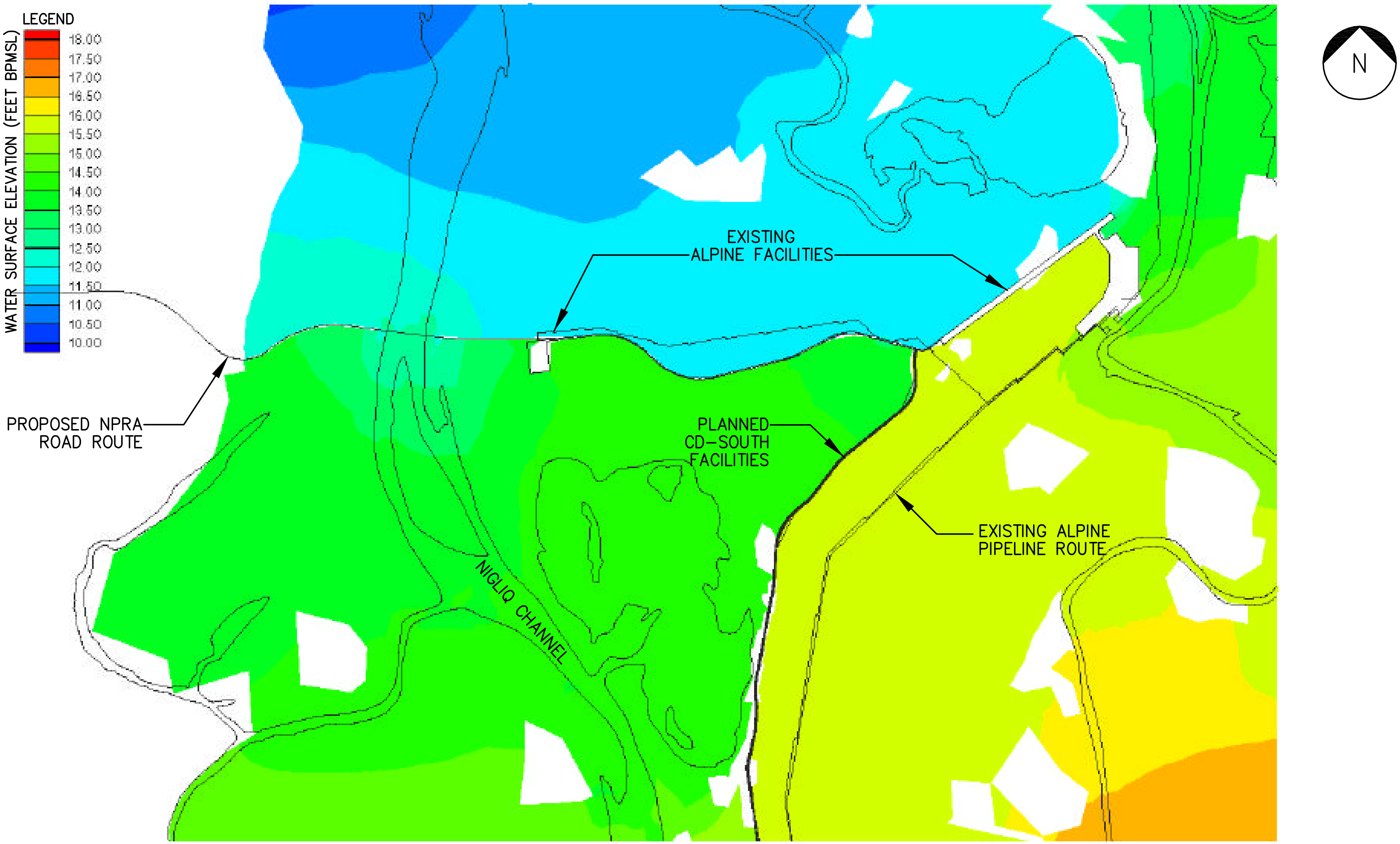
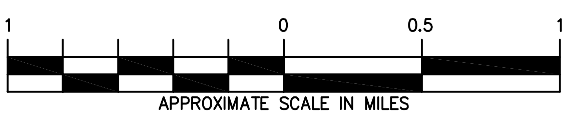
Baker Michael Baker Jr., Inc.	TITLE: 200-YEAR FLOOD, DEPTH AVERAGED VELOCITY AT ALPINE WITH NPRA ROAD/900-FT NIGLIQ BRIDGE		
COLVILLE RIVER DELTA TWO-DIMENSIONAL SURFACE WATER MODEL NPRA ROAD/NIGLIQ BRIDGE UPDATE – FEB 2004	FILE NAME: 102579_A38	SCALE: AS SHOWN	FIGURE A38





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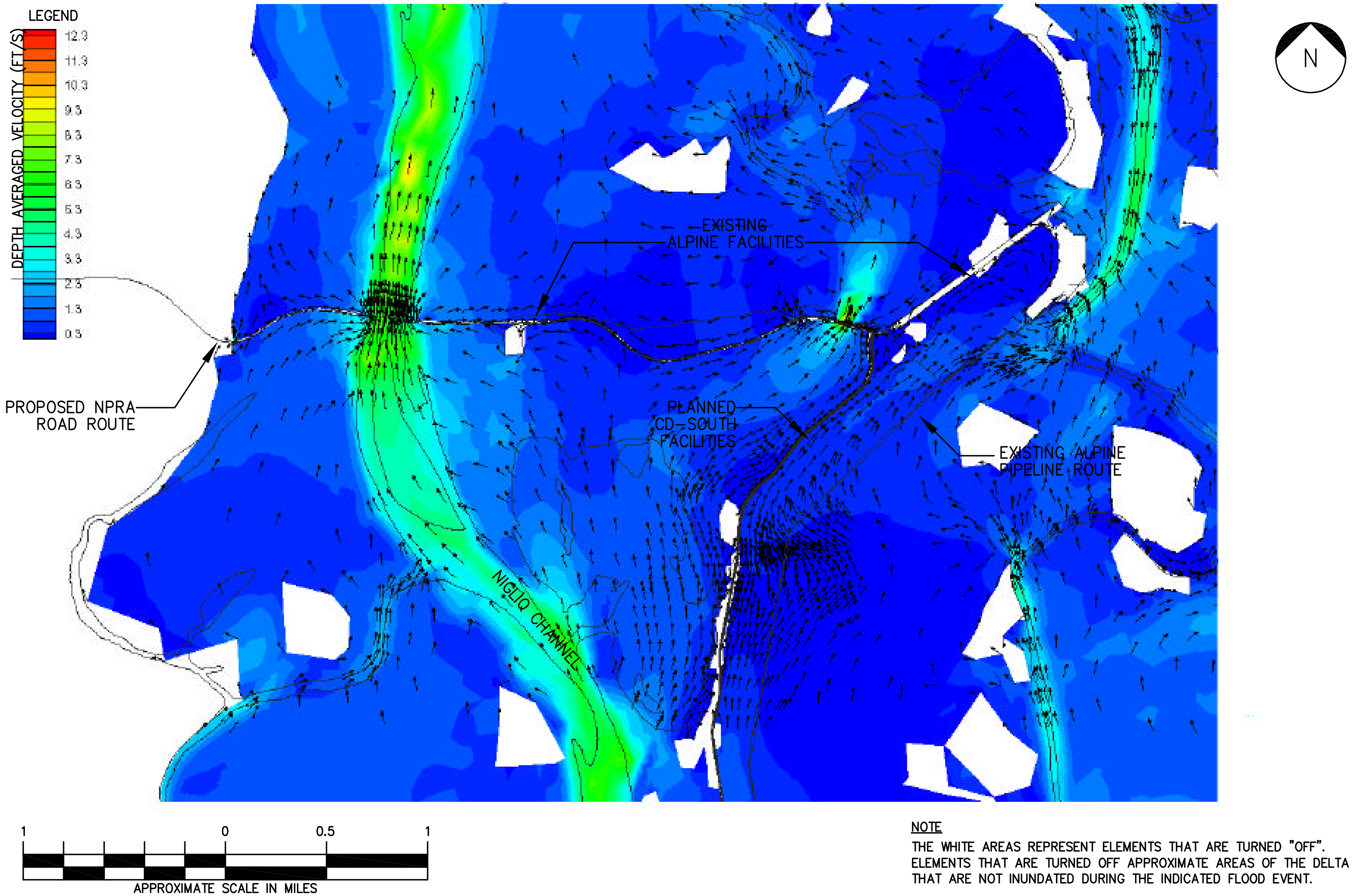
Baker Michael Baker Jr., Inc.	TITLE: 200–YEAR FLOOD, WATER SURFACE ELEVATIONS AT ALPINE WITH NPRA ROAD/1500–FT NIGLIQ BRIDGE WITH SCOUR		
COLVILLE RIVER DELTA TWO–DIMENSIONAL SURFACE WATER MODEL NPRA ROAD/NIGLIQ BRIDGE UPDATE – FEB 2004	FILE NAME: 102579_A39	SCALE: AS SHOWN	FIGURE A39



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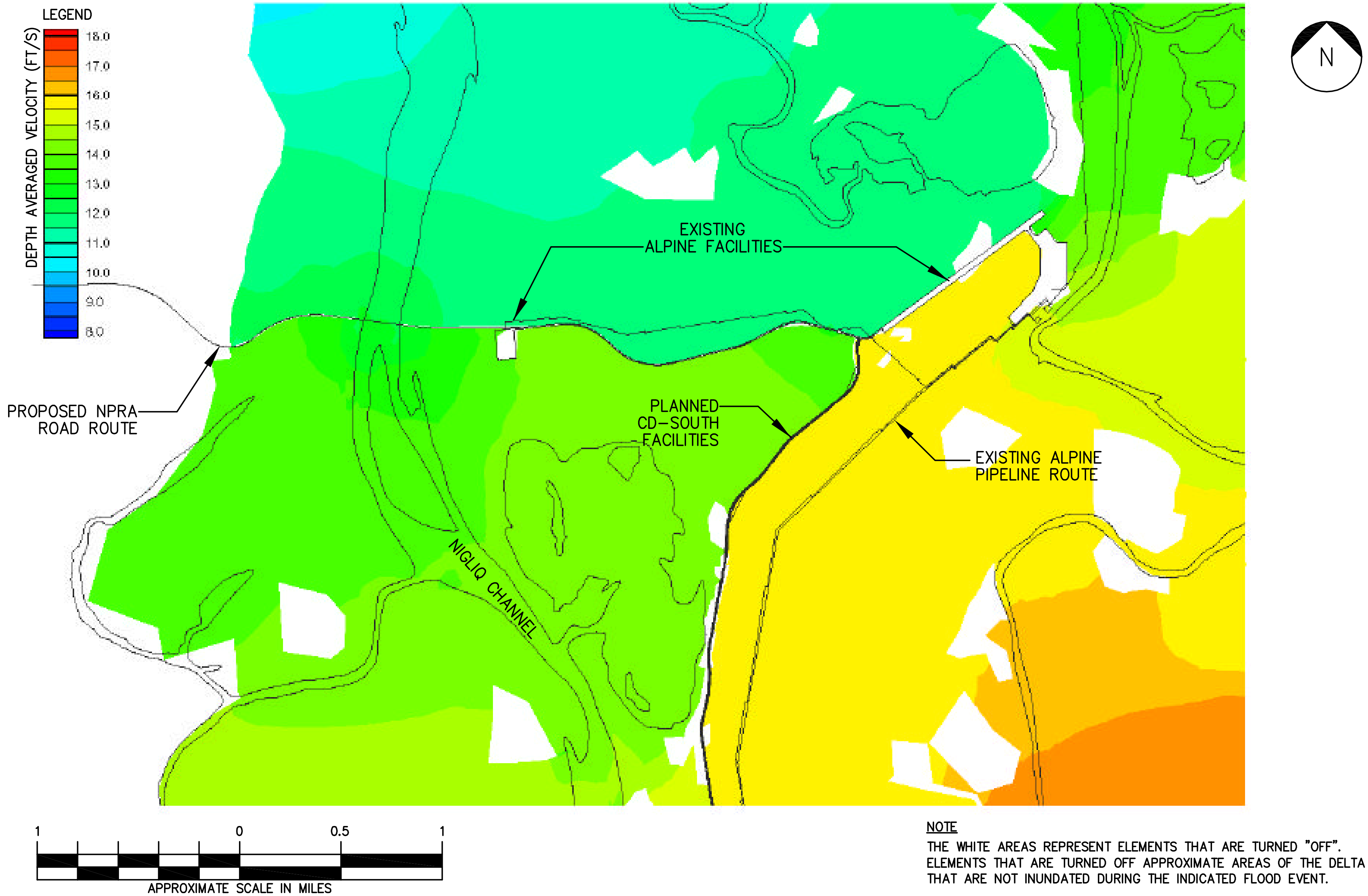
Baker — Michael Baker Jr., Inc.	TITLE: 200-YEAR FLOOD, DEPTH AVERAGED VELOCITY AT ALPINE WITH NPRA ROAD/1500-FT NIGLIQ BRIDGE WITH SCOUR		
COLVILLE RIVER DELTA TWO-DIMENSIONAL SURFACE WATER MODEL NPRA ROAD/NIGLIQ BRIDGE UPDATE - FEB 2004	FILE NAME: 102579_A40	SCALE: AS SHOWN	FIGURE A40



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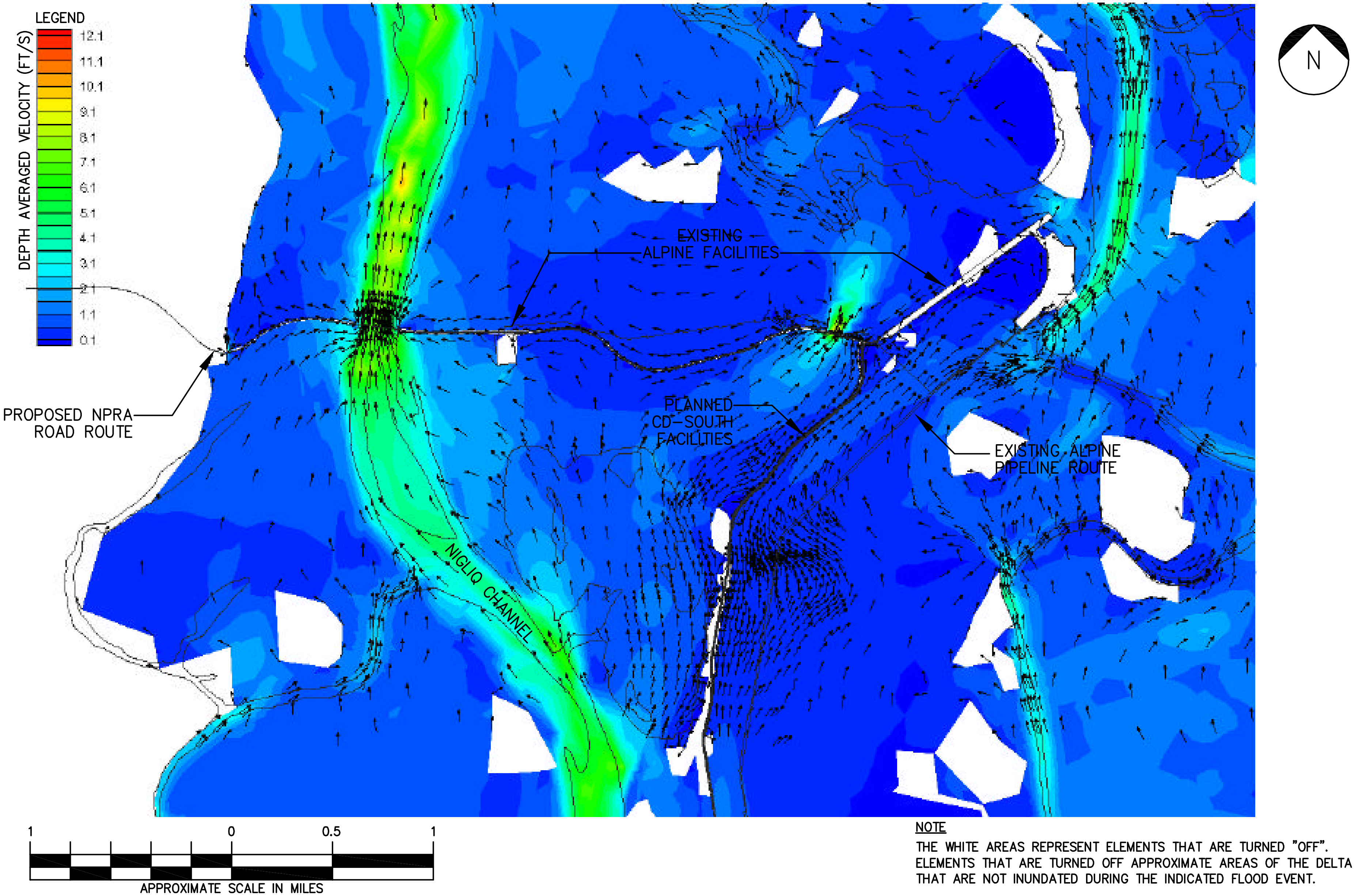
Baker Michael Baker Jr., Inc.	TITLE: 200–YEAR FLOOD, WATER SURFACE ELEVATIONS AT ALPINE WITH NPRA ROAD/1200–FT NIGLIQ BRIDGE WITH SCOUR		
COLVILLE RIVER DELTA TWO–DIMENSIONAL SURFACE WATER MODEL NPRA ROAD/NIGLIQ BRIDGE UPDATE – FEB 2004	FILE NAME: 102579_A41	SCALE: AS SHOWN	FIGURE A41



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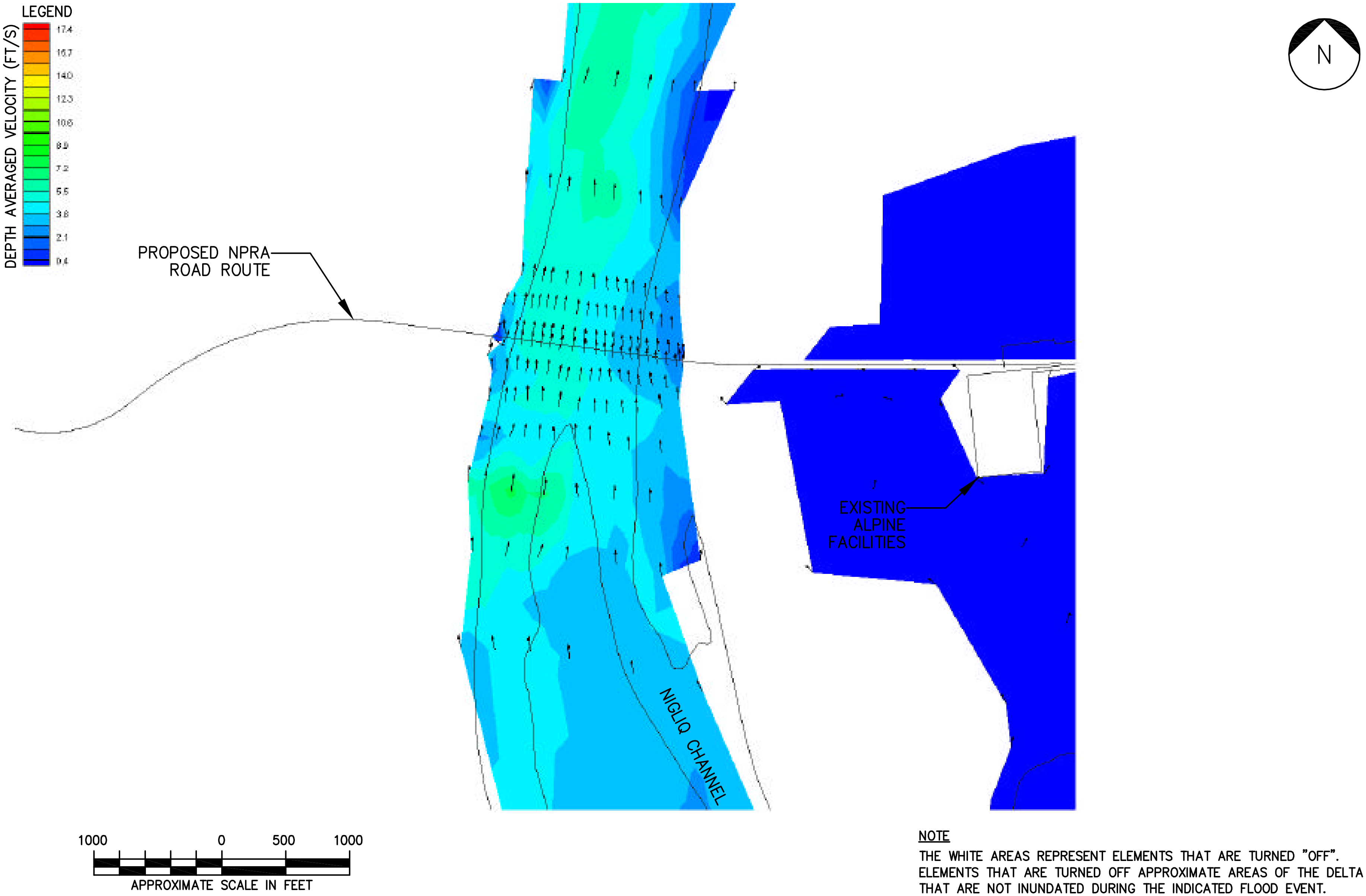
Baker — Michael Baker Jr., Inc.	TITLE: 200-YEAR FLOOD, DEPTH AVERAGED VELOCITY AT ALPINE WITH NPRA ROAD/1200-FT NIGLIQ BRIDGE WITH SCOUR		
COLVILLE RIVER DELTA TWO-DIMENSIONAL SURFACE WATER MODEL NPRA ROAD/NIGLIQ BRIDGE UPDATE - FEB 2004	FILE NAME: 102579_A42	SCALE: AS SHOWN	FIGURE A42



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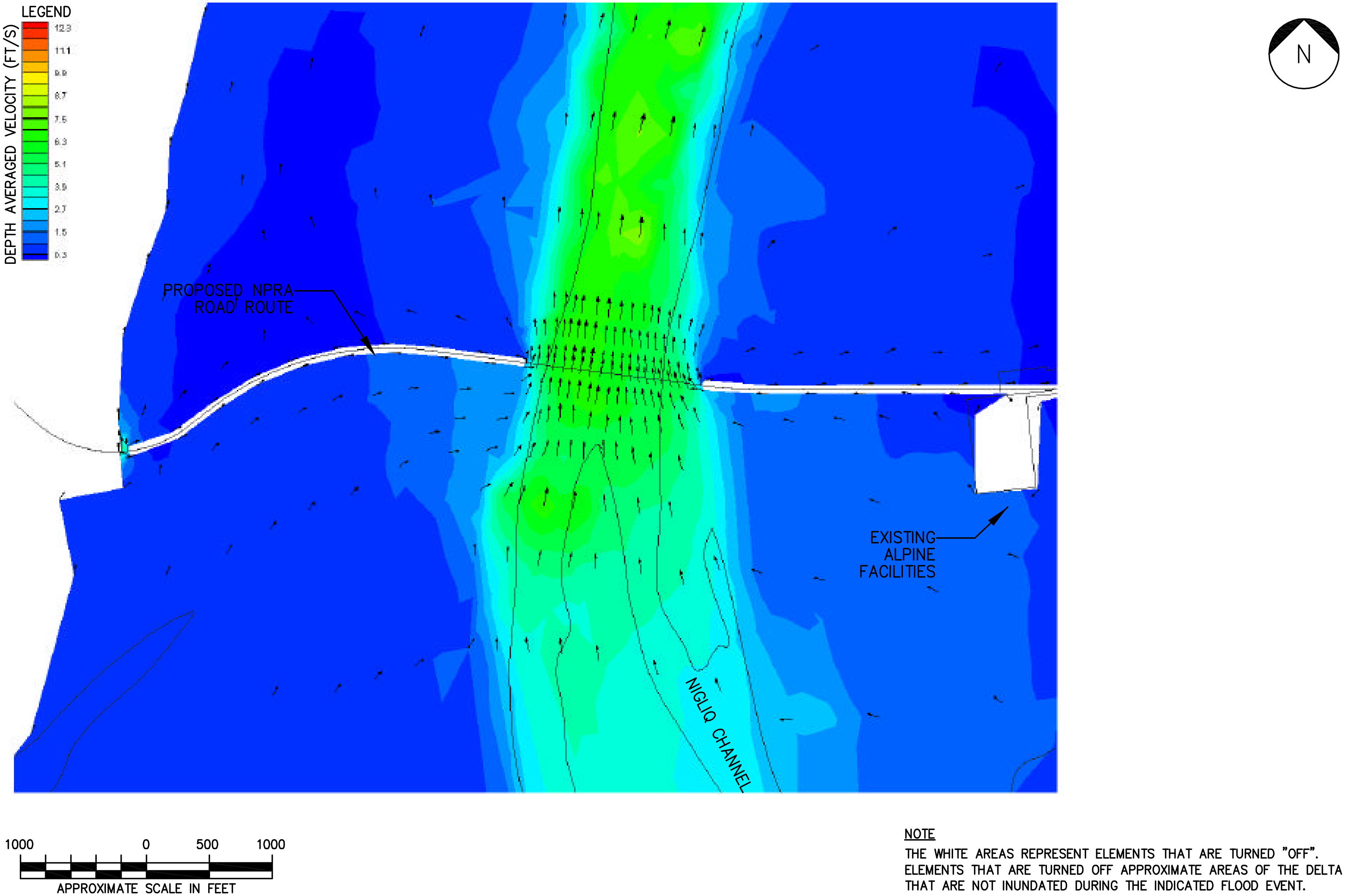
Baker Michael Baker Jr., Inc.	TITLE: 10–YEAR FLOOD, DEPTH AVERAGED VELOCITY AT NIGLIQ CHANNEL WITH NPRA ROAD/1500–FT NIGLIQ BRIDGE		
COLVILLE RIVER DELTA TWO–DIMENSIONAL SURFACE WATER MODEL NPRA ROAD/NIGLIQ BRIDGE UPDATE – FEB 2004	FILE NAME: 102579_A43	SCALE: AS SHOWN	FIGURE A43



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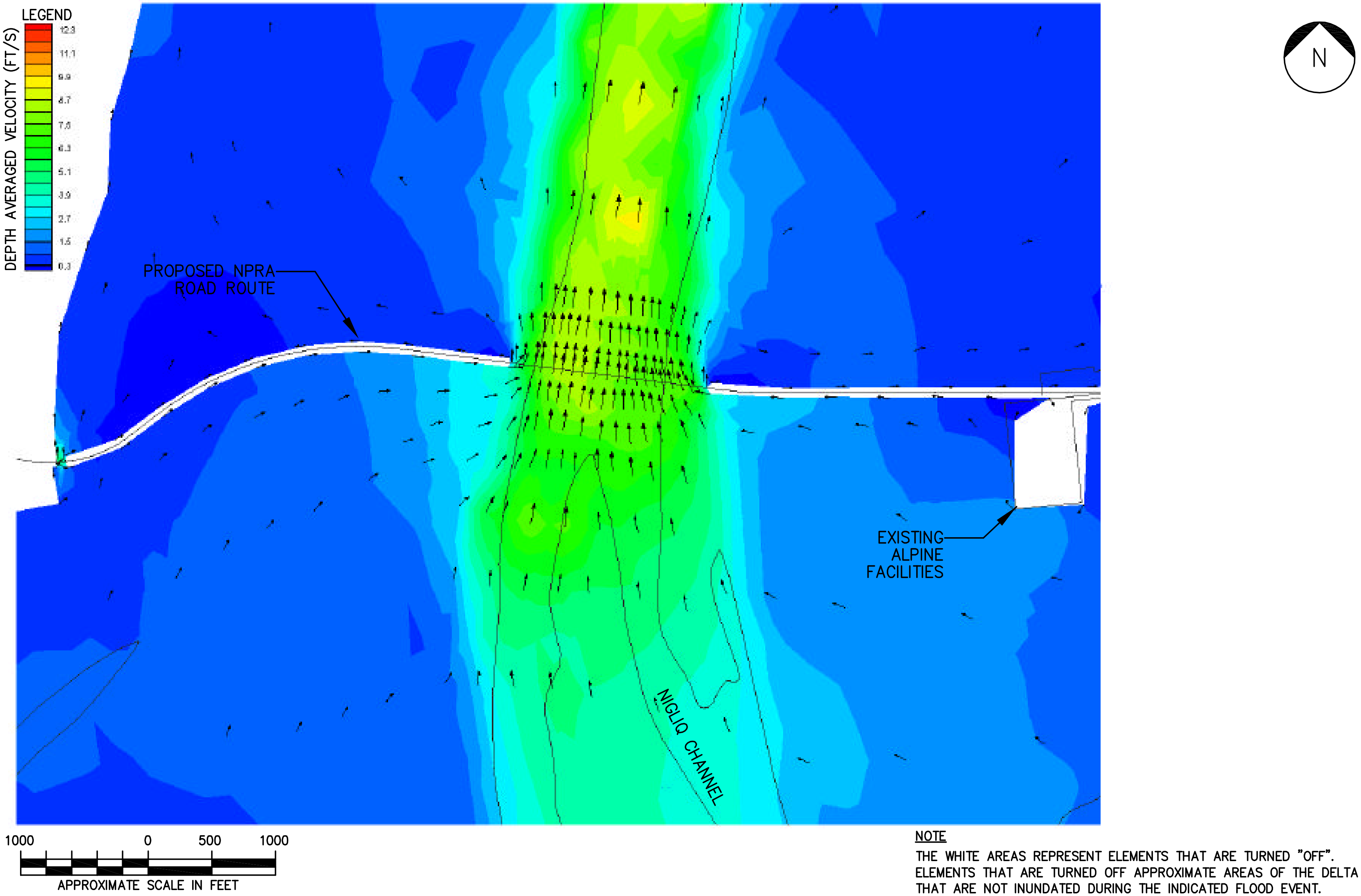
Baker Michael Baker Jr., Inc.	TITLE: 50–YEAR FLOOD, DEPTH AVERAGED VELOCITY AT NIGLIQ CHANNEL WITH NPRA ROAD/1500–FT NIGLIQ BRIDGE		
COLVILLE RIVER DELTA TWO–DIMENSIONAL SURFACE WATER MODEL NPRA ROAD/NIGLIQ BRIDGE UPDATE – FEB 2004	FILE NAME: 102579_A44	SCALE: AS SHOWN	FIGURE A44



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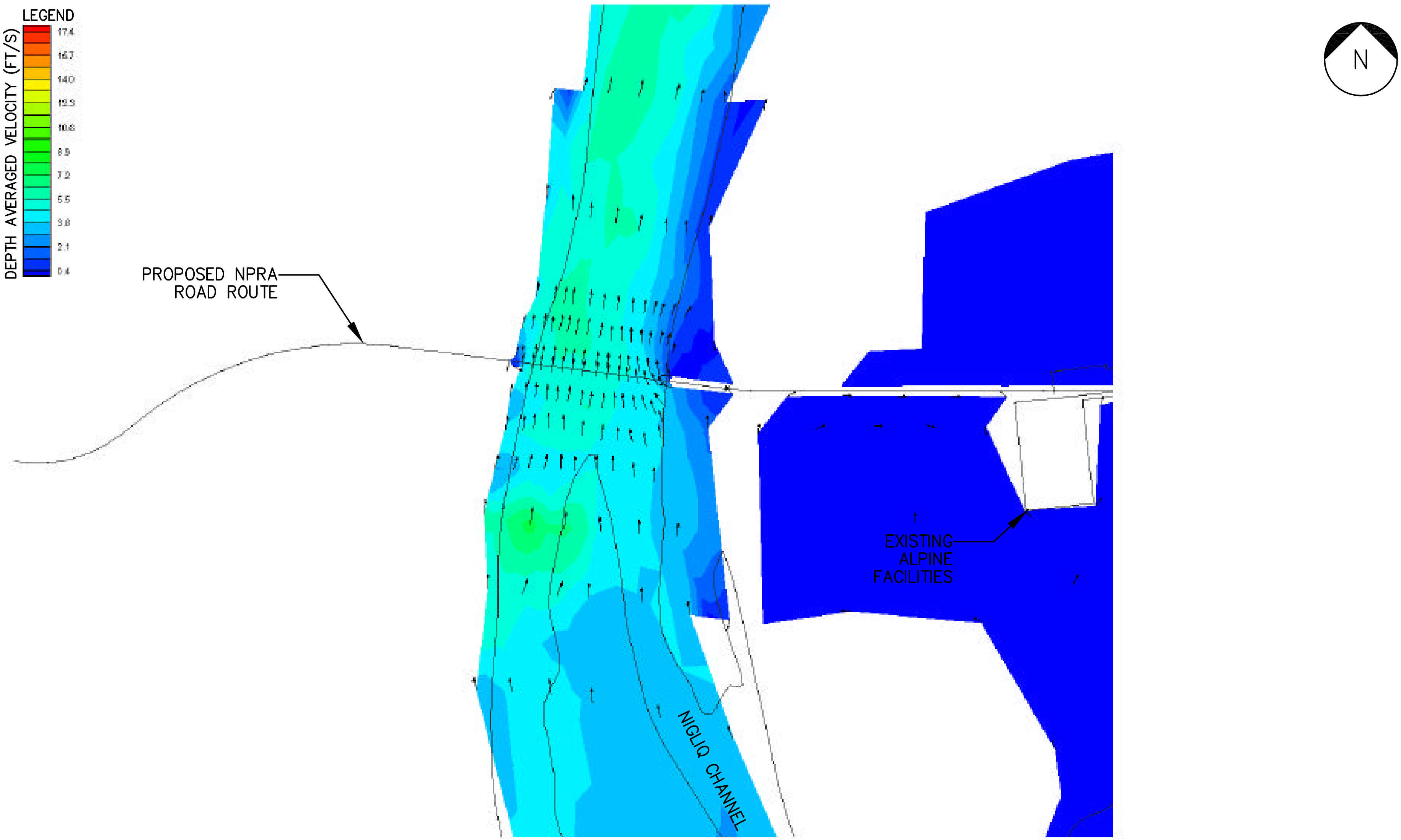
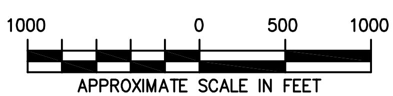
Baker Michael Baker Jr., Inc.	TITLE: 200-YEAR FLOOD, DEPTH AVERAGED VELOCITY AT NIGLIQ CHANNEL WITH NPRA ROAD/1500-FT NIGLIQ BRIDGE		
COLVILLE RIVER DELTA TWO-DIMENSIONAL SURFACE WATER MODEL NPRA ROAD/NIGLIQ BRIDGE UPDATE - FEB 2004	FILE NAME: 102579_A45	SCALE: AS SHOWN	FIGURE A45

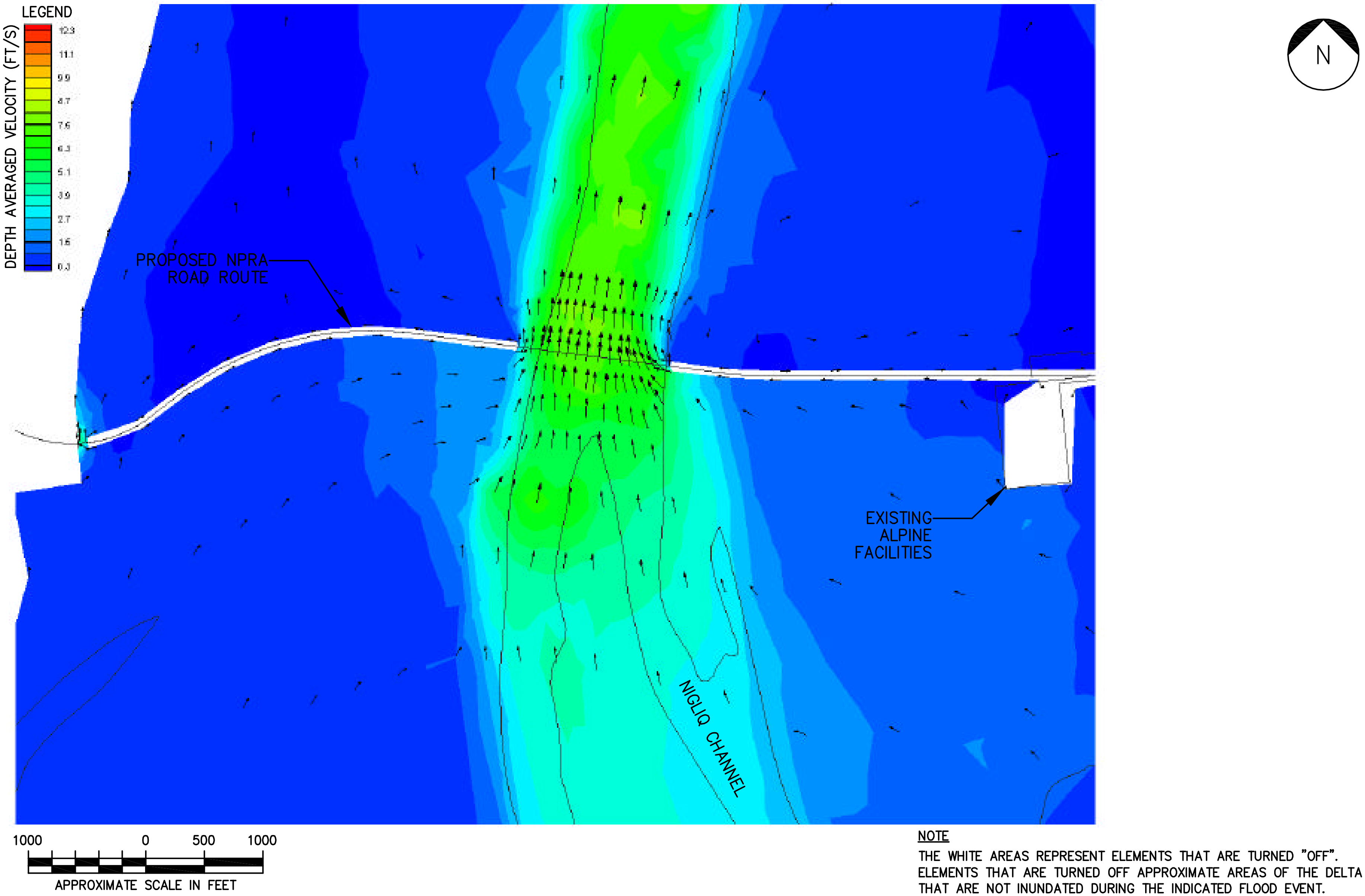




NOTE

THE WHITE AREAS REPRESENT ELEMENTS THAT ARE TURNED "OFF". ELEMENTS THAT ARE TURNED OFF APPROXIMATE AREAS OF THE DELTA THAT ARE NOT INUNDATED DURING THE INDICATED FLOOD EVENT.

Baker Michael Baker Jr., Inc.	TITLE: 10–YEAR FLOOD, DEPTH AVERAGED VELOCITY AT NIGLIQ CHANNEL WITH NPRA ROAD/1200–FT NIGLIQ BRIDGE		
COLVILLE RIVER DELTA TWO–DIMENSIONAL SURFACE WATER MODEL NPRA ROAD/NIGLIQ BRIDGE UPDATE – FEB 2004	FILE NAME: 102579_A46	SCALE: AS SHOWN	FIGURE A46



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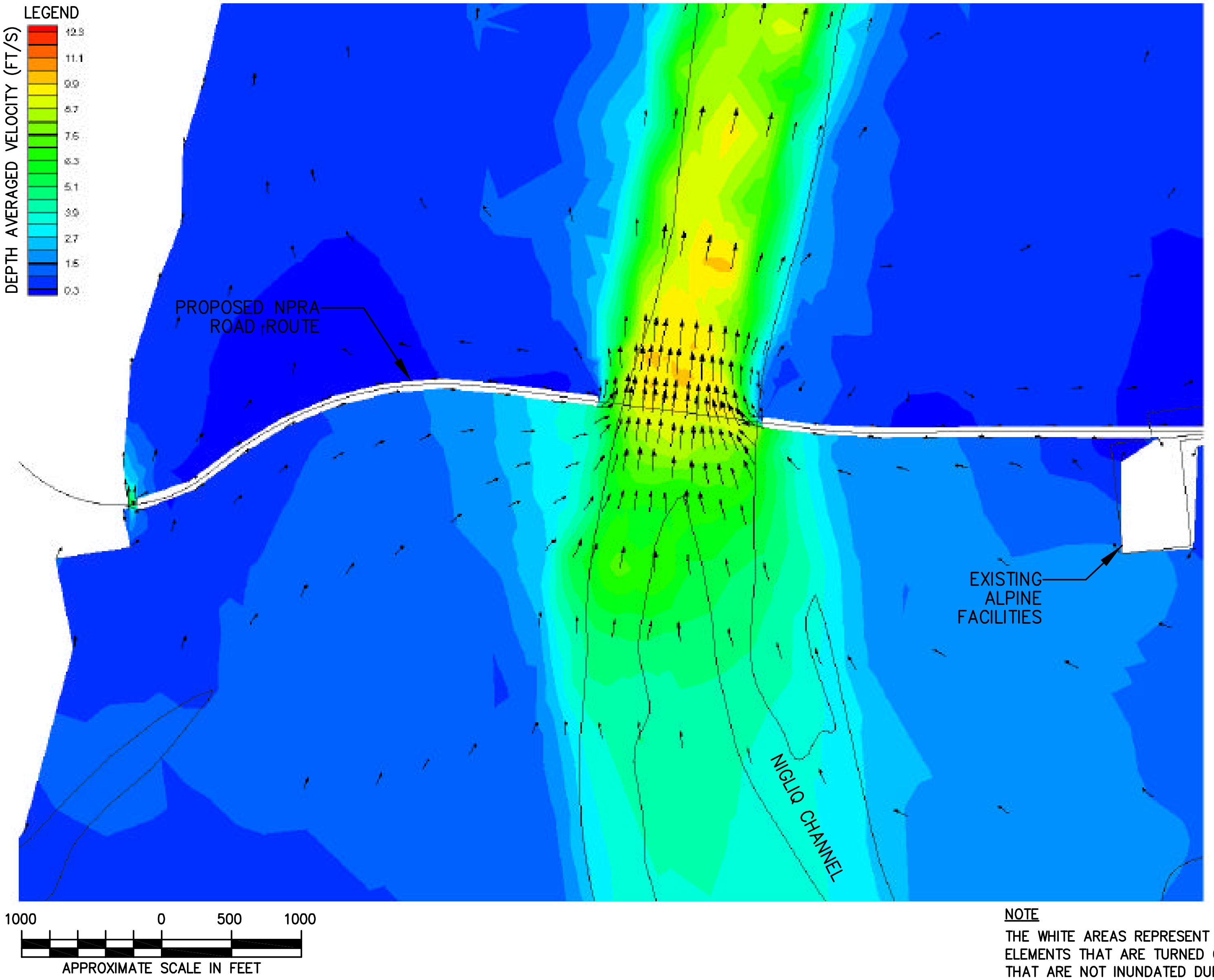
Baker Michael Baker Jr., Inc.	TITLE: 50–YEAR FLOOD, DEPTH AVERAGED VELOCITY AT NIGLIQ CHANNEL WITH NPRA ROAD/1200–FT NIGLIQ BRIDGE		
COLVILLE RIVER DELTA TWO–DIMENSIONAL SURFACE WATER MODEL NPRA ROAD/NIGLIQ BRIDGE UPDATE – FEB 2004	FILE NAME: 102579_A47	SCALE: AS SHOWN	FIGURE A47



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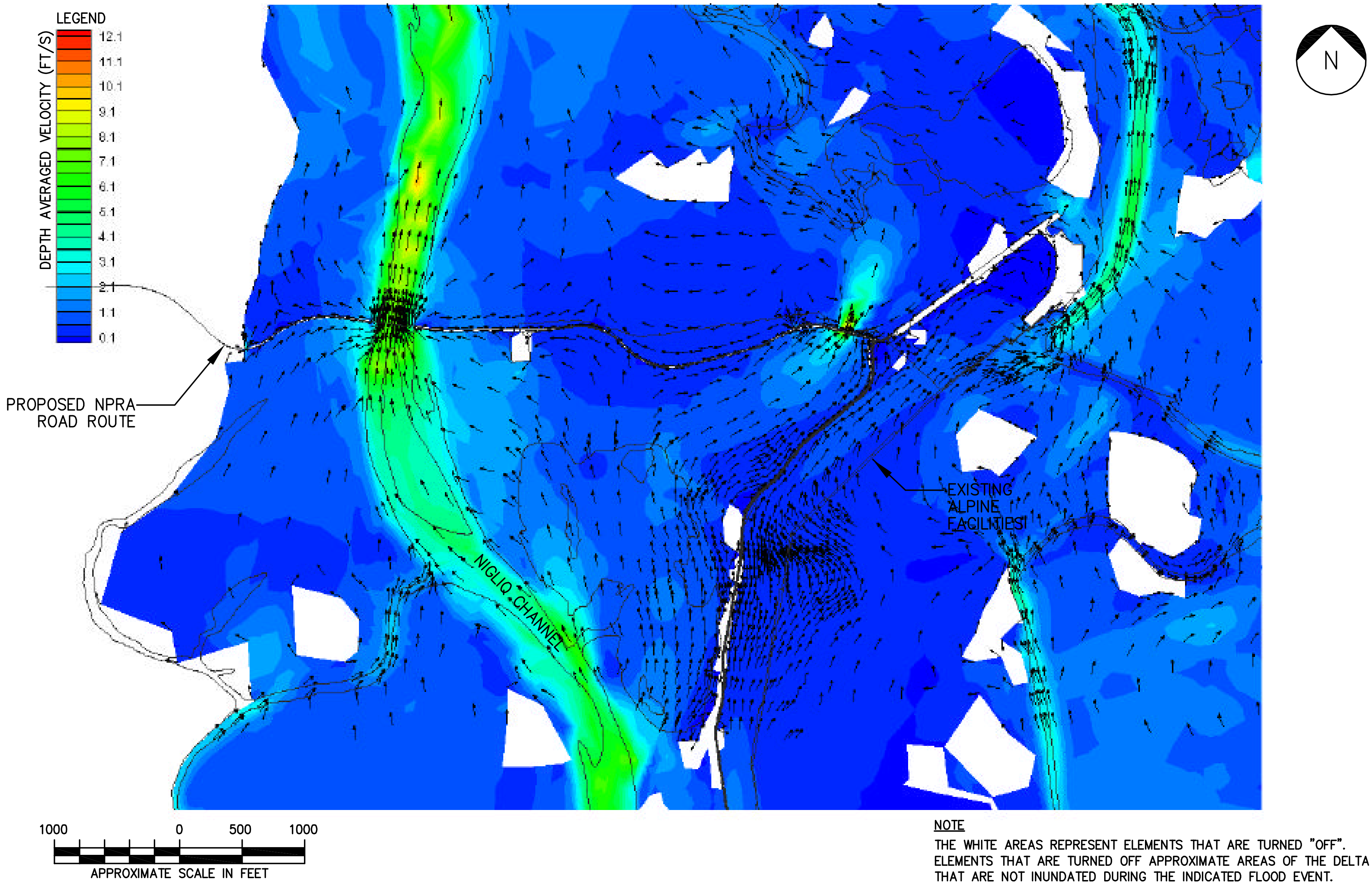
Baker **Michael Baker Jr., Inc.**	TITLE: 200-YEAR FLOOD, DEPTH AVERAGED VELOCITY AT NIGLIQ CHANNEL WITH NPRA ROAD/1200-FT NIGLIQ BRIDGE		
COLVILLE RIVER DELTA TWO-DIMENSIONAL SURFACE WATER MODEL NPRA ROAD/NIGLIQ BRIDGE UPDATE – FEB 2004	FILE NAME: 102579_A48	SCALE: AS SHOWN	FIGURE A48



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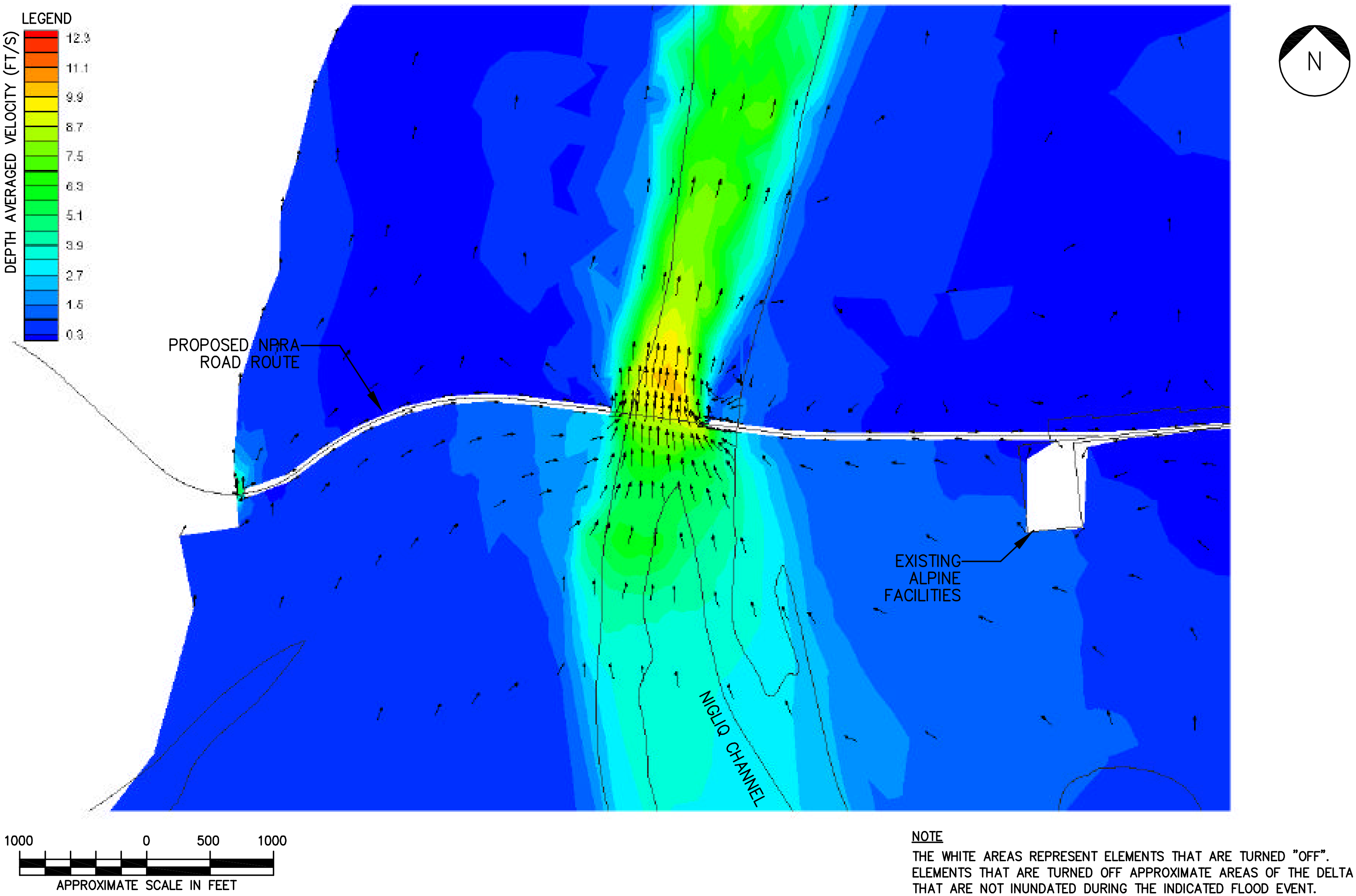
Baker Michael Baker Jr., Inc.	TITLE: 10–YEAR FLOOD, DEPTH AVERAGED VELOCITY AT NIGLIQ CHANNEL WITH NPRA ROAD/900–FT NIGLIQ BRIDGE		
COLVILLE RIVER DELTA TWO–DIMENSIONAL SURFACE WATER MODEL NPRA ROAD/NIGLIQ BRIDGE UPDATE – FEB 2004	FILE NAME: 102579_A49	SCALE: AS SHOWN	FIGURE A49



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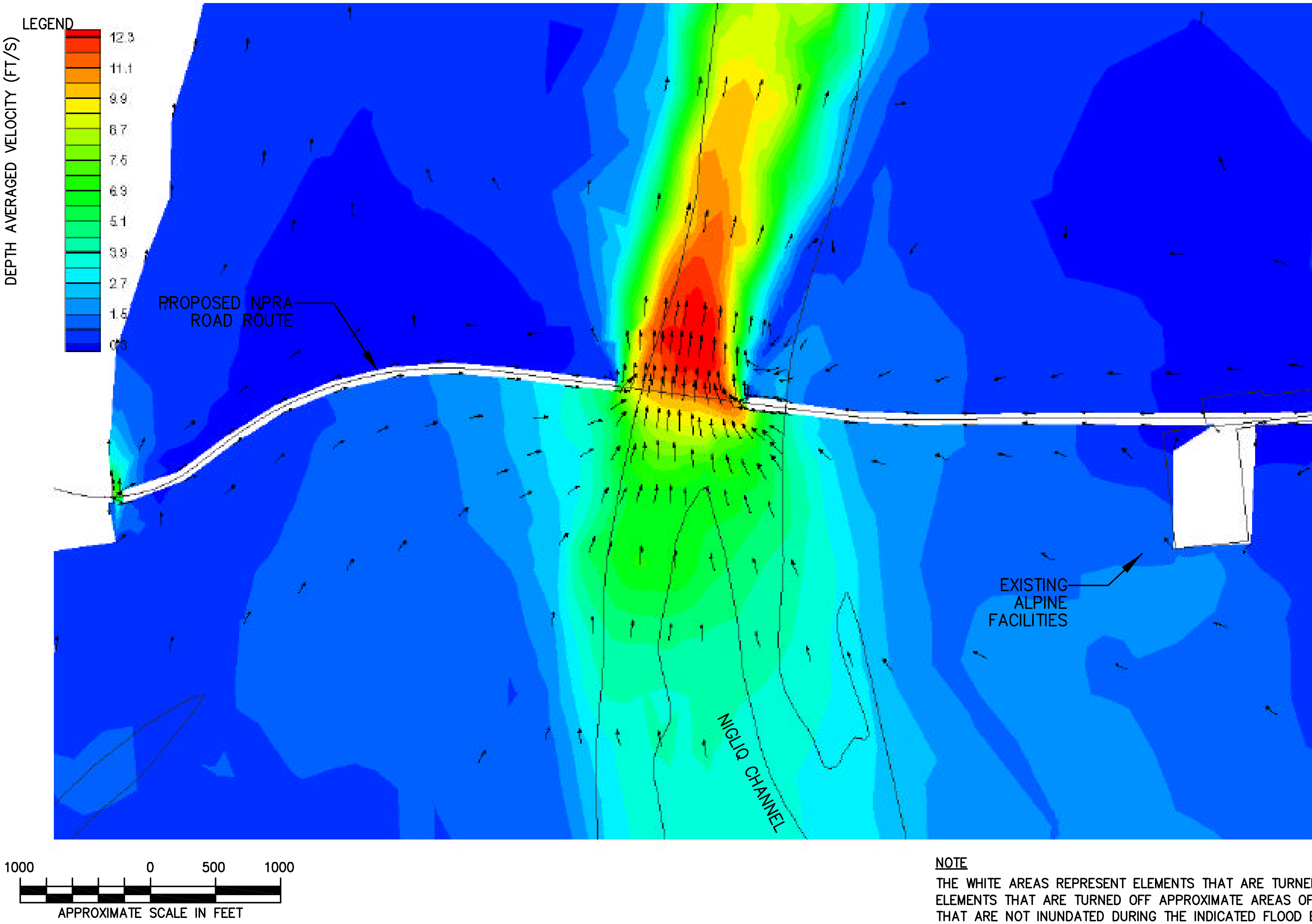
Baker Michael Baker Jr., Inc.	TITLE: 50-YEAR FLOOD, DEPTH AVERAGED VELOCITY AT NIGLIQ CHANNEL WITH NPRA ROAD/900-FT NIGLIQ BRIDGE		
COLVILLE RIVER DELTA TWO-DIMENSIONAL SURFACE WATER MODEL NPRA ROAD/NIGLIQ BRIDGE UPDATE – FEB 2004	FILE NAME: 102579_A50	SCALE: AS SHOWN	FIGURE A50



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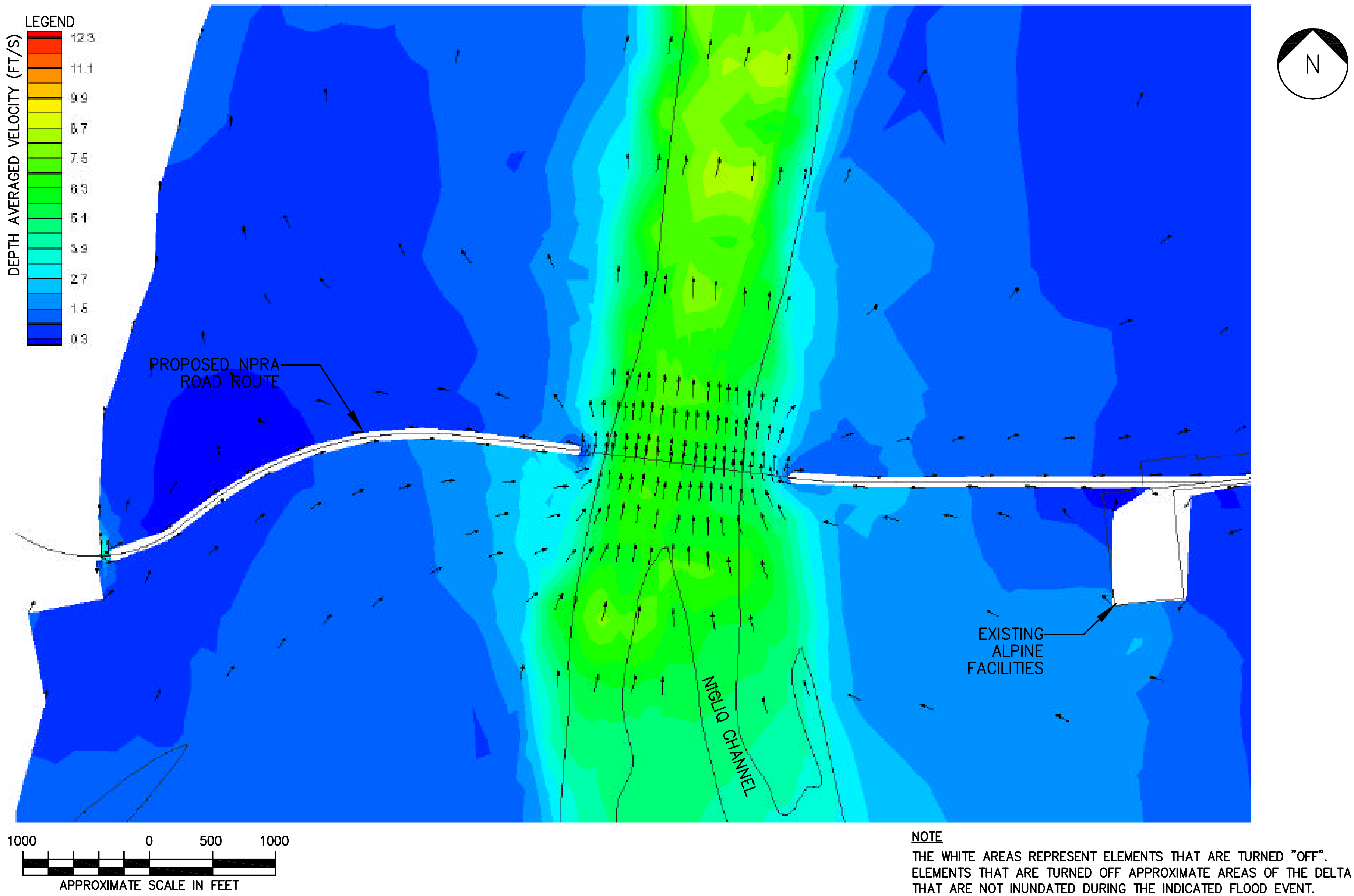
Baker **Michael Baker Jr., Inc.**	TITLE: 200–YEAR FLOOD, DEPTH AVERAGED VELOCITY AT NIGLIQ CHANNEL WITH NPRA ROAD/900–FT NIGLIQ BRIDGE

COLVILLE RIVER DELTA TWO–DIMENSIONAL SURFACE WATER MODEL NPRA ROAD/NIGLIQ BRIDGE UPDATE – FEB 2004	FILE NAME: 102579_A51	SCALE: AS SHOWN	FIGURE A51



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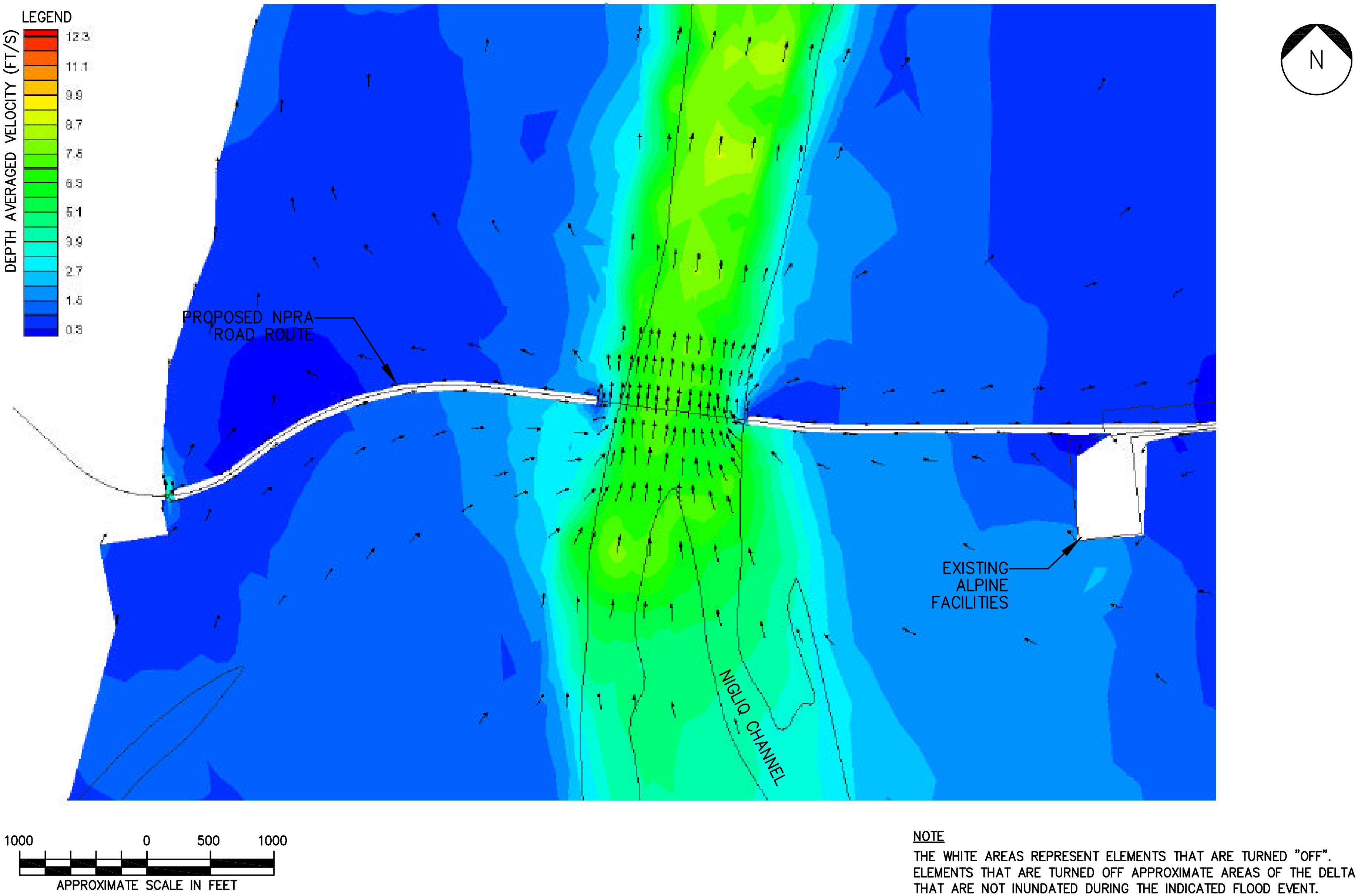
Baker — Michael Baker Jr., Inc.	TITLE: 200–YEAR FLOOD, DEPTH AVERAGED VELOCITY AT NIGLIQ CHANNEL WITH NPRA ROAD/1500–FT NIGLIQ BRIDGE WITH SCOUR

COLVILLE RIVER DELTA TWO–DIMENSIONAL SURFACE WATER MODEL NPRA ROAD/NIGLIQ BRIDGE UPDATE – FEB 2004	FILE NAME: 102579_A52	SCALE: AS SHOWN	FIGURE A52



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Baker Michael Baker Jr., Inc.	TITLE: 200-YEAR FLOOD, DEPTH AVERAGED VELOCITY AT NIGLIQ CHANNEL WITH NPRA ROAD/1200-FT NIGLIQ BRIDGE WITH SCOUR		
COLVILLE RIVER DELTA TWO-DIMENSIONAL SURFACE WATER MODEL NPRA ROAD/NIGLIQ BRIDGE UPDATE – FEB 2004	FILE NAME: 102579_A53	SCALE: AS SHOWN	FIGURE A53