Calculation of Base Flood Elevation

Kidder Creek

Approximately 2.5-mi above Br 02-052 SR003 PM 27.03

Kidder Creek Orchard Camp

Kidder Creek Orchard Camp Planned Development

2700 S Kidder Creek Rd, Etna, CA 96027

Hydrologic and Hydraulic Calculations

By: Chris Gaido, P.E.

February 20,2014

These hydrologic and hydraulic calculations and related information have been prepared under the direction of the following Professional Engineer. The Engineer attests, to the best of his knowledge, to the accuracy of the technical information contained herein and has judged appropriate the engineering data which recommendations, conclusions, and decisions are based.

Chris Gaido PE
Civil Engineer

Date

Summary

Kidder Creek Orchard Camp is currently planning an expansion to their existing facility. Kidder Creek Orchard Camp development plans are preliminary, details found under separate cover. A portion of the planned development includes construction of a natural recreational water feature within and near the potential floodplain of Kidder Creek. This report endeavors to establish a draft base flood elevation (BFE) for Kidder Creek for the impacted areas of the development plan.

Kidder Creek Orchard Camp has a physical address of 2700 South Kidder Creek Road, Etna CA. Located 6.25-mi northwest of the town of Etna, the area of interest along Kidder Creek is centered at approximately, 41.530873^{o} N latitude, 122.95298741^{o} W Longitude, NAD 1983. The estimated 100-yr Return Period (RP) baseflood elevation (BFE) for the approximate project area immediately upstream of the water feature is 3023.9-ft. This elevation does not correlate with the Zone A delineation found on the January 19, 2011 FEMA Flood Insurance Rate Map, FIRM (Map Number 06093C200D). The upper limit of the Zone A found on this FIRM map appears to represent the study limits and not the actual floodplain for all of Kidder Creek (Exhibit B). There is no detailed floodplain study available for Kidder Creek.

The calculated BFE is considered a pre-project condition. The position and orientation of the final embankments for the water feature will have minimal impact to upstream BFE. The download stream impacts are limited to the potential streambed lateral movements caused by the new embankment.

The property owner and developers are advised to construct all living space dwellings and attached outbuildings at a minimum finished floor elevation of the estimated BFE plus 2-ft or as required by local building code/regulations. The actual BFE varies significantly with location along Kidder Creek. See subsequent section for detailed analysis. The estimated baseflood elevation does not consider or account for localized flooding caused by obstructions and backwater that may be present in the overbank areas of the river during flood flows.

Although survey data and sound engineering principles were employed in the calculation of the 100-yr BFE, the engineering field of hydrology and hydraulics of natural stream/river systems is an inexact science. The calculation of 100-yr BFE is only an estimate and should not be considered a detailed study of the hydrologic and hydraulic characteristics of Kidder Creek above project area. Other indeterminate factors do and will impact BFE. Debris accumulation, landsides, sediment load, bedload, channel lateral instabilities, and climatic changes all impact the transient 100-BFE of a river or creek. Therefore, even with the construction of the property above the 100-yr BFE the property owner should consider appropriate flood insurance to protect against unforeseen adverse changes to the creek's BFE.

Hydrology

The watershed of interest is Kidder Creek, above project area at 41.530873^{o} N latitude, 122.95298741^{o} W Longitude, NAD 1983. The watershed area, above this point, is approximately 24.866-mi^{2} (15,914-acres). The elevation ranges from 3010-ft at the centerline of the Kidder Creek downstream of the property to approximately 7,190-ft in the upper watershed. The upper watershed is rather complicated hydrologic system because of the volcanic soil, large winter/spring snowpack, irrigation diversions and convoluted natural drainage courses. The watershed has two predominant tributaries, a west-to-east draining sub-watershed and a south-to-north draining sub-watershed. A watershed map of the Kidder Creek above the project area is provided, (Exhibit A).

There are a few smaller lakes within the upper watershed but none of significant storage potential. The watershed is predominantly forest land with steep to very steep gradients. There is little development within the watershed. Portions of the upper watershed are most likely ineffective and contribute little to the overall discharge from the watershed (predominately contributing to groundwater). Nevertheless this area is considered in the calculation of Return Period discharges for watershed.

Stream bed slope is quite steep in the immediate and upper watershed. At or near the lower limit of this study area the stream bed slope flattens significantly. The stream channel changes from an incised stable channel to an alluvial transient basin. The alluvial basin allows the stream to meander and change course, as is evident from aerial photography (Google maps). The upper watershed produces significant sediment load in the form of cobbles, boulders and coarse sands. This sediment load is deposited in the alluvial basin and hence causes the meandering nature of the stream in the lower watershed.

Annual precipitation for watershed was obtained from nearby gages and synthetic climatological mapping. The gage data period of record is 1955 – present. The average annual precipitation for Etna California is approximately 18-in. The upper watershed experiences significantly more precipitation. The predominance of precipitation occurs during the winter months of October – March, with January and February being the historic period of highest monthly snowfall and rainfall totals. The 100-yr Return Period, 24-hr precipitation estimate is 8.00-in. No detailed historic precipitation data gathering was required. The methods used to estimate runoff were not contingent on detailed analysis of climatological factors.

Estimated RP discharge for the watershed Kidder Creek was calculated by two methods, (USGS Regional Method, and the Log Pearson III statistical analysis of stream gage data. Both methods are common to hydrologic calculations for Northern California and are well documented in the appropriate technical reference(s). Detailed data results provided in Exhibit C. Summary table below:

Table 1 Summary of Return Period Discharges for Kidder Creek Above Project Area (24.866-mi^2)

Method	Q 100-yr (cfs)	Q 50-yr (cfs)	Q 25-yr (cfs)	Q 10-yr (cfs)	Note
Regional Method (S)	2830	2270	1680	1180	North Coast Regional Method Equation (reasonable approximation)
LPIII – s11518050	4500	3600	2700	1700	USGS gaging station s11518050 Scott River with basin comparison method employed. (1960-74) short period of record
LPIII – s11516900	1850	1300	880	500	USGS gaging station s11516900 Little Shasta R, NR Montague (1957-77) short record
Project	3050	2400	1750	1200	Rounded average of all values

Hydraulics

Survey data, cross sections and proposed development limits taken from photogrammetry mapping provided by Kidder Creek Orchard Camp management. Alignment and cross section locations found on development planning map, (Exhibit D).

Cross sectional data incorporated into a one-dimensional, steady-state hydraulic model (HEC-RAS 4.01). Overbank and flowline limits from survey and geo-referenced aerial photographic image. Manning N-values from field investigation and comparative review of similar studies. Manning N-values ranged from 0.045 to 0.070.

Hydraulic modeling boundary conditions used the critical depth calculation for all RP flows. Detailed cross sectional data and result tabular data found in Exhibit D.

Hydraulics Discussion

The controlling water surface elevation for the 100-yr Return Period discharge is considered the upstream cross section above station “k” line STA 36+00 (XS – 4800). Review of the tabular data in Exhibit D finds the calculated water surface elevation (BFE) for the 100-yr event as 2023.9-ft. The

average channel velocity for the 100-yr event is near 9-fps. The in-channel velocity is significantly higher and has the ability to move large cobbles and boulders (200-lbs or more) as bedload down the stream channel.

All return period discharges produced flow regimes at or near super critical flow. Froude numbers range for 0.6 to 1.0, though field observations suggest transient supercritical flow conditions and unstable flow regime expected throughout the river reach. Large amounts of bedload are expected during medium to large discharge events. The super critical flow analysis was not endeavored and all resultant cross sections with high Froude numbers were limited to their critical depth calculation. This result giving the conservative answer for BFE calculations.

The transient lateral condition of downstream Kidder Creek is disconcerting. The landuse patterns in this area and the continued encroachment into the floodplain were not considered. The meandering nature of the downstream channel and its inevitable impact to BFE are difficult to analyze in preliminary study. Further, downstream encroachments and landuse changes will ultimately impact BFE in the general area. There is no cost effective method at present to estimate the streambed and channel movements with respect to time, landuse and future hydrologic events.

EXHIBIT A

USGS WATERSHED MAP

Kidder Creek Orchard Camp
Planned Development

February 2014

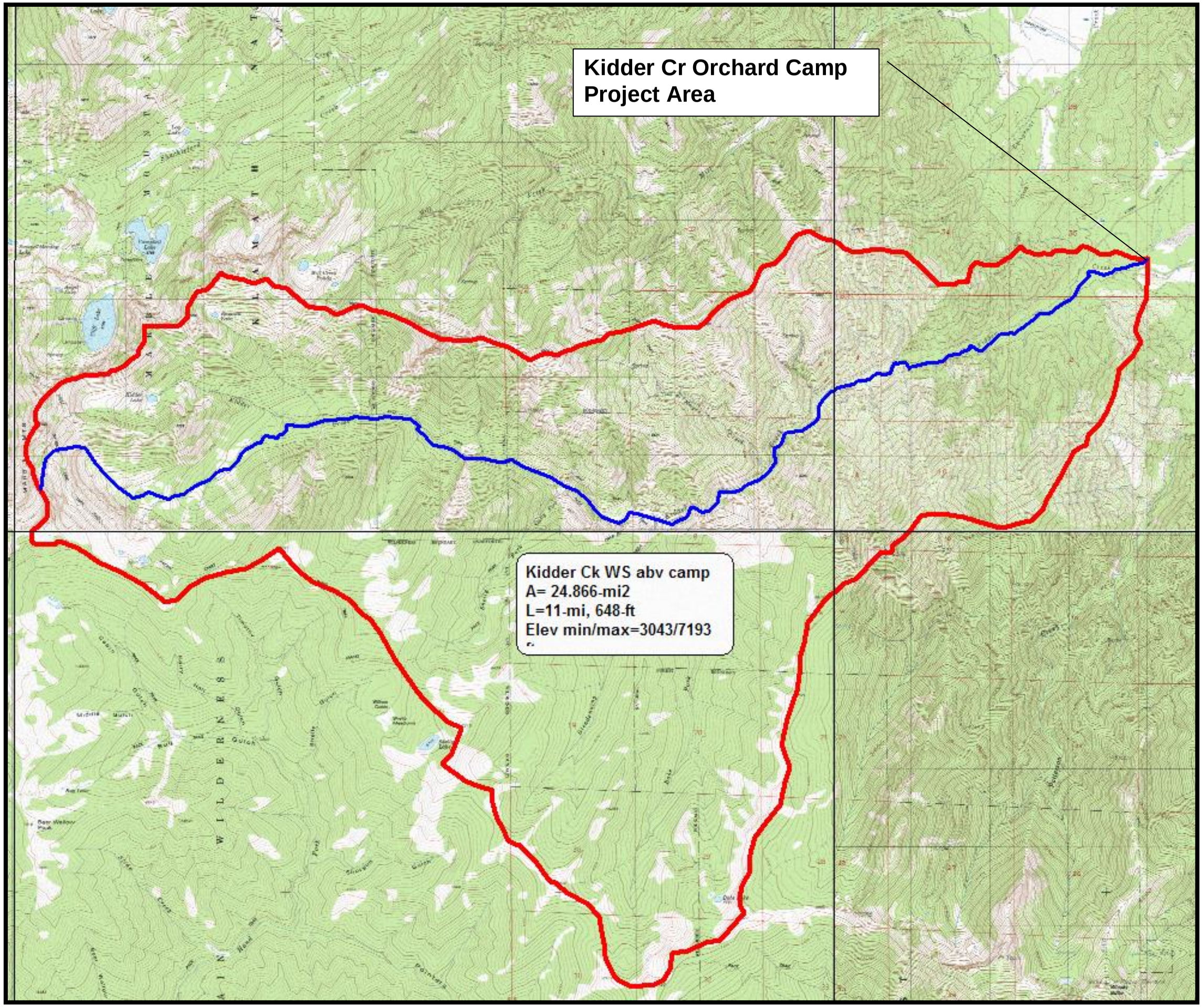

Kidder Cr Orchard Camp
Project Area
Kidder Ck WS abv camp
A= 24.866-mi2
L=11-mi, 648-ft
Elev min/max=3043/7193

EXHIBIT B

FEMA FLOOD INSURANCE RATE MAP
FIRM
MAP NUMBER 06093C200D
JAN 19, 2011

Kidder Creek Orchard Camp
Planned Development

February 2014

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 10. The **horizontal datum** was NAD 83, GRS80 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713-3242**, or visit its website at http://www.ngs.noaa.gov.

Road centerline information shown on this FIRM was provided in digital format by the Siskiyou County Department of Public Works. These data were developed in 2001 using vehicle mounted sub-meter GPS equipment. Railroad centerlines were derived from 2006 Second Edition TIGER/Line files published by the U.S. Census Bureau.

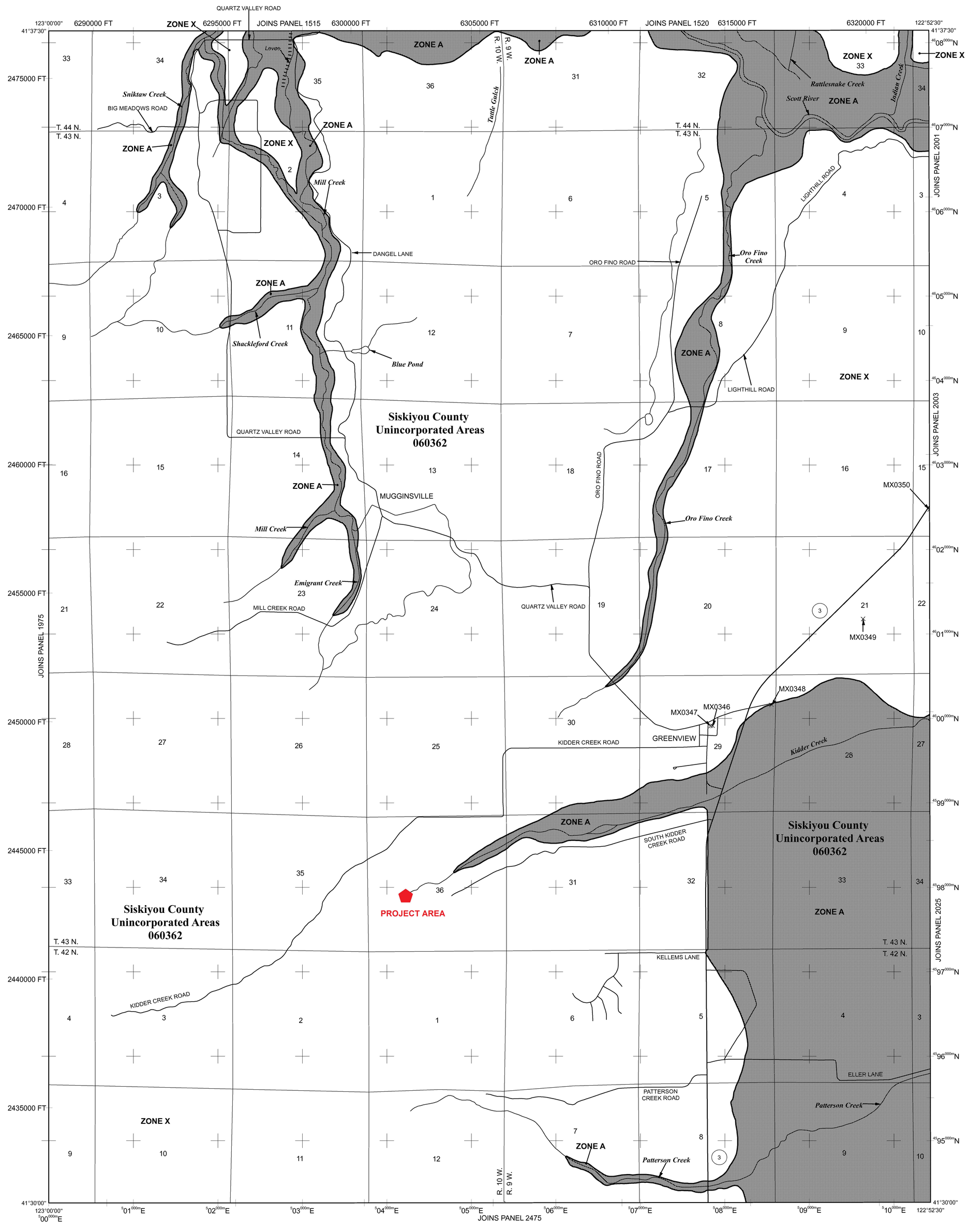
This map reflects more detailed and up-to-date **stream channel configurations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to confirm to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study Report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

For information on **available products** associated with this FIRM visit the Map Service Center (MSC) website at http://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the MSC website.

If you have **questions about this map**, how to order products or the National Flood Insurance Program in general, please call the FEMA Map Information eXchange (FMIX) at 1-877-FEMA-MAP (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip.



LEGEND

SPECIAL FLOOD HAZARD AREAS SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

- Floodplain boundary
- Floodway boundary
- Zone D boundary
- CBRS and OPA boundary
- Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
- Limit of Moderate Wave Action
- 513 — Base Flood Elevation line and value; elevation in feet*
- (EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988

- Cross section line
- Transect line
- Culvert, Flume, Penstock or Aqueduct
- Road or Railroad Bridge
- Footbridge
- 87°07'45", 32°22'30" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), Western Hemisphere
- 4276000mN — 1000-meter Universal Transverse Mercator grid values, zone 10N
- 600000 FT — 5000-foot grid values: California State Plane coordinate system, zone I (FIPSZONE 0401), Lambert Conformal Conic projection
- DX5510 × — Bench mark (see explanation in Notes to Users section of this FIRM panel)
- M1.5 — River Mile

MAP REPOSITORY
Refer to listing of Map Repositories on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
January 19, 2011

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your Insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 2000'
1000 0 2000 4000 FEET
600 0 600 1200 METERS

NFIP
NATIONAL FLOOD INSURANCE PROGRAM

PANEL 2000D

FIRM
FLOOD INSURANCE RATE MAP

SISKIYOU COUNTY, CALIFORNIA
AND INCORPORATED AREAS

PANEL 2000 OF 3750

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
SISKIYOU COUNTY	060362	2000	D

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
06093C2000D

EFFECTIVE DATE
JANUARY 19, 2011

Federal Emergency Management Agency

EXHIBIT C

HYDROLOGY

REGIONAL METHOD
AND
USGS STREAM GAGE DATA
LPIII STATISTICAL ANALYSIS

Kidder Creek Orchard Camp
Planned Development

February 2014

Hydrologic Estimate
REGIONAL METHOD
North Coast

INPUT

NAME: Kidder Creek Camp
DATE: 1/30/2014
CREEK/RIVER NAME: Kidder Creek
QUAD MAP NAME: Etna
LOCATION: 2700 S Kidder Creek Rd, Etna, CA

A = Drainage area in square miles
P = Mean annual precipitation in inches
H = Altitude index in thousands of feet (min. value is 1)

A =	24.87 sq. mi.
P =	20.50 inches
H =	4.2000

OUTPUT

$Q_2 = 3.52 * A^{0.90} * P^{0.89} * H^{-0.87}$ = **270 cfs**

$Q_5 = 5.04 * A^{0.89} * P^{0.91} * H^{-0.35}$ = **830 cfs**

$Q_{10} = 6.21 * A^{0.88} * P^{0.93} * H^{-0.27}$ = **1180 cfs**

$Q_{25} = 7.64 * A^{0.87} * P^{0.94} * H^{-0.17}$ = **1680 cfs**

$Q_{50} = 8.57 * A^{0.87} * P^{0.96} * H^{-0.08}$ = **2270 cfs**

$Q_{100} = 9.23 * A^{0.87} * P^{0.97}$ = **2830 cfs**

Gaged basin name	EF SCOTT R CALAHAN CA	
Latitude gaged basin	41.3	Decimal Degrees
Longitude gaged basin	122.7666	Decimal Degrees
Ungaged basin name	Kidder Creek Above Camp	
Latitude ungaged basin	41.53102	Decimal Degrees
Longitude ungaged basin	122.95294	Decimal Degrees
Distance Between Gages	18.8	miles
Bearing from Gaged to Ungaged Basin	NorthWest	
Gaged basin Area	110.000	mi^2
Ungaged Basin Area	24.866	mi^2
Hydrologic Region	North Coast	Select Hydrologic Region from pulldown menu (See HDM pg 810-19)

Yrs of Record	15
Begin Record	Feb-1960
End Record	Jan-1974
Min Q recorded	825.00
Max Q recorded	12500.00
Q_{MPD} [A]	53962

			EF SCOTT R CALAHAN CA		Kidder Creek Above Camp	
Return Period (yr)	**Gaged Log-Normal Q (cfs)**	**Ungaged Log-Normal Q (cfs)**	**Gaged LP-3 Q (cfs)**	**Gaged Unit Q (cfs/mi^2)**	**Ungaged LP-3 Q (cfs)**	**Ungaged Unit Q (cfs/mi^2)**
2	2095.58	549.66	**2040.45**	18.5	**535.20**	21.5
2.5	2606.64	685.41	2541.31	23.1	**668.23**	26.9
3	3292.14	869.24	3226.56	29.3	**851.93**	34.3
5	4326.61	1151.86	4288.18	39.0	**1141.62**	45.9
10	6320.08	1707.77	**6420.04**	58.4	**1734.78**	69.8
25	9467.26	2596.51	**9989.31**	90.8	**2739.69**	110.2
50	12291.27	3371.03	**13377.99**	121.6	**3669.07**	147.6
100	15544.42	4263.24	**17474.29**	158.9	**4792.53**	192.7
200	19270.94	5285.29	22395.46	203.6	**6142.22**	247.0
500	25003.59	6857.53	30394.71	276.3	**8336.11**	335.2
1000	30014.85	8231.93	37773.37	343.4	**10359.80**	416.6

A. Q_{MPD} = Maximum Peak Discharge (cfs). Estimate as per Creager enveloping curve. From reference 2 below. pg. 9

References:

1. Regional Flood Frequency Equation. HDM May 2001, pg. 810-19
2. Magnitude and Frequency of Floods in California, USGS Water-Resources Investigation 77-21 1977 pg 4-6
3. Guidelines for Determing Flood Flow Frequency, Bulletin No. 17B, USGS, office of Water Data Coordination, 1982
4. Design Hydrology and Sedimentology for Small Catchments, Hydrologic Frequency Analysis, pg 8-18, 1994

Gaged basin name	LITTLE SHASTA R NR MONTAGUE CA	
Latitude gaged basin	41.75305	Decimal Degrees
Longitude gaged basin	122.032778	Decimal Degrees
Ungaged basin name	Kidder Creek Above Camp	
Latitude ungaged basin	41.53102	Decimal Degrees
Longitude ungaged basin	122.95294	Decimal Degrees
Distance Between Gages	51.1	miles
Bearing from Gaged to Ungaged Basin	SouthWest	
Gaged basin Area	48.200	mi^2
Ungaged Basin Area	24.866	mi^2
Hydrologic Region	North Coast	Select Hydrologic Region from pulldown menu (See HDM pg 810-19)

Yrs of Record	21
Begin Record	Nov-1957
End Record	Dec-1977
Min Q recorded	41.00
Max Q recorded	5910.00
Q_{MPD} [A]	53962

			LITTLE SHASTA R NR MONTAGUE CA		Kidder Creek Above Camp	
Return Period (yr)	Gaged Log-Normal Q (cfs)	Ungaged Log-Normal Q (cfs)	Gaged LP-3 Q (cfs)	Gaged Unit Q (cfs/mi^2)	Ungaged LP-3 Q (cfs)	Ungaged Unit Q (cfs/mi^2)
2	213.92	117.91	**202.01**	4.2	**111.35**	4.5
2.5	280.77	154.93	265.75	5.5	**146.64**	5.9
3	375.58	207.63	359.32	7.5	**198.64**	8.0
5	527.93	292.93	517.06	10.7	**286.89**	11.5
10	846.56	472.83	**873.64**	18.1	**487.96**	19.6
25	1400.72	787.55	**1568.16**	32.5	**881.69**	35.5
50	1939.21	1090.31	**2321.23**	48.2	**1305.10**	52.5
100	2598.36	1460.92	**3335.27**	69.2	**1875.24**	75.4
200	3396.23	1909.51	4685.06	97.2	**2634.16**	105.9
500	4698.19	2641.54	7146.82	148.3	**4018.27**	161.6
1000	5899.14	3316.76	9677.25	200.8	**5440.99**	218.8

A. Q_{MPD} = Maximum Peak Discharge (cfs). Estimate as per Creager enveloping curve. From reference 2 below. pg. 9

References:

1. Regional Flood Frequency Equation. HDM May 2001, pg. 810-19
2. Magnitude and Frequency of Floods in California, USGS Water-Resources Investigation 77-21 1977 pg 4-6
3. Guidelines for Determing Flood Flow Frequency, Bulletin No. 17B, USGS, office of Water Data Coordination, 1982
4. Design Hydrology and Sedimentology for Small Catchments, Hydrologic Frequency Analysis, pg 8-18, 1994

EXHIBIT D

MAPPING AND STREAM ALIGNMENT

Kidder Creek Orchard Camp
Planned Development

February 2014


KIDDER CREEK
45+45.92
45+00
44+00
43+00
42+00
41+00
40+00
39+00
3010
3020


35+00
36+00
37+00
38+00
39+00
40+00
41+00
ROPES
COURSE
SWIM AR


KIDDER CREEK
15+00
16+00
17+00
18+00
19+00
20+00
21+00
22+00
23+00
24+00
25+00
26+00
1412
3108.25
RETREAT & SEASONAL
STAFF HOUSING

EXHIBIT E

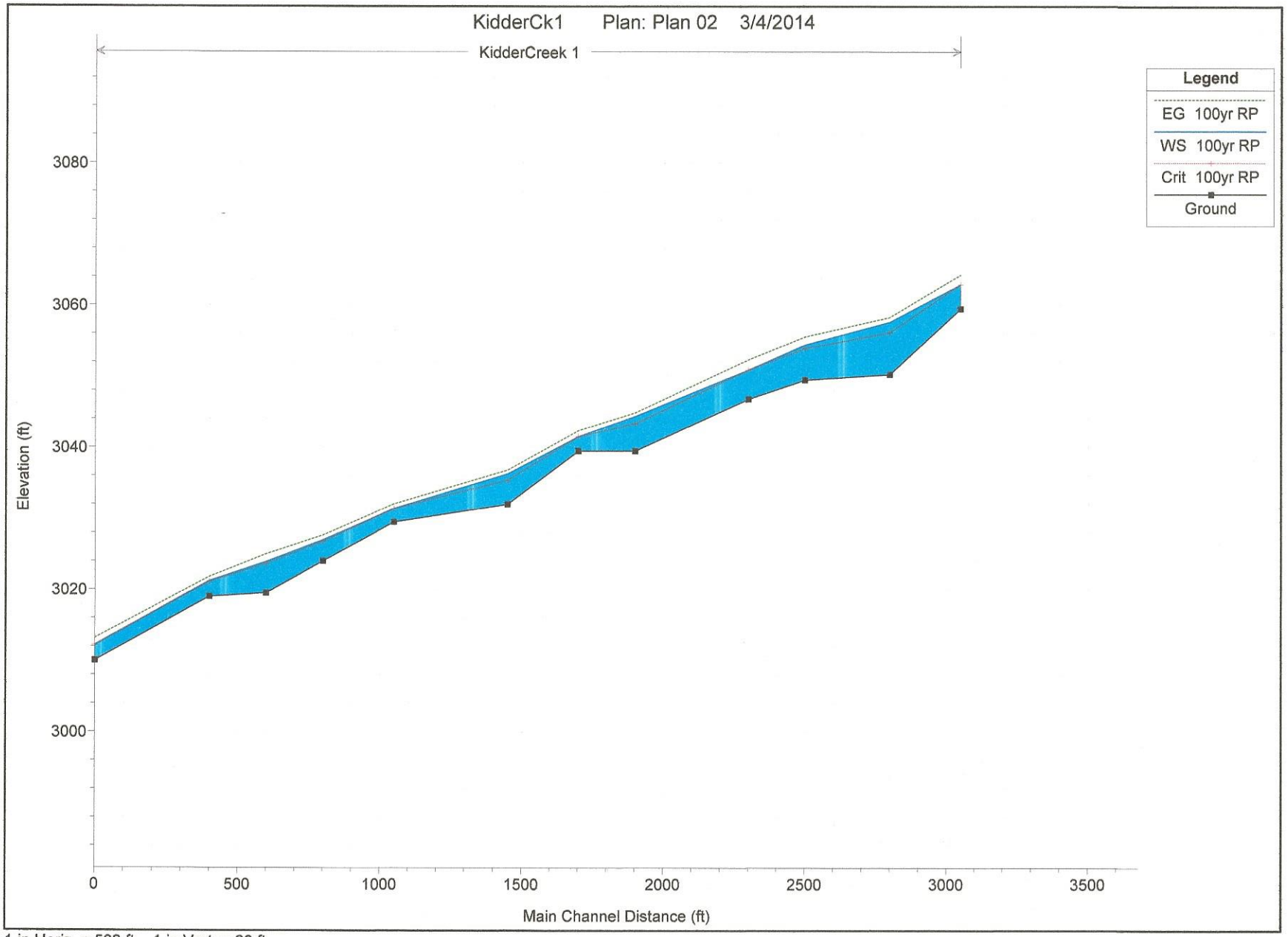
PRELIMINARY HYDRAULIC MODELING RESULTS

Kidder Creek Orchard Camp
Planned Development

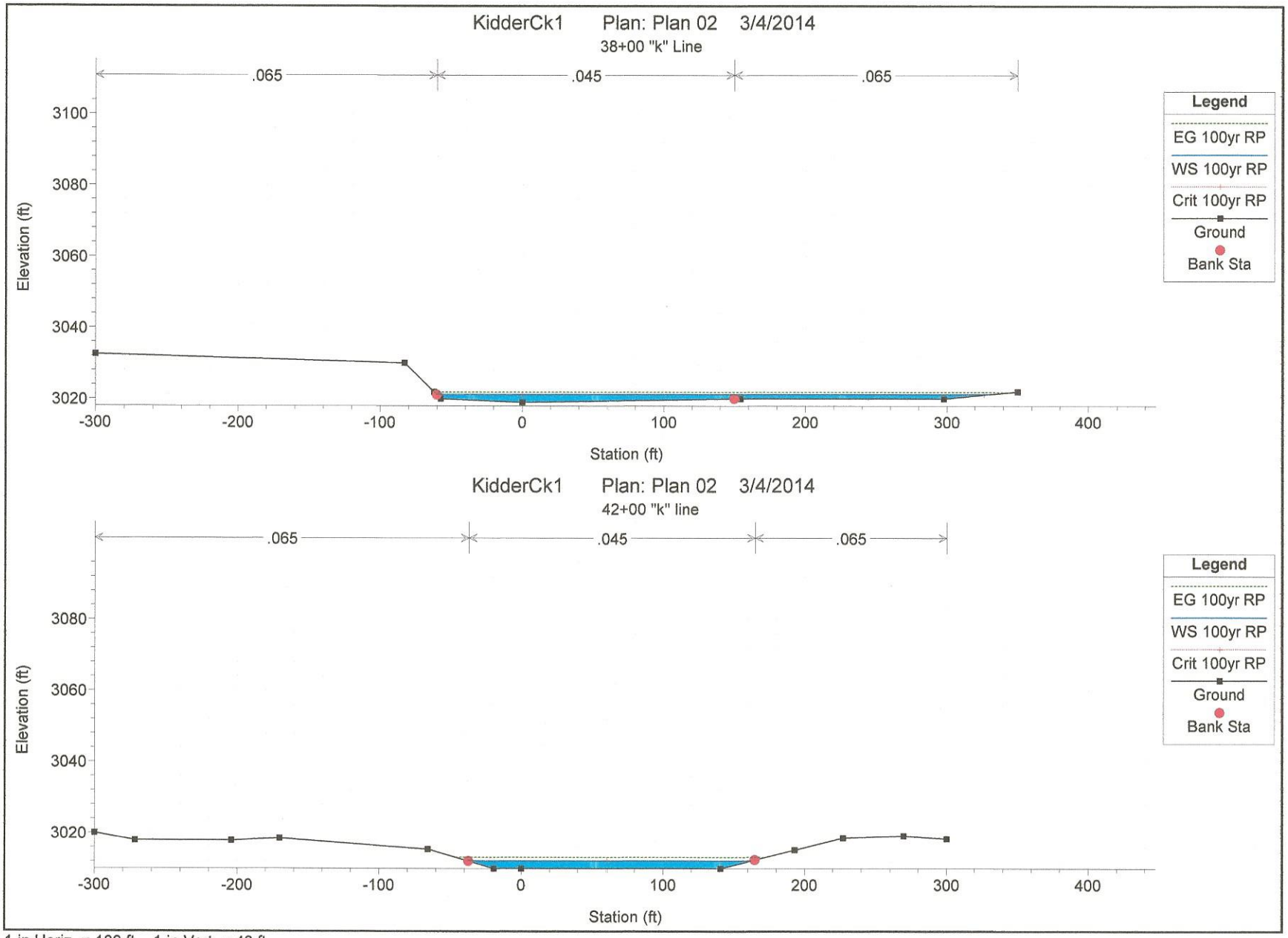
February 2014

HEC-RAS Plan: Plan 02 River: KidderCreek Reach: 1

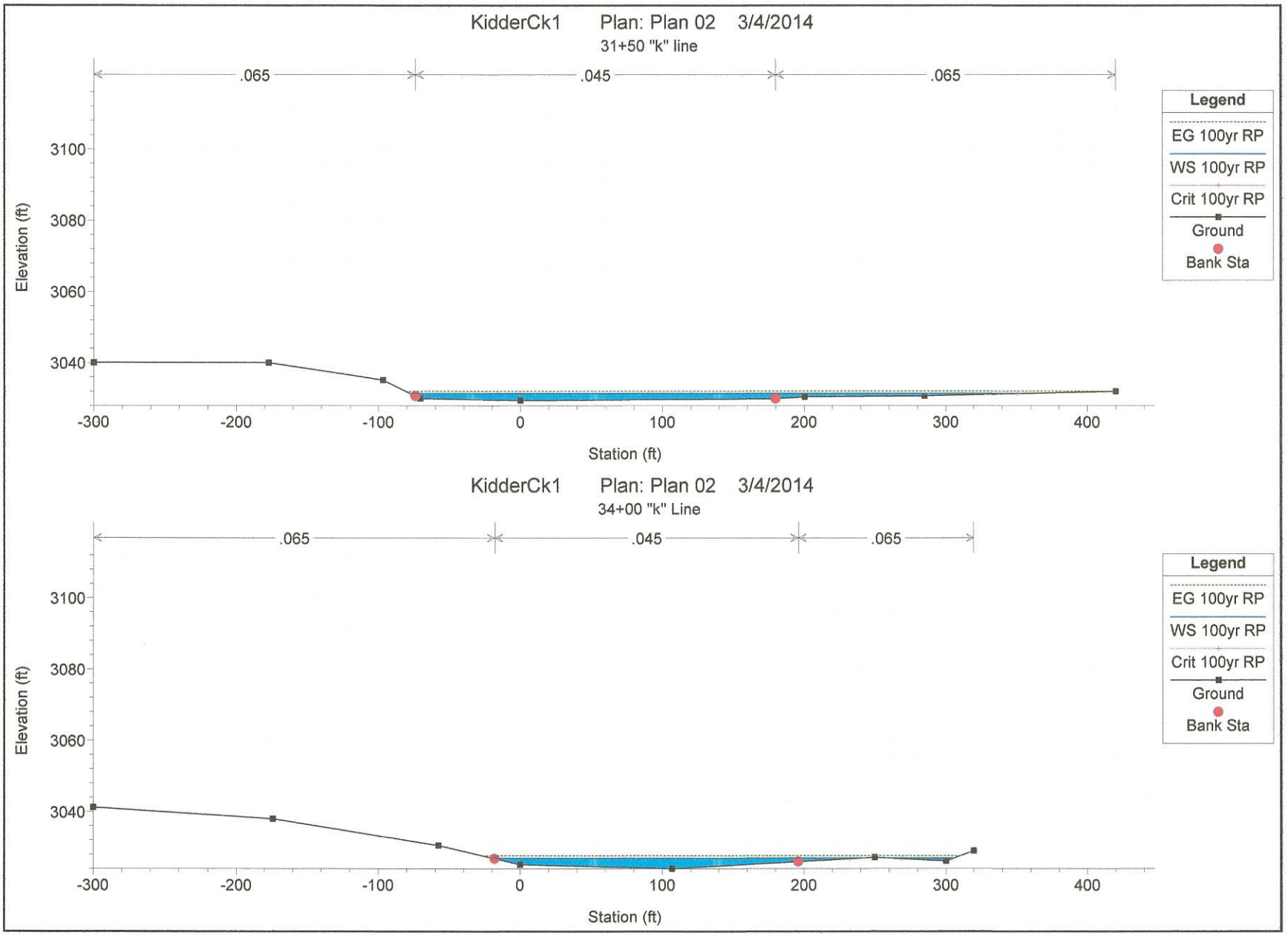
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
1	7250	100yr RP	3050.00	3059.50	3062.89	3062.89	3064.24	0.021716	9.33	326.92	122.43	1.01
1	7250	50yr RP	2400.00	3059.50	3062.45	3062.45	3063.64	0.022738	8.75	274.43	117.27	1.01
1	7250	25yr RP	1750.00	3059.50	3061.97	3061.97	3062.96	0.024092	8.00	218.65	111.53	1.01
1	7250	10yr RP	1200.00	3059.50	3061.49	3061.49	3062.29	0.025826	7.17	167.25	105.97	1.01
1	7000	100yr RP	3050.00	3050.25	3057.62	3056.17	3058.28	0.006640	6.55	465.64	121.68	0.59
1	7000	50yr RP	2400.00	3050.25	3056.95	3055.65	3057.54	0.006755	6.19	387.94	111.90	0.59
1	7000	25yr RP	1750.00	3050.25	3056.18	3055.02	3056.69	0.006876	5.72	305.86	100.54	0.58
1	7000	10yr RP	1200.00	3050.25	3055.39	3054.35	3055.81	0.006990	5.19	231.06	88.94	0.57
1	6700	100yr RP	3050.00	3049.50	3054.43	3053.88	3055.54	0.012846	8.46	360.72	104.54	0.80
1	6700	50yr RP	2400.00	3049.50	3053.95	3053.34	3054.87	0.011948	7.69	312.19	98.93	0.76
1	6700	25yr RP	1750.00	3049.50	3053.39	3052.72	3054.10	0.010923	6.79	257.89	92.24	0.72
1	6700	10yr RP	1200.00	3049.50	3052.79	3052.12	3053.32	0.009930	5.86	204.88	85.21	0.67
1	6500	100yr RP	3050.00	3046.80	3050.89	3050.89	3052.31	0.020428	9.59	321.79	115.77	0.99
1	6500	50yr RP	2400.00	3046.80	3050.43	3050.43	3051.68	0.021914	8.98	269.25	111.98	1.00
1	6500	25yr RP	1750.00	3046.80	3049.93	3049.93	3050.97	0.023657	8.19	214.02	107.08	1.01
1	6500	10yr RP	1200.00	3046.80	3049.42	3049.42	3050.27	0.025531	7.40	162.24	97.55	1.01
1	6100	100yr RP	3050.00	3039.50	3044.35	3043.32	3044.87	0.007324	5.77	528.73	185.62	0.59
1	6100	50yr RP	2400.00	3039.50	3043.99	3042.91	3044.41	0.006701	5.18	463.50	174.45	0.56
1	6100	25yr RP	1750.00	3039.50	3043.52	3042.42	3043.84	0.005910	4.55	384.57	159.89	0.52
1	6100	10yr RP	1200.00	3039.50	3043.03	3041.93	3043.26	0.005017	3.88	309.47	144.68	0.47
1	5900	100yr RP	3050.00	3039.50	3041.54	3041.54	3042.37	0.025225	7.32	416.63	252.33	1.00
1	5900	50yr RP	2400.00	3039.50	3041.28	3041.28	3042.00	0.026615	6.82	351.87	246.73	1.01
1	5900	25yr RP	1750.00	3039.50	3040.99	3040.99	3041.59	0.028306	6.19	282.92	240.62	1.01
1	5900	10yr RP	1200.00	3039.50	3040.72	3040.72	3041.19	0.031013	5.52	217.30	234.66	1.01
1	5650	100yr RP	3050.00	3032.00	3036.26	3035.37	3036.80	0.007671	5.90	522.31	195.84	0.61
1	5650	50yr RP	2400.00	3032.00	3035.81	3034.98	3036.28	0.008227	5.50	437.03	180.38	0.61
1	5650	25yr RP	1750.00	3032.00	3035.28	3034.53	3035.68	0.008511	5.04	347.04	162.48	0.61
1	5650	10yr RP	1200.00	3032.00	3034.80	3034.07	3035.10	0.007733	4.40	272.94	146.11	0.57
1	5250	100yr RP	3050.00	3029.50	3031.38	3031.36	3032.02	0.021065	6.67	527.49	430.87	0.92
1	5250	50yr RP	2400.00	3029.50	3031.28	3031.14	3031.74	0.016605	5.67	483.19	419.05	0.81
1	5250	25yr RP	1750.00	3029.50	3031.11	3030.90	3031.44	0.013422	4.72	415.09	400.21	0.71
1	5250	10yr RP	1200.00	3029.50	3030.86	3030.63	3031.11	0.013255	4.09	317.12	371.44	0.68
1	5000	100yr RP	3050.00	3024.00	3026.95	3026.72	3027.61	0.014991	6.63	493.32	310.57	0.81
1	5000	50yr RP	2400.00	3024.00	3026.53	3026.42	3027.20	0.019781	6.62	373.01	262.77	0.89
1	5000	25yr RP	1750.00	3024.00	3026.09	3026.09	3026.75	0.027716	6.54	268.21	213.43	1.01
1	5000	10yr RP	1200.00	3024.00	3025.77	3025.77	3026.31	0.029944	5.88	204.15	195.61	1.01
1	4800	100yr RP	3050.00	3019.50	3023.90	3023.60	3024.94	0.011929	8.98	450.76	180.27	0.79
1	4800	50yr RP	2400.00	3019.50	3023.56	3023.13	3024.39	0.010557	7.96	391.07	168.01	0.74
1	4800	25yr RP	1750.00	3019.50	3023.15	3022.60	3023.77	0.008985	6.78	324.79	153.26	0.66
1	4800	10yr RP	1200.00	3019.50	3022.70	3022.03	3023.14	0.007470	5.61	259.46	137.17	0.59
1	4600	100yr RP	3050.00	3019.00	3021.22	3021.10	3021.79	0.019672	6.61	557.35	389.92	0.89
1	4600	50yr RP	2400.00	3019.00	3021.02	3020.90	3021.49	0.019330	6.02	479.30	384.13	0.87
1	4600	25yr RP	1750.00	3019.00	3020.78	3020.69	3021.17	0.019058	5.36	390.89	377.45	0.84
1	4600	10yr RP	1200.00	3019.00	3020.56	3020.46	3020.86	0.018539	4.65	306.38	370.96	0.80
1	4200	100yr RP	3050.00	3010.00	3012.14	3012.14	3013.11	0.023934	7.92	385.18	199.92	1.00
1	4200	50yr RP	2400.00	3010.00	3011.84	3011.84	3012.68	0.025200	7.38	325.04	194.23	1.01
1	4200	25yr RP	1750.00	3010.00	3011.50	3011.50	3012.20	0.026655	6.71	260.98	187.98	1.00
1	4200	10yr RP	1200.00	3010.00	3011.18	3011.18	3011.73	0.028720	5.97	200.84	181.91	1.00



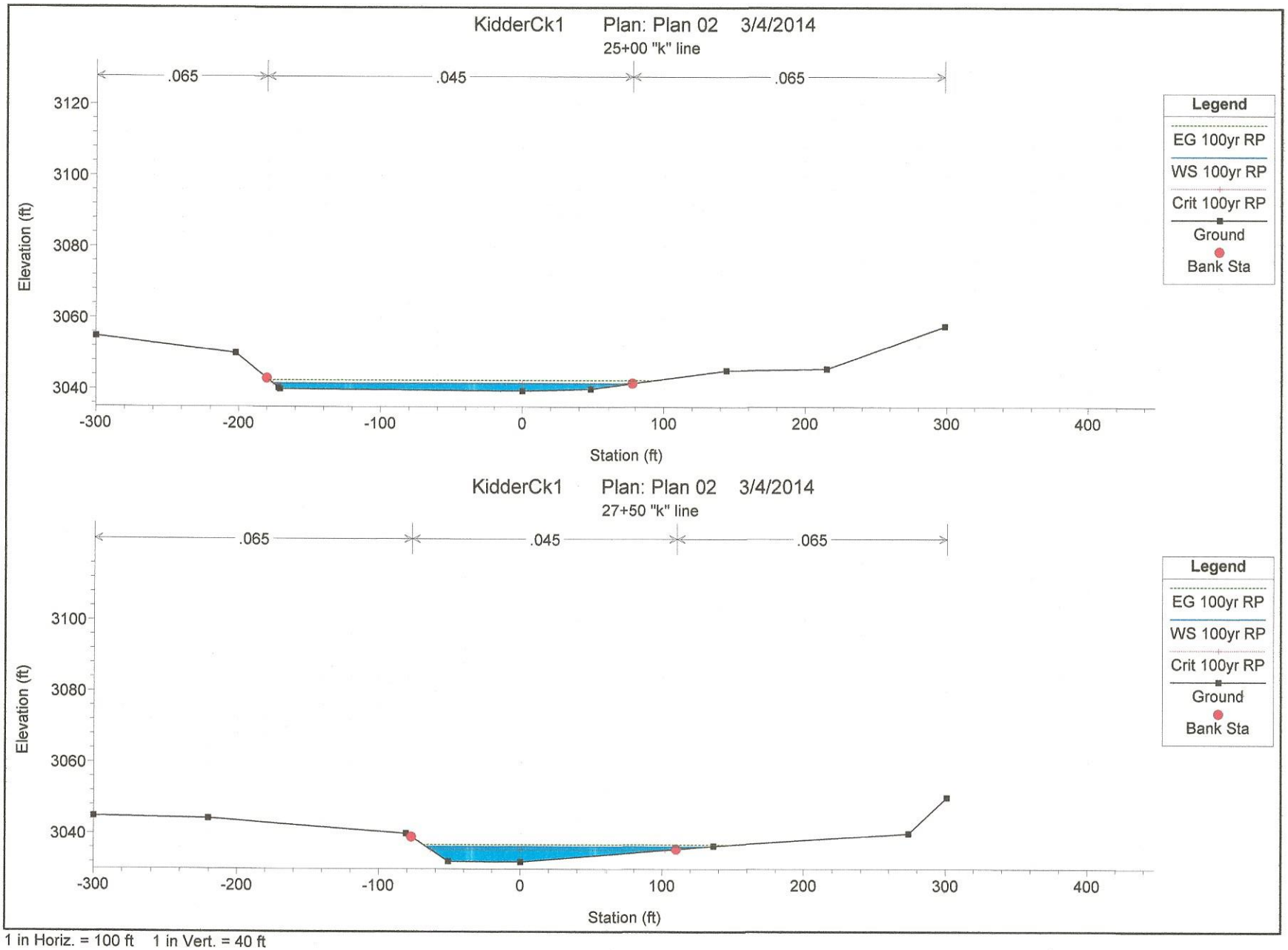
1 in Horiz. = 500 ft 1 in Vert. = 20 ft



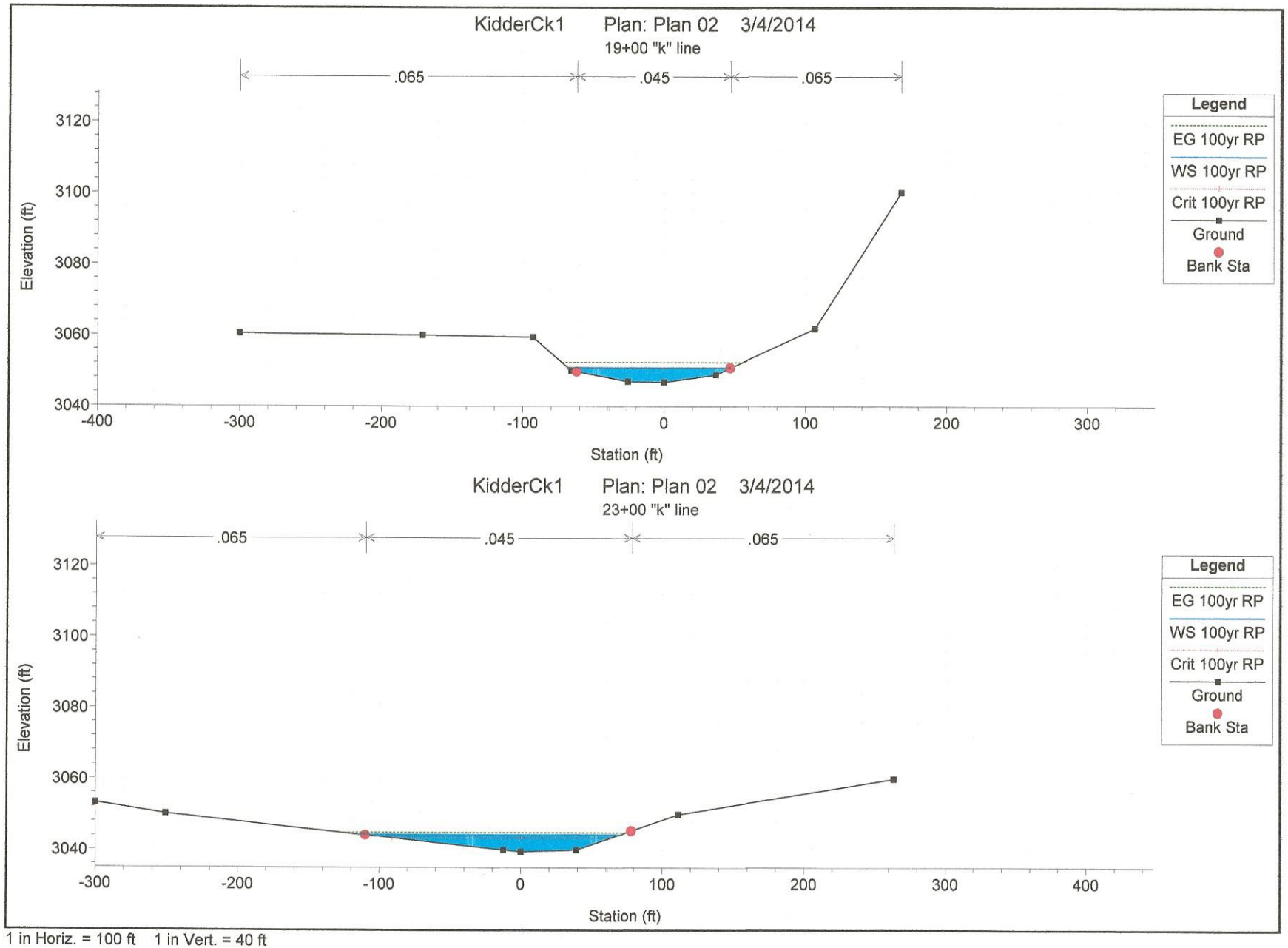
1 in Horiz. = 100 ft 1 in Vert. = 40 ft



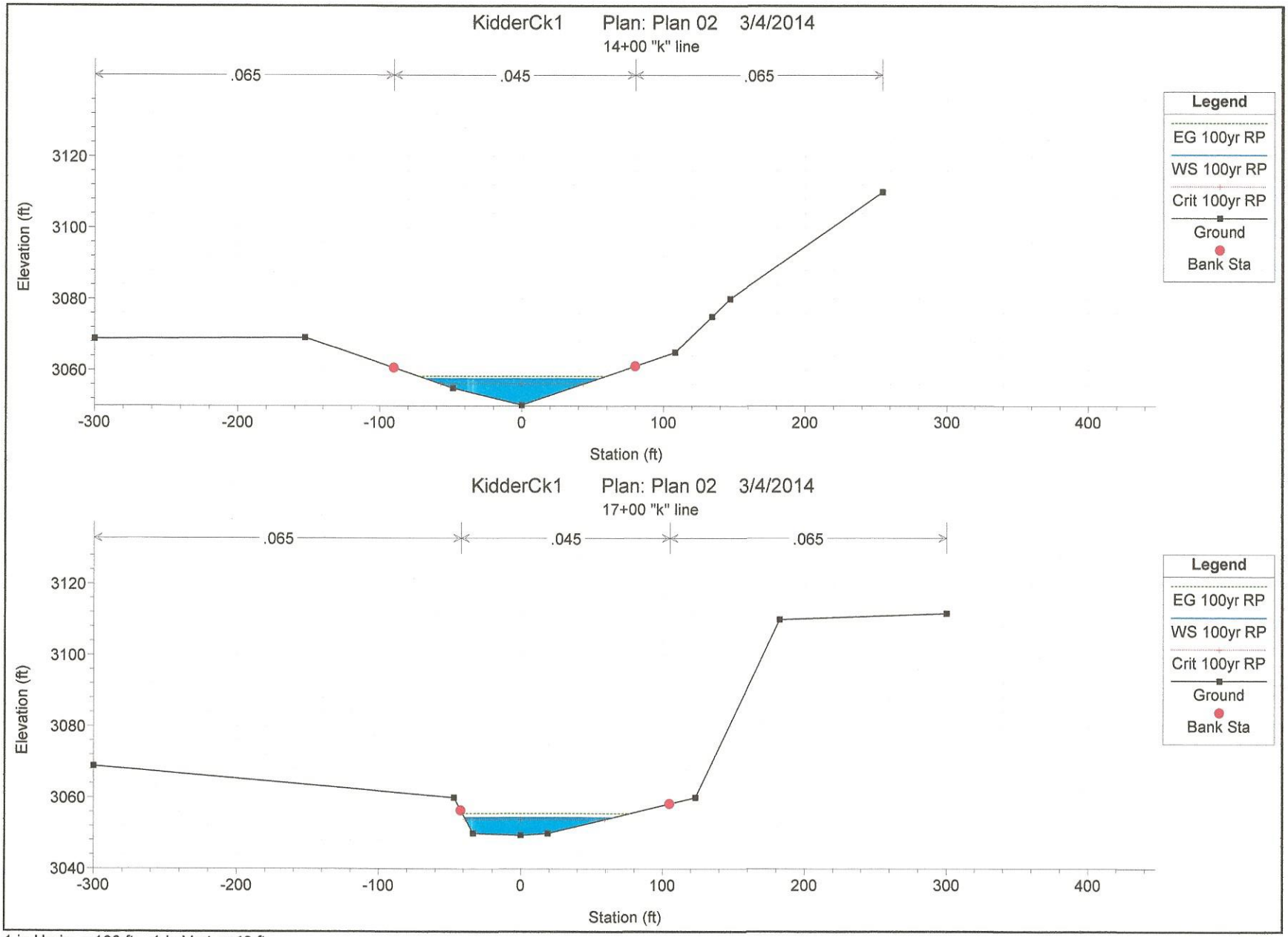
1 in Horiz. = 100 ft 1 in Vert. = 40 ft



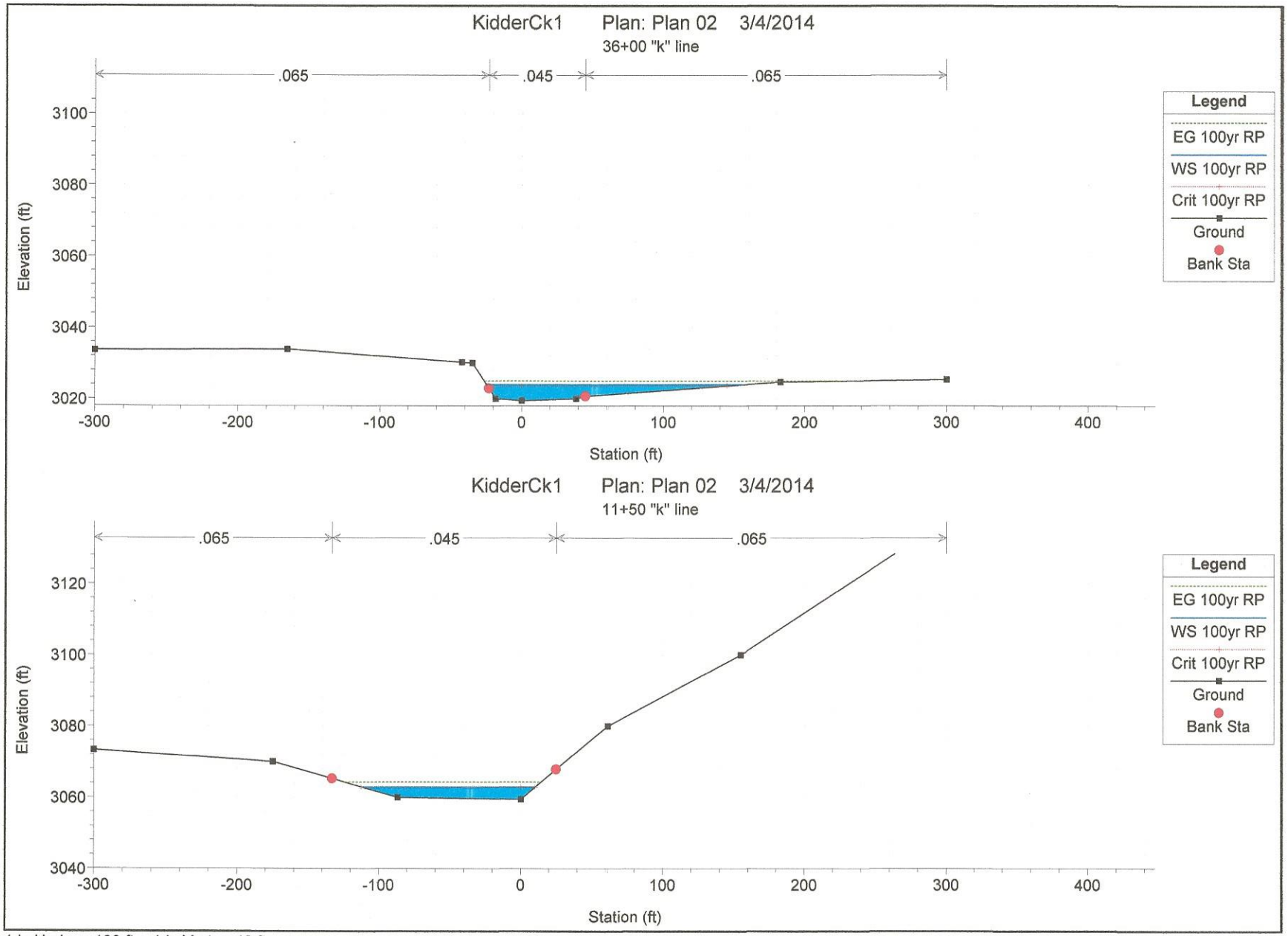
1 in Horiz. = 100 ft 1 in Vert. = 40 ft



1 in Horiz. = 100 ft 1 in Vert. = 40 ft



1 in Horiz. = 100 ft 1 in Vert. = 40 ft



1 in Horiz. = 100 ft 1 in Vert. = 40 ft