EXHIBIT F-2
LU 12-0032

APPENDIX B-7

FOOTHILLS DISTRICT FRAMEWORK PLAN: FLOODPLAIN

EXHIBIT F-2
LU 12-0032

TECHNICAL MEMORANDUM

EXPIRES: 6/30/2012

TO: Matt Brown and Christe White
Williams/Dame & White – Lake Oswego LLC

FROM: Eirik Schulz, P.E.
Ken Vigil, P.E.
Vigil-Agrimis, Inc.

DATE: February 15, 2011

SUBJECT: Foothills District Framework Plan
Preliminary Floodplain Development Feasibility Analysis

PURPOSE

On June 15, 2010, the Lake Oswego City Council approved a Pre-Development Agreement (PDA) with Foothills Road Redevelopment LLC and Williams/Dame & White – Lake Oswego LLC (WDW). The PDA calls for the establishment of a Framework Plan for the Foothills District and assigns responsibility for the delivery of a final Framework Plan document from WDW to the City.

Approximately 40% of the area identified for redevelopment within the Foothills district lies within the Lake Oswego Flood Management area and the 100-yr floodplain of the Willamette River. Vigil-Agrimis, Inc. (VAI) was tasked with conducting a preliminary assessment of impacts to the Willamette River floodplain as a result of the proposed Foothills development. One of the key issues in moving forward with this project is the feasibility of filling, or protecting by levee, the proposed development area. VAI conducted a screening level analysis to determine the potential rise, or no-rise, in 100-yr water surface elevations as a result of filling the proposed development area. The purpose of this preliminary assessment was to determine if the project appears feasible from a floodplain analysis perspective.

This course screening level analysis was conducted using readily available topographic and hydraulic modeling information. A more detailed analysis will be conducted in the following months using improved topographic data.

ANALYSIS APPROACH

The 100-year flood event documented in the current Clackamas County Federal Emergency Management Agency (FEMA) Flood Insurance Study (FIS) was used as the baseline condition for the floodplain analysis. VAI used the following procedure to estimate the change in water surface elevations due to future development of the Foothills area.

1. VAI reviewed the current Flood Insurance Study, maps, workmaps, and background information available from the Army Corps of Engineers (Corps) and FEMA.

Engineering • Landscape Architecture • Environmental Science
819 SE Morrison Street, Suite 310, Portland, Oregon 97214 • 503.274.2010 • 503.274.2024 fax • www.vigil-agrimis.com

2. The original hydraulic model developed by the Corps used the outdated HEC-2 hydraulic modeling software. The original HEC-2 model data was imported into the current HEC-RAS hydraulic modeling software to create an existing conditions model.
3. VAI added three new cross sections to the model in the vicinity of the Foothills Development area. These cross sections were created using existing aerial topographic survey and National Oceanic and Atmospheric Administration (NOAA)/National Oceanic Service (NOS) smooth sheet bathymetry data. The NOAA charts were developed in 1946 and do not provide current or detailed bathymetry data, but they are suitable for this preliminary analysis. Improved bathymetry data will be required for future modeling efforts.
4. Hydrology data from the original HEC-2 model was used to calculate 100-yr Base Flood Elevations in the new HEC-RAS model. This new HEC-RAS model was used as the existing conditions baseline model in the comparative water surface elevation analysis.
5. VAI modified the three new cross sections to reflect proposed grading within the Foothills district and ran the new proposed conditions model. For this analysis, we conservatively assumed the entire Foothills district development area was filled above the 100-year flood elevation.
6. The water surface elevations from the existing conditions and proposed conditions models were compared.

FINDINGS

- Preliminary modeling of the 100-year flood event indicates a small rise (less than 2 inches) in local and upstream water surface elevations as a result of fill placement within the Foothills District.
- A small rise in water surface elevation could still be considered "no-rise" depending on the reporting requirements of the local jurisdiction. For FEMA Flood Insurance Studies water surface elevations are reported to the nearest $1/10^{th}$ of a foot. If the rise in water surface elevation is a few 1/100ths of a foot and the value rounds off to the same value as the regulatory 100-yr flood elevation (base flood elevation) then it could still be considered "no-rise".
- Likewise, some jurisdictions define no-rise as less than $1/10^{th}$ of foot (1.2 inches) increase in water surface elevation.
- It is likely that using a more detailed model with improved topographic information would result in a similar conclusion.
- Therefore, based on this preliminary analysis, it seems feasible that development of the Foothills District could be accomplished with only a minimal rise, or no-rise in water surface elevation.

LIMITATIONS

This preliminary analysis focuses only on the impacts to the regulatory base flood elevation (100-year) as a result of placing fill within the Foothills District development area. Flooding in

this area could still occur during larger storm events or as a result of surface water runoff from adjacent areas. During the future phases of the project, other sources of flooding will need to be investigated. These other flooding sources include, but are not limited to, the following:

- Flooding from Tryon Creek and the Willamette River through the existing stormwater outfall to Tryon Creek.
- Flooding from the stormwater system that discharges to the detention pond located within the Foothills district development area.
- Overland flow resulting from overtopping of the Lake Oswego banks in the vicinity of Lakewood Bay. It is our understanding that modifications to the Lake Oswego dam are underway to address this potential flooding source.

The preliminary model developed for this analysis is based on dated and somewhat course topographic information. During the next phase of analysis, more detailed and accurate topographic data will be required for determining impacts to local water surface elevations.

This review does not address affects from larger flood events, such as those experienced during the 1996 flood or the regulatory 500-year flood. With larger storm events we would expect a more significant change in water surface elevation between the existing and post development conditions.

NEXT STEPS

The following steps are needed to further complete the floodplain analysis tasks associated with the project.

- Obtain more detailed, current, site-specific topographic information for the District and bathymetry data for the Willamette River.
- Work with the project team to develop reasonable site development concepts for the District.
- Using the updated topographic data, and new site development concepts, complete additional hydraulic modeling analysis to compare existing conditions with future development scenarios.
- Review regulatory requirements with the various regulators that have authority for floodplain and riparian development including the City of Lake Oswego, FEMA, Metro, Clackamas County, NOAA Fisheries, etc.
- Develop strategies for addressing all regulatory requirements as part of the District development plan.
- One regulatory requirement that appears particularly challenging at this time would be the requirement by Lake Oswego floodplain ordinance and Metro Title 3 to balance cut and fill within the regulatory floodplain.
- The loss of regulatory floodplain storage volume (through fill or use of levees to protect the District) would result in the need for an equal amount of floodplain excavation, which may be a difficult requirement to meet.

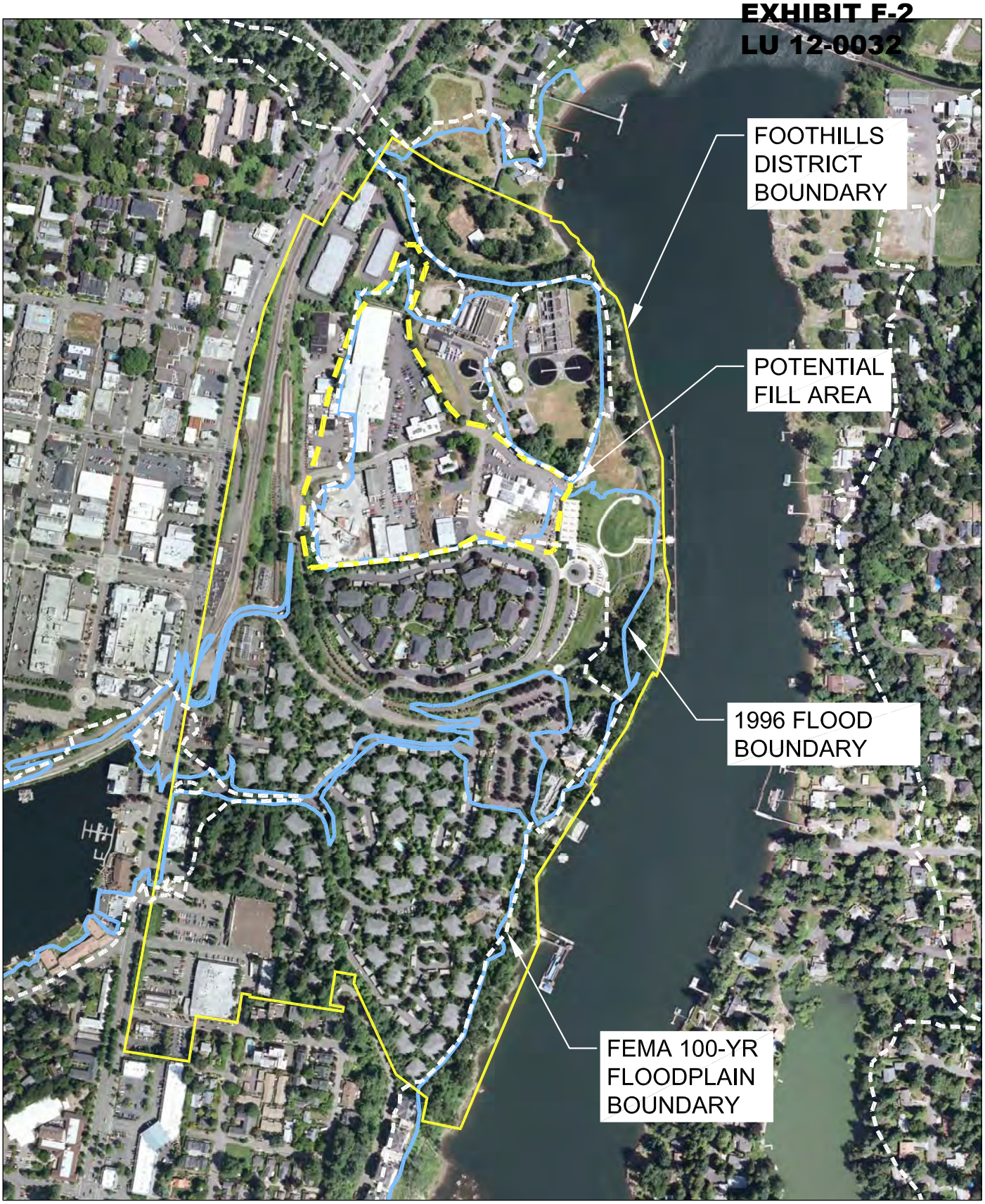
- Develop Strategies for addressing this cut and fill balancing requirement.

EXHIBITS

Attached at the end of this memorandum are exhibits that provide documentation for this preliminary screening analysis as itemized below.

- Figure 1 - Plan view aerial photograph showing the Foothill District Boundary and potential fill placement or levee area, with 100-year floodplain and 1996 flood boundaries shown.
- Figure 2 – Plan view showing the location of HEC-RAS model cross sections.
- Example HEC-RAS hydraulic model output tables, cross sections and river profile. Elevations listed in the attached tables reference NAVD88 datum.

EXHIBIT F-2
LU 12-0032



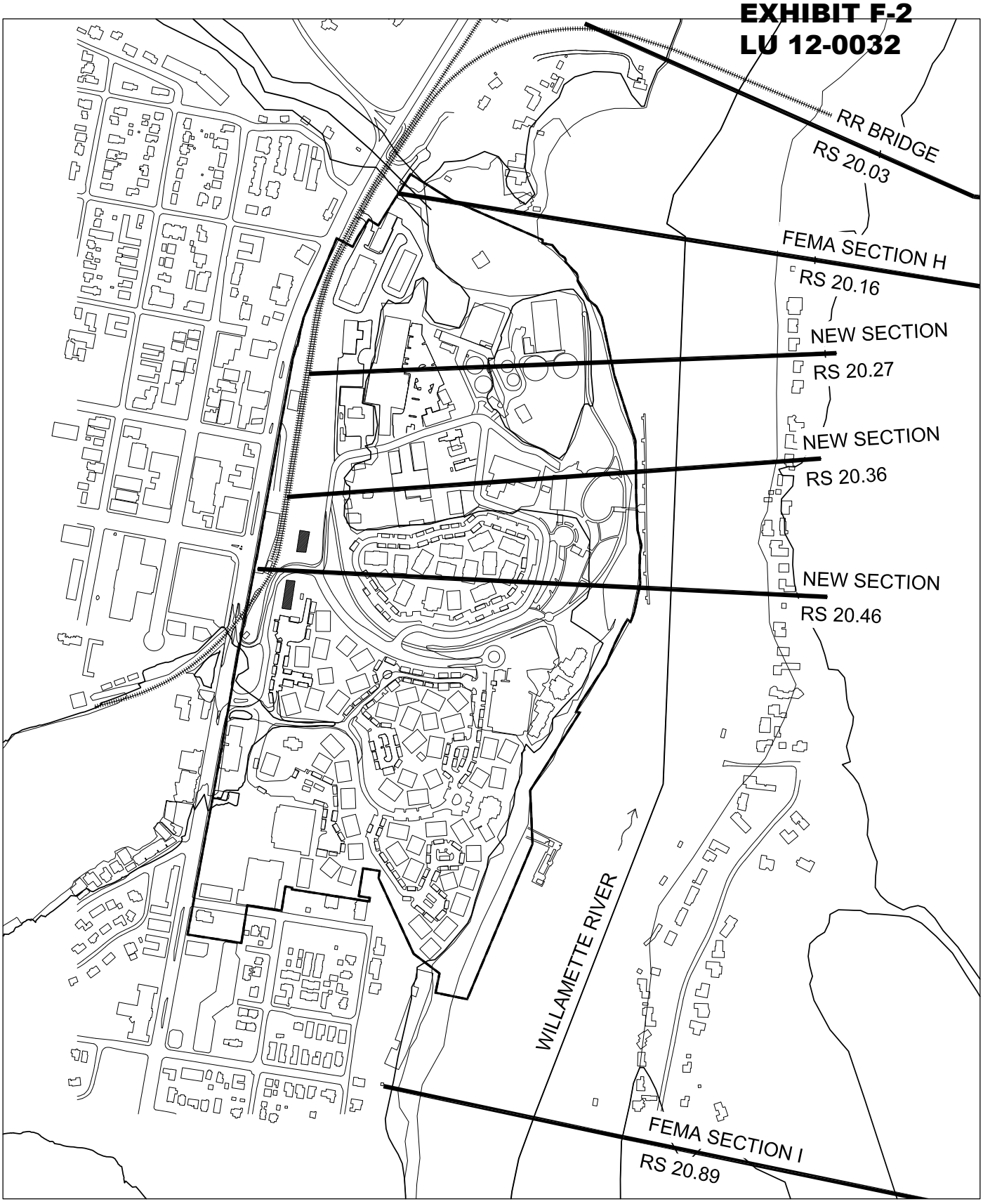
0 250' 500' 1000'

FIGURE 1
FLOODPLAIN BASE MAP

Foothills District Framework Plan
Lake Oswego, Oregon

VIGIL AGRIMIS
design professionals

EXHIBIT F-2
LU 12-0032



DWG: Y:\WDWLO001\CAD\PLOT DWGS\Memo\HEC-RAS Sections.dwg USER: eschultz
DATE: Dec 15, 2010 12:41pm XREFS:TB_Figure_8x11-port EXIST-SITE BASE HEC-BASE

0 300' 600' 1200'

FIGURE 2
HEC-RAS MODEL
CROSS SECTIONS

Foothills District Framework Plan
Lake Oswego, Oregon

VIGIL AGRIMIS
design professionals

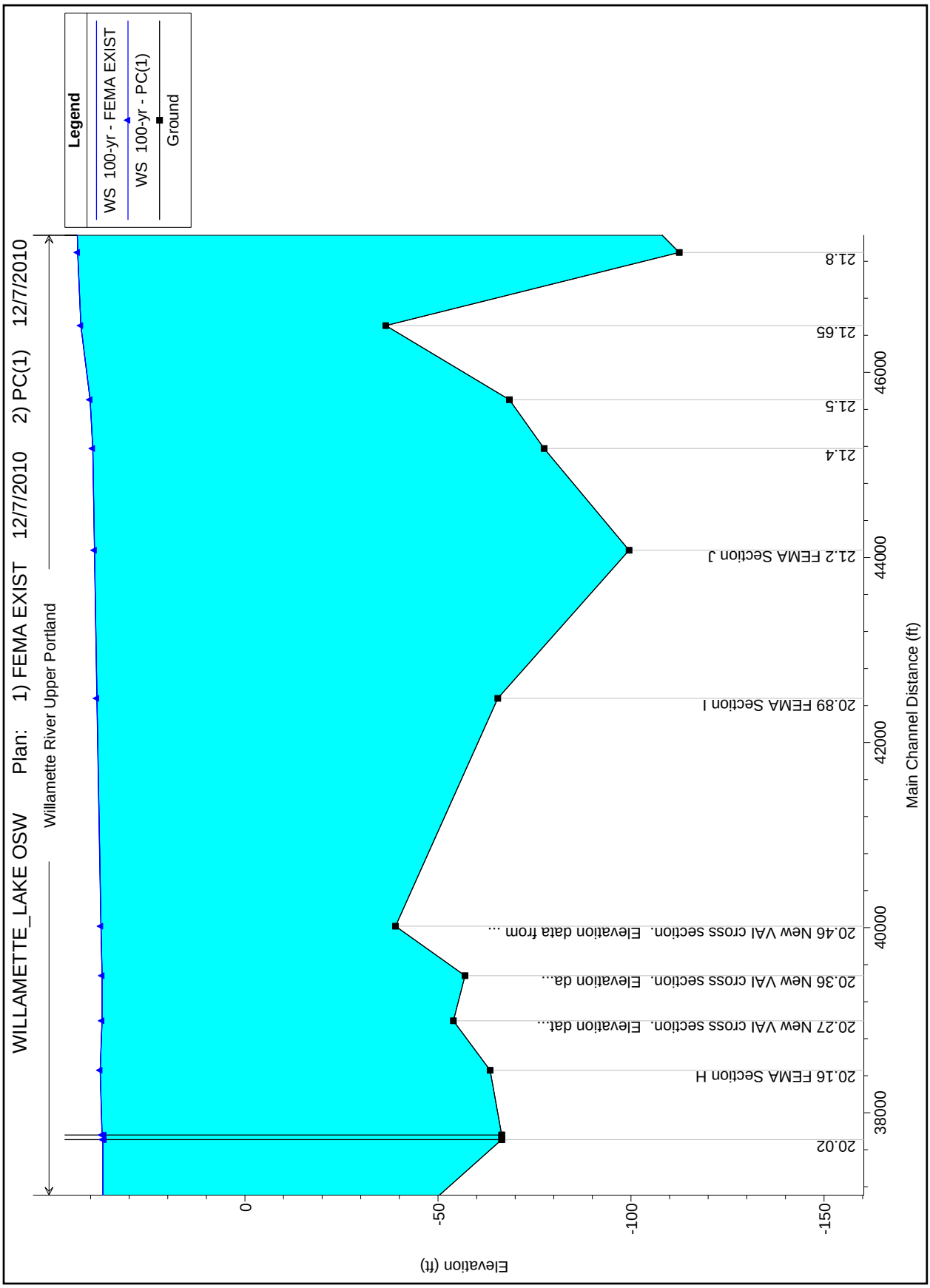
Table 1 - HEC-RAS output data
Plan FEMA EXIST = Existing Conditions Model
Plan PC(1) = Proposed Conditions Model

EXHIBIT F-2
LU 12-0032

HEC-RAS Locations: User Defined Profile: 100-yr

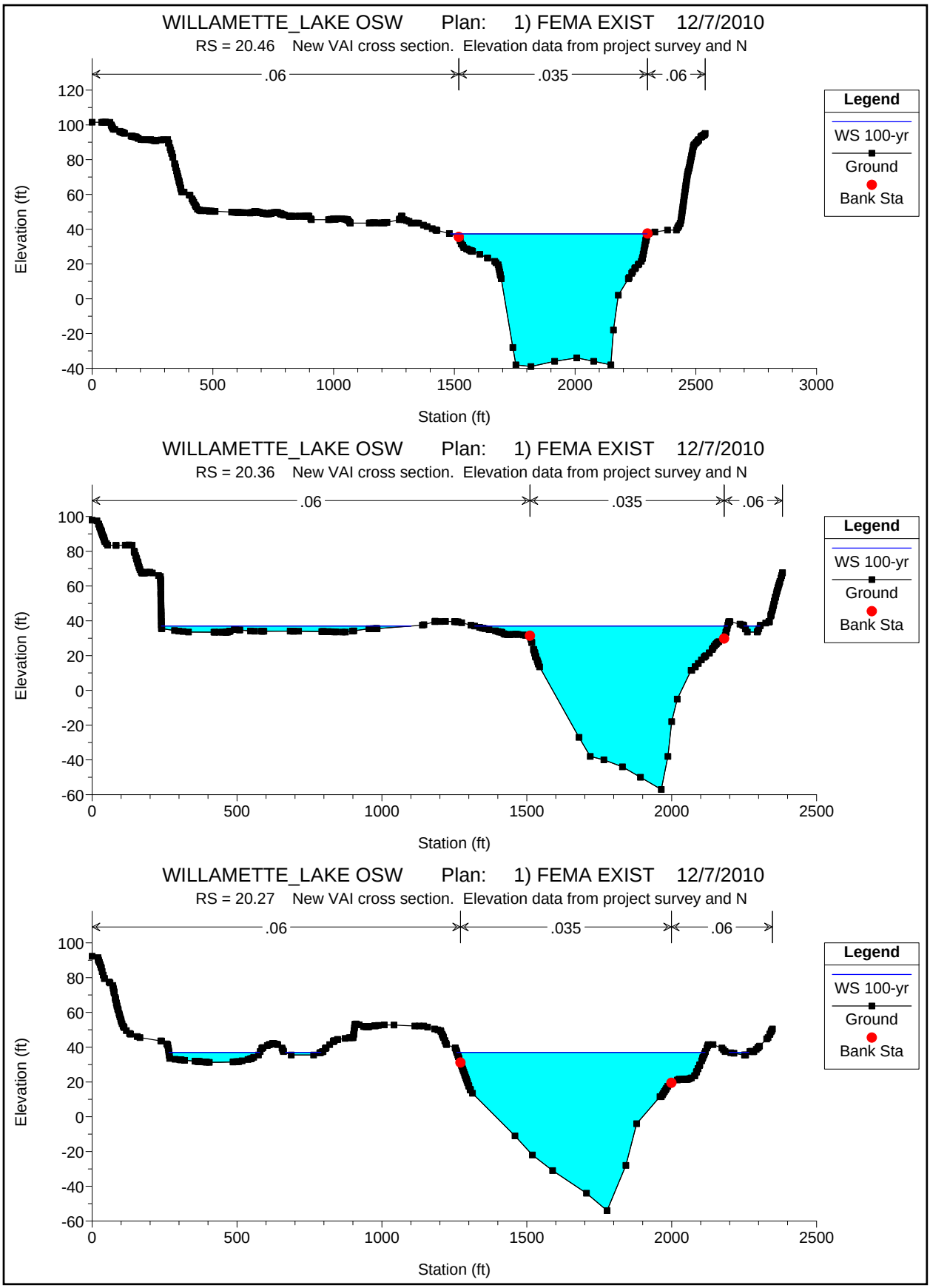
River	Reach	River Sta	Profile	Plan	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
					(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Willamette River	Upper Portland	21.8	100-yr	FEMA EXIST	375000.00	-112.50	43.32		44.03	0.000380	6.81	57456.36	1096.35	0.15
Willamette River	Upper Portland	21.8	100-yr	PC(1)	375000.00	-112.50	43.33		44.04	0.000379	6.81	57466.46	1096.44	0.15
Willamette River	Upper Portland	21.65	100-yr	FEMA EXIST	375000.00	-36.50	42.50		43.51	0.000690	8.10	46936.35	994.91	0.20
Willamette River	Upper Portland	21.65	100-yr	PC(1)	375000.00	-36.50	42.51		43.52	0.000690	8.10	46945.96	994.96	0.20
Willamette River	Upper Portland	21.5	100-yr	FEMA EXIST	375000.00	-68.50	40.11		42.30	0.001310	11.95	33174.12	851.11	0.27
Willamette River	Upper Portland	21.5	100-yr	PC(1)	375000.00	-68.50	40.12		42.31	0.001310	11.95	33183.43	851.16	0.27
Willamette River	Upper Portland	21.4	100-yr	FEMA EXIST	375000.00	-77.50	39.41		41.47	0.001543	11.52	32556.89	636.83	0.28
Willamette River	Upper Portland	21.4	100-yr	PC(1)	375000.00	-77.50	39.42		41.48	0.001542	11.52	32564.15	636.89	0.28
Willamette River	Upper Portland	21.2	100-yr	FEMA EXIST	375000.00	-99.50	38.97		40.04	0.000452	8.34	45248.98	611.26	0.16
Willamette River	Upper Portland	21.2	100-yr	PC(1)	375000.00	-99.50	38.98		40.06	0.000452	8.34	45256.07	611.34	0.16
Willamette River	Upper Portland	20.89	100-yr	FEMA EXIST	375000.00	-65.50	38.34	-5.97	39.49	0.000247	8.63	44116.83	1543.38	0.22
Willamette River	Upper Portland	20.89	100-yr	PC(1)	375000.00	-65.50	38.35	-5.97	39.50	0.000247	8.63	44129.46	1543.60	0.22
Willamette River	Upper Portland	20.46	100-yr	FEMA EXIST	375000.00	-39.00	37.29		38.77	0.000317	9.76	38451.36	815.03	0.25
Willamette River	Upper Portland	20.46	100-yr	PC(1)	375000.00	-39.00	37.31		38.79	0.000317	9.76	38462.09	815.32	0.24
Willamette River	Upper Portland	20.36	100-yr	FEMA EXIST	375000.00	-57.00	37.01		38.60	0.000297	10.15	39809.64	1790.43	0.24
Willamette River	Upper Portland	20.36	100-yr	PC(1)	375000.00	-57.00	36.99		38.61	0.000300	10.21	37523.13	928.08	0.24
Willamette River	Upper Portland	20.27	100-yr	FEMA EXIST	375000.00	-54.00	37.02		38.40	0.000259	9.51	42146.89	1360.87	0.23
Willamette River	Upper Portland	20.27	100-yr	PC(1)	375000.00	-54.00	37.00		38.41	0.000262	9.55	40501.84	924.06	0.23
Willamette River	Upper Portland	20.16	100-yr	FEMA EXIST	375000.00	-63.50	37.50		38.09	0.000080	6.17	61737.45	1990.09	0.13
Willamette River	Upper Portland	20.16	100-yr	PC(1)	375000.00	-63.50	37.50		38.09	0.000080	6.17	61737.45	1990.09	0.13
Willamette River	Upper Portland	20.03	100-yr	FEMA EXIST	375000.00	-66.50	37.01	-20.47	37.98	0.000158	7.91	47427.79	898.47	0.18
Willamette River	Upper Portland	20.03	100-yr	PC(1)	375000.00	-66.50	37.01	-20.47	37.98	0.000158	7.91	47427.79	898.47	0.18
Willamette River	Upper Portland	20.025			Bridge									
Willamette River	Upper Portland	20.02	100-yr	FEMA EXIST	375000.00	-66.50	36.79	-20.47	37.77	0.000159	7.93	47261.16	890.93	0.18
Willamette River	Upper Portland	20.02	100-yr	PC(1)	375000.00	-66.50	36.79	-20.47	37.77	0.000159	7.93	47261.16	890.93	0.18
Willamette River	Upper Portland	19.88	100-yr	FEMA EXIST	375000.00	-46.60	36.81		37.60	0.000142	7.17	54223.14	1476.02	0.17
Willamette River	Upper Portland	19.88	100-yr	PC(1)	375000.00	-46.60	36.81		37.60	0.000142	7.17	54223.14	1476.02	0.17

* Elevations reference NAVD88 datum

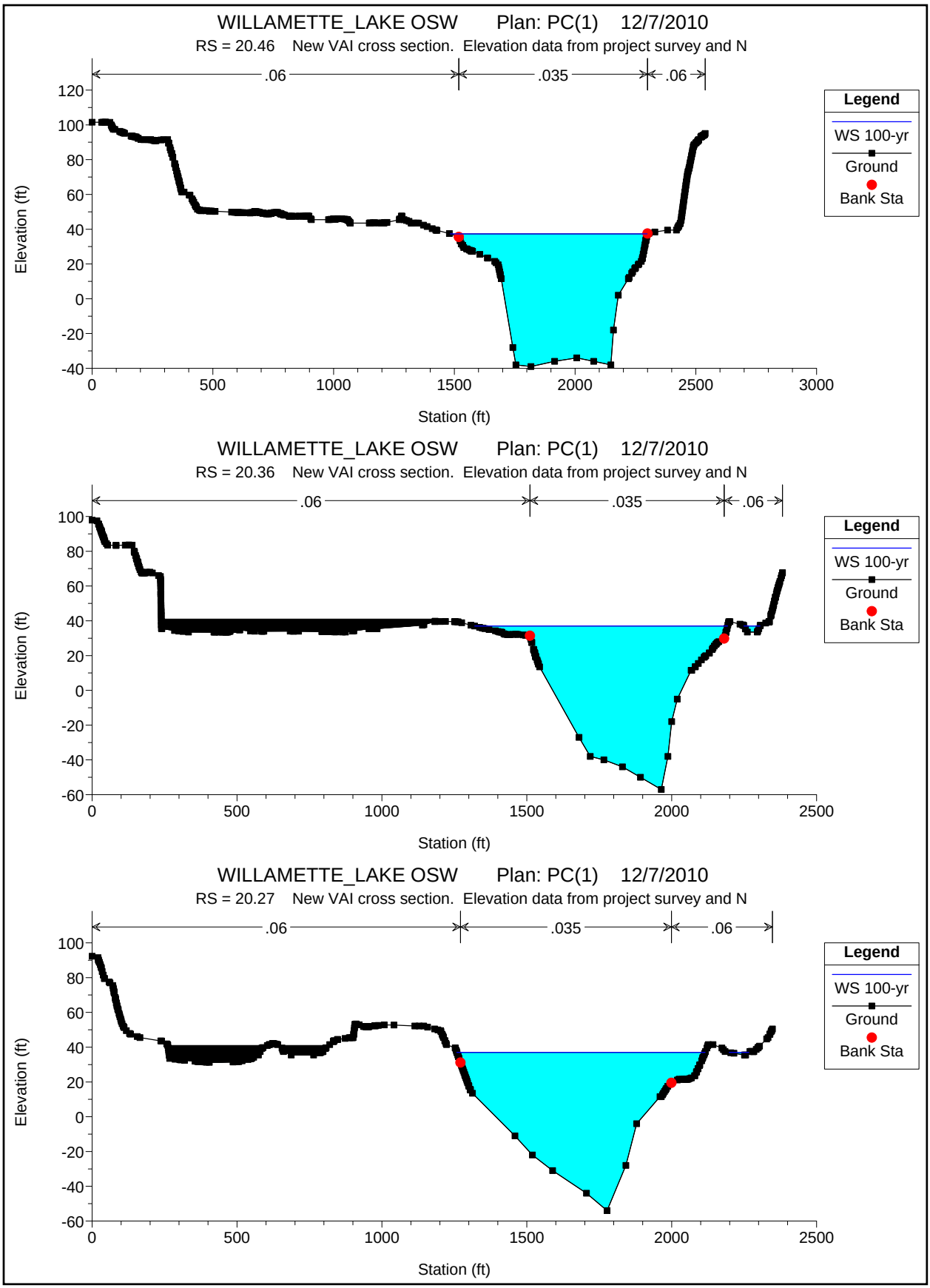


* Elevations reference NAVD88 datum

EXHIBIT F-2
LU 12-0032



* Elevations reference NAVD88 datum



* Elevations reference NAVD88 datum