TECHNICAL MEMORANDUM

Date:	April 21, 2016
To:	Barry O'Regan (KSN)
From:	Sridhar Ponangi, Chris Campbell
Project:	16-1002 – Wallace Weir Fish Rescue Facility
Subject:	DRAFT Flood Impact Assessment

1 INTRODUCTION

This Technical Memorandum (TM) describes the modeling approach and results of the flood impacts assessment conducted to support the US Army Corps of Engineers (USACE) 408 Certification, the Yolo County Flood Hazard Development Permit, and the Central Valley Flood Protection Board (CVFPB) Encroachment Permit for the proposed Wallace Weir Fish Rescue Facility (Project). The Project includes replacement of the existing weir structure at the terminus of Knights Landing Ridge Cut (KLRC) at the Yolo Bypass with operable gates, fish barriers, and a fish collection facility. Based on the results of the hydraulic analysis, it can be concluded that the project will not increase water surface elevations of the design flood event by more than 0.10 feet along KLRC.

2 MODEL DEVELOPMENT

A key component of this assessment was the use of a hydraulic model to evaluate the potential impacts to water levels during the design flood due to the construction of the Project. A one-dimensional (1D) hydraulic model of KLRC was developed in HEC-RAS 4.1. to perform the assessment. Key elements of the hydraulic model development are discussed below. All elevations in this TM are referenced to the North American Vertical Datum of 1988 (NAVD88) in feet.

2.1 GEOMETRY

The hydraulic model prepared to support the flood assessment included the KLRC below County Road 16 bridge and portions of Yolo Bypass, which were derived from the Central Valley Floodplain Evaluation and Delineation (CVFED) HEC-RAS model (Figure 1). The KLRC reach extends from RM 7.13 (just upstream of Hwy 113 bridge crossing) to RM 0.570 while the Yolo Bypass reach extends from RM 54.261 (3,900 feet north of Wallace Weir) to RM 52.059 (8,700 feet south of Wallace Weir). The KLRC reach in

the CVFED model terminates just upstream of the existing Wallace weir and did not include the structure. The KLRC reach was therefore extended approximately 800 feet downstream to capture the existing weir and the proposed relocation of Wallace Weir. The KLRC was extended using cross sections prepared by cbec for the Yolo Bypass Salmonid Habitat Restoration and Fish Passage Project (DWR, in draft) and supplemented with recent survey data collected by DWR North Region Office (NRO) in October 2015 (Figure 1). The extended KLRC reach is connected to the Yolo Bypass cross sections using lateral weirs on the east side (river left) such that flow in excess of channel/weir capacity flows across the agricultural fields. An inline weir was added to the CVFED model (Figure 2(a)) to represent the current Wallace Weir configuration typical of winter conditions when the gates on the 28-foot rectangular opening are fully open and the earthen berm is partially degraded in preparation for the flood season (pers. comm. with John Brennan, Knaggs Ranch, LLC, on February 4, 2016).

The Project conditions geometry (Figures 2(b)(c)) was based on preliminary design drawings prepared by KSN (dated February 2016) and reflects the following design features:

- Two 33.5-foot gate openings with inverts set at 20.83 feet, and one 33.5-foot gate opening with invert set at 16.5 feet; separated by 2-foot thick walls (see Figure 2 (b))
- Gate crest elevation was assumed to be at the proposed upstream road deck elevation of 26.2 feet per preliminary design drawings.
- Six 16-foot wide fish barriers (pickets) separated by 1.5-foot thick walls. Four bays have invert elevations set at 17.7 feet (assuming 6-inch protrusion when the screens are in down position during flood conditions) and two have invert elevations set at 15.7 feet (see Figure 2(c)). The fish barriers are approximately 16-foot wide and maintain a height of 18-inches above the downstream water surface when in the raised position.
- Proposed hardened road crossing with an upstream crest set at 28.2 feet with a 1-foot thick road deck.
- Proposed access road / field berm north of Wallace Weir set to 27.8 feet.
- Channel transition from the downstream end of the fish barrier sill 100 feet wide to the existing channel geometry 200 feet downstream and 30 feet wide.

2.2 ROUGHNESS

The cross sections added to the RAS model to extend KLRC channel in the vicinity of the existing Wallace Weir assumed roughness values consistent with the CVFED cross sections for the KLRC, i.e. 0.035 for the low flow channels and 0.047 for overbank areas. Under project conditions, a roughness value of 0.015 was assumed for cross-sections that represented the gate and fish barrier structure while the remaining cross sections had roughness values similar to the existing conditions.

2.3 BOUNDARY CONDITIONS

Based on DWR communication with US Army Corps of Engineers (USACE) (Meegan G. Nagy, SPK on November 2, 2015), 1957 design flows and stages prepared for the Sacramento River Flood Control

Project were adopted for the flood impact assessment. The 1957 design profiles assume 20,000 cfs along KLRC and 343,000 cfs along the Yolo Bypass between Fremont Weir and KLRC (Figure 1).

The downstream end of the RAS model is 8,700 feet south of Wallace Weir. An interpolated stage of 35.5 feet USED (or 34.25 feet NAVD88) was used assuming a USED to NAVD88 adjustment of -1.25 feet per DWR (see Appendix A).

At the request of upstream landowners, two additional flows were simulated in the model: 4,000 cfs and 10,000 cfs in KLRC. The 4,000 cfs event represents an observed flow condition on 1/3/2006 as derived from TUFLOW model outputs for the Yolo Bypass from the Yolo Bypass Salmonid Habitat Restoration and Fish Passage Project. The 10,000 cfs event represents a hypothetical flow condition outside of the range of measured flows on KLRC. Both flow profiles assumed 203,000 cfs in the Yolo Bypass between Fremont Weir and KLRC and a downstream boundary condition of 32.5 feet NAVD88 as derived from the TUFLOW model on 1/3/2006.

The model was simulated as an unsteady model by incorporating the flows and stages as constant time series. During a typical flood season, the operable gates and picket barriers will be in the raised position to facilitate fish rescue operations, which require varied operations of the operable gates to force water (by gravity) into the fish rescue facility intake. The operable gates are designed to pass 4,000 cfs from KLRC during Fremont Weir non-overtopping conditions. When KLRC flows are greater than 3,800 cfs, all three operable gates are in a lowered positioned. If Fremont Weir is forecasted to overtop, all operable gates and pickets will be in the lowered position. An unsteady approach was used over a steady state approach because of steady state convergence issues with flow over the RAS lateral weirs on the left bank of KLRC between station 0.810 and 0.570. It should be noted that the maximum water surface elevations WSEs occurred during the initial time steps ("warm up period") leading up to the model reaching its stable condition. Therefore, the existing and project WSEs at the end of the simulation period (when flows and WSEs are stable) were compared to evaluate hydraulic impacts, if any, of the proposed project.

3 RESULTS

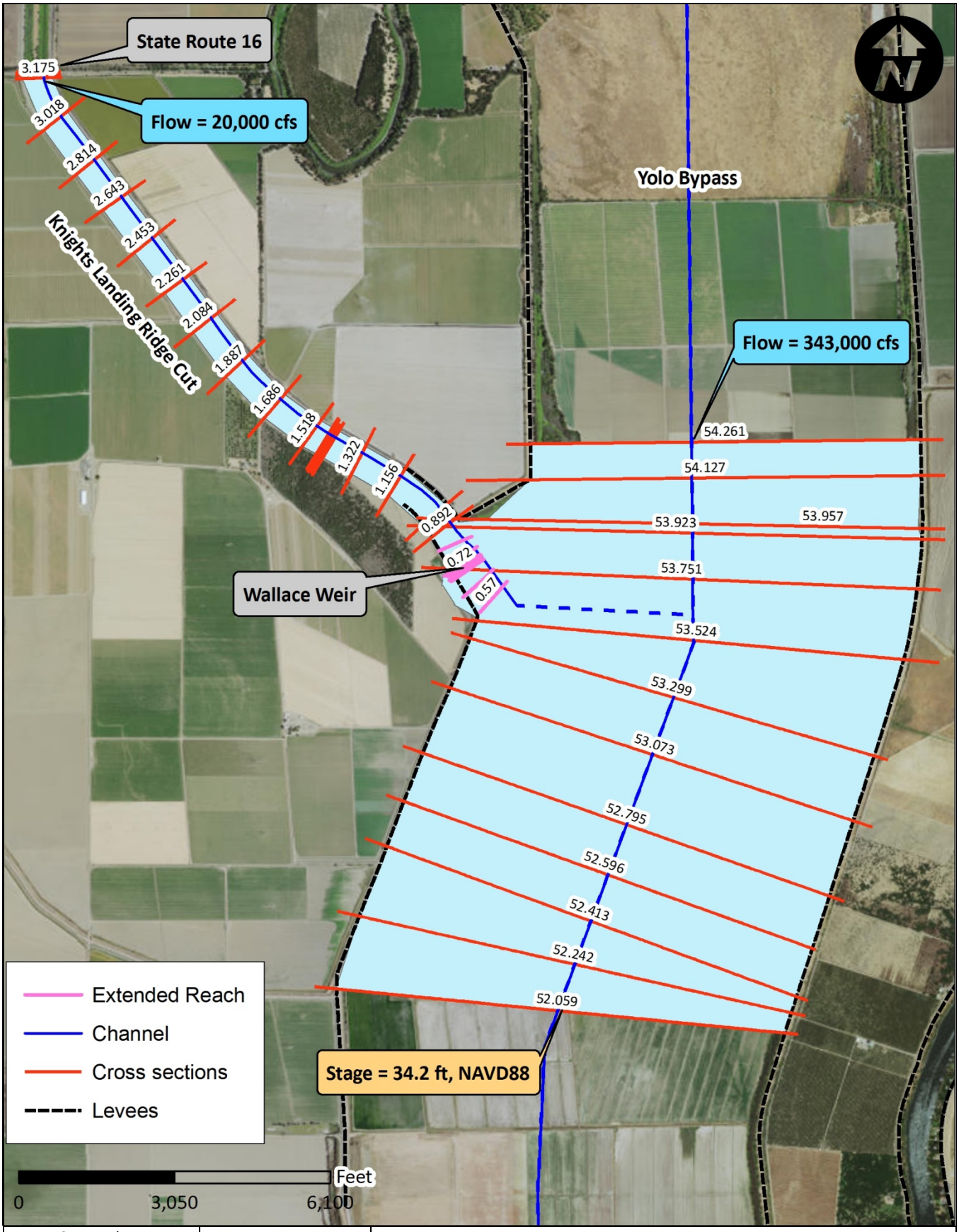
The results of the hydraulic analysis show no rise in water surface elevations under the 1957 design flood conditions and for the 4,000 cfs and 10,000 cfs conditions in the confined reach of KLRC above station 0.810. Table 1 presents the stage at key locations along KLRC. There is less than 0.05 foot rise in water surface elevations just upstream of the weir for the 1957 event and less than 0.01 foot rise for 4,000 cfs and 10,000 cfs. Under existing conditions, the velocity of flow over the berms ranged between 0.5 and 1.0 foot per second, while under project conditions, the velocity ranges between 0.5 and 1.8 feet per second. Detailed tabular results of the HEC-RAS analysis are presented in Appendix B. Based on the results of the hydraulic analysis, it can be concluded that the project will not increase water surface elevations of the design flood event by more than 0.10 feet and so does not have a flood conveyance impact along KLRC.

Sensitivity testing was also conducted to evaluate the impact on stages in KLRC when all gates are closed either due to debris blockage at the gates or pickets or gate malfunction. For simplicity, both of these conditions were represented keeping all three gates fully raised. The results of this testing show that the project will not increase water surface elevations of the design flood event by more than 0.10 feet and so does not have a flood conveyance impact along KLRC upstream of Wallace Weir.

Table 1. Results of the Proposed Wallace Weir Fish Rescue Facility Flood Impact Assessment

Location	Existing WSE (existing gates open)	Project WSE (with all gates open)	Project WSE (with all gates closed)
4,000 cfs			
Downstream of Hwy 113 (Station 7.13)	34.21	34.22	34.22
Downstream of SR 16 (Station 3.175)	33.32	33.32	33.32
Station 0.892	33.19	33.20	33.20
Station 0.810	33.19	33.20	33.20
Station 0.753	33.19	33.20	33.20
Station 0.726	33.19	33.20	33.20
Upstream of Wallace Weir (Station 0.720)	33.19	33.20	33.20
Downstream of Wallace Weir (Station 0.646)	33.18	33.18	33.18
KLRC confluence with Yolo Bypass (Station 0.570)	33.16	33.16	33.16
10,000 cfs			
Downstream of Hwy 113 (Station 7.13)	36.47	36.47	36.47
Downstream of SR 16 (Station 3.175)	33.93	33.93	33.93
Station 0.892	33.24	33.24	33.24
Station 0.810	33.24	33.24	33.24
Station 0.753	33.24	33.25	33.25
Station 0.726	33.25	33.26	33.26
Upstream of Wallace Weir (Station 0.720)	33.25	33.27	33.27
Downstream of Wallace Weir (Station 0.646)	33.23	33.22	33.22
KLRC confluence with Yolo Bypass (Station 0.570)	33.20	33.20	33.20
20,000 cfs			

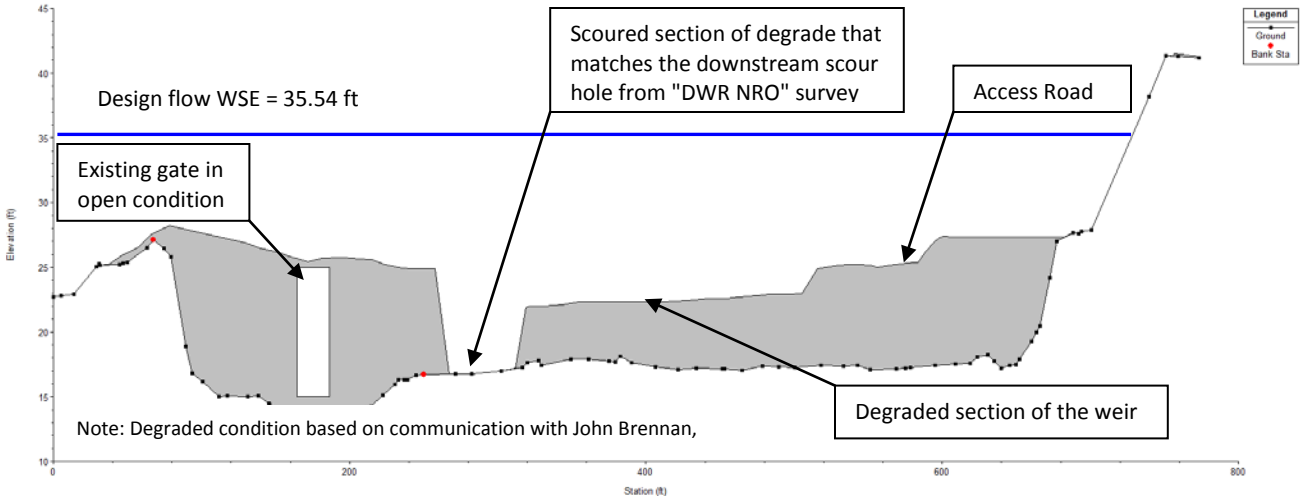
Downstream of Hwy 113 (Station 7.13)	40.77	40.77	40.77
Downstream of SR 16 (Station 3.175)	37.00	37.00	37.00
Station 0.892	35.50	35.50	35.50
Station 0.810	35.50	35.51	35.51
Station 0.753	35.51	35.53	35.53
Station 0.726	35.53	35.56	35.56
Upstream of Wallace Weir (Station 0.720)	35.54	35.57	35.58
Downstream of Wallace Weir (Station 0.646)	35.5	35.49	35.49
KLRC confluence with Yolo Bypass (Station 0.570)	35.43	35.43	35.43



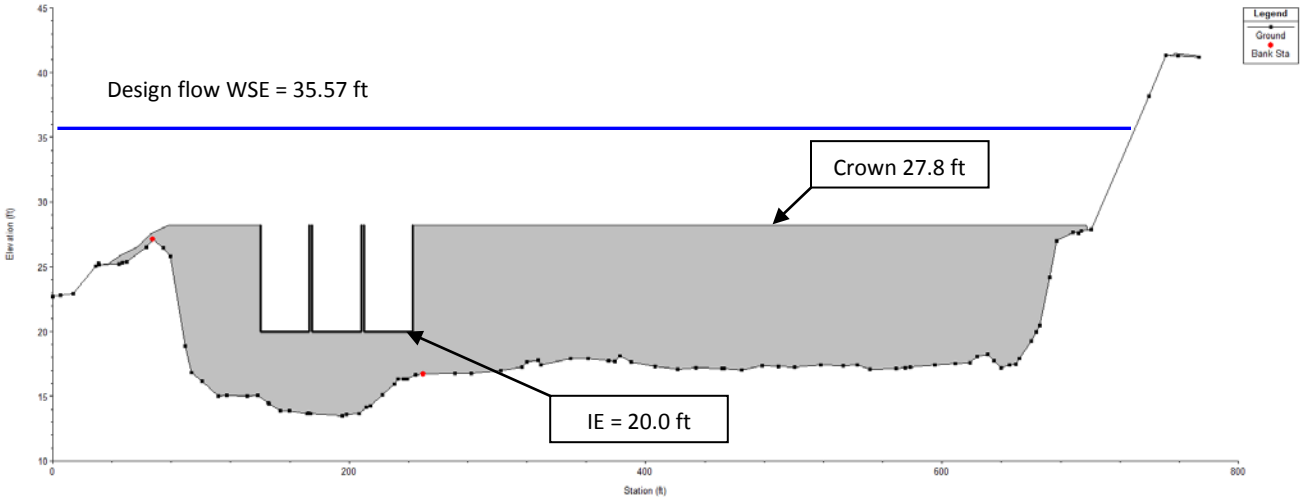
Notes: Source data: CVFED model, cbec prepared cross sections and DWR NRO survey	cbec eco engineering	*Wallace Weir Fish Rescue Facility* **Model extents**		
		Project No. 16-1002	Created By: SP	**Figure 1**

Fig_1_Model_Domain.docx
4/21/2016

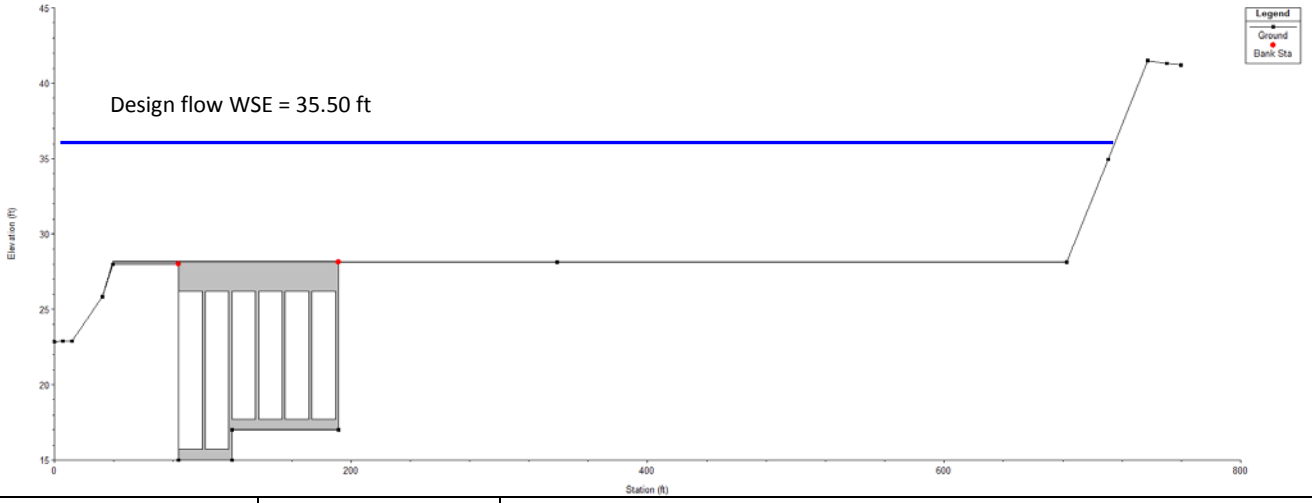
(a) Existing Wallace Weir (Inline Structure 0.712)



(b) Proposed Wallace Weir Gates (Inline Structure 0.712)
Upstream Face at Obermeyer Weirs



(c) Proposed Fish Barrier Structure (Inline Structure 0.707)
Downstream Face at Fish Barrier Pickets



Notes: Left to Right looking downstream

Wallace Weir Fish Rescue Facility

Modeled Wallace Weir Configurations

Project No. 16-1002	Created By: SP	**Figure 2**

APPENDIX A

USED to NAVD88 Datum Conversion

Datum Conversion from U.S.E.D. to NAVD88 at Fremont Weir

The purpose of this document is to describe the estimated conversion of elevations relative to the United States Engineering Datum (U.S.E.D) to the North American Vertical Datum of 1988 (NAVD88). It is important to understand that this conversion is only an estimate and is valid only at a specific location and time which will be described in more detail below.

In order to explain how this conversion was determined, it helps to understand the basis for each of these vertical datums. The U.S.E.D. datum is a tidal datum and is based on mean lowerlow water. Each river system has its own reference point for a basis of measurement, in the case of the Sacramento River the reference point is a tidal station at the Golden Gate. So the zero value for U.S.E.D. along the Sacramento River will not be the same as that of the Klamath River, for example. And as with any tidal datum, it is based on a series of measurements that occurred over a 19 year period known as the National Tidal Datum Epoch. Because of changes in sea level, it is possible for the same point to have a different basis (zero value) depending which epoch is used. Unfortunately, I have not been able to find documentation describing the epoch used as reference for the Fremont Gage or Fremont Weir but I am sure it is not the current epoch of 1983-2001.

The NAVD88 datum is an orthometric vertical reference datum. It uses a single point, called Father Point/Rimouski near the mouth of the St. Lawrence River in Quebec as reference. And although this point is a tidal benchmark, because of variations in tides from north to south and from the east coast to west coast, it is not actually mean sea level for all of North America.

Regardless of the datum, nearly all monuments (physical markers) are subject to some degree of movement. The changes may be localized due to settling, erosion or ground swell, or they may be large scale due to plate tectonics or subsidence. In the case of the Fremont Weir, it is logical to assume the crest was built reasonably close to a constant elevation. But as we look at it today, there are variations along the crest of at least several tenths indicating it has had some localized change. Also, recent extensometer readings in the Yolo Bypass show there may be a significant level of subsidence occurring in the area. All of these factors affect the level of accuracy for the existing monuments as well as the conversion.

At the Fremont Weir, the methodology used to determine the conversion from U.S.E.D. to NAVD88 was based on field observations using known historical elevations. The control point used for determining the NAVD88 elevation was SM NO 15 (PID AI5070). Using Real-Time-Kinematic (RTK) GPS surveying, control points were established near the western portion of the Fremont Weir. Since the primary purpose of the survey at that time was to measure the crest of the weir on the west side and be consistent with previous measurements collected by others on the east side of the weir, the control point elevations were checked and verified against the

previous measurements. Using these control points and an active trackingrobotic total station, a measurement was taken at the staff gage onNovember 14th, 2012. At that time, the staff gage at posted elevation 40.00 was measured and the NAVD88 elevation was determined to be 38.75 feet. From that information the conversion is computed to be:

U.S.E.D – 1.25 ft= NAVD88

This conversion was used to check the elevation of the weir crest and the result appears to be correct.

Because of the variables listed above, it is possible for someone to compute a slightly different conversion. Also, if it has not already been done, it would be advisable to verify that the staff gage at the weir is on the same datum as the Sacramento River at Fremont Weir station (http://cdec4gov.water.ca.gov/cgi-progs/stationInfo?station_id=FRE).

If you have questions regarding this information please contact Jim West (jwest@water.ca.gov /530-529-7317) or Seth Lawrence (Seth.Lawrence@water.ca.gov /530-528-7449).

Jim West
L.S. 7660

The NGS Data Sheet

See file dsdata.txt for more information about the datasheet.

```
PROGRAM = datasheet95, VERSION = 8.8
1        National Geodetic Survey,   Retrieval Date = MARCH  3, 2016
 AI5070 ***********************************************************************
 AI5070  HT_MOD      -  This is a Height Modernization Survey Station.
 AI5070  DESIGNATION -  SM NO 15
 AI5070  PID         -  AI5070
 AI5070  STATE/COUNTY-  CA/YOLO
 AI5070  COUNTRY     -  US
 AI5070  USGS QUAD   -  GRAYS BEND (1975)
 AI5070
 AI5070                        *CURRENT SURVEY CONTROL
 AI5070  ______________________________________________________________________
 AI5070* NAD 83(2011) POSITION- 38 43 51.60578(N) 121 37 59.39431(W)   ADJUSTED
 AI5070* NAD 83(2011) ELLIP HT-   -23.221 (meters)        (06/27/12)   ADJUSTED
 AI5070* NAD 83(2011) EPOCH   -  2010.00
 AI5070* NAVD 88 ORTHO HEIGHT -     7.27  (meters)       23.9   (feet) GPS OBS
 AI5070  ______________________________________________________________________
 AI5070  NAVD 88 orthometric height was determined with geoid model    GEOID09
 AI5070  GEOID HEIGHT    -        -30.543 (meters)                     GEOID09
 AI5070  GEOID HEIGHT    -        -30.484 (meters)                     GEOID12B
 AI5070  NAD 83(2011) X  - -2,612,978.520 (meters)                     COMP
 AI5070  NAD 83(2011) Y  - -4,241,832.367 (meters)                     COMP
 AI5070  NAD 83(2011) Z  -  3,969,051.101 (meters)                     COMP
 AI5070  LAPLACE CORR    -         -1.00  (seconds)                    DEFLEC12B
 AI5070
 AI5070  Network accuracy estimates per FGDC Geospatial Positioning Accuracy
 AI5070  Standards:
 AI5070         FGDC (95% conf, cm)     Standard deviation (cm)     CorrNE
 AI5070            Horiz  Ellip           SD_N   SD_E   SD_h      (unitless)
 AI5070  ------------------------------------------------------------------
 AI5070  NETWORK    0.35   0.55           0.16   0.12   0.28     -0.00934785
 AI5070  ------------------------------------------------------------------
 AI5070  Click here for local accuracies and other accuracy information.
 AI5070
 AI5070
 AI5070.The horizontal coordinates were established by GPS observations
 AI5070.and adjusted by the National Geodetic Survey in June 2012.
 AI5070
 AI5070.NAD 83(2011) refers to NAD 83 coordinates where the reference
 AI5070.frame has been affixed to the stable North American tectonic plate. See
 AI5070.NA2011 for more information.
 AI5070
 AI5070.The horizontal coordinates are valid at the epoch date displayed above
 AI5070.which is a decimal equivalence of Year/Month/Day.
 AI5070
 AI5070.The orthometric height was determined by GPS observations and a
 AI5070.high-resolution geoid model using precise GPS observation and
 AI5070.processing techniques.
 AI5070
 AI5070.Significant digits in the geoid height do not necessarily reflect accuracy.
 AI5070.GEOID12B height accuracy estimate available here.
 AI5070
```

AI5070.The X, Y, and Z were computed from the position and the ellipsoidal ht.
AI5070
AI5070.The Laplace correction was computed from DEFLEC12B derived deflections.
AI5070
AI5070.The ellipsoidal height was determined by GPS observations
AI5070.and is referenced to NAD 83.
AI5070
AI5070. The following values were computed from the NAD 83(2011) position.
AI5070
AI5070;   North   East   Units Scale Factor Converg.
AI5070;SPC CA 2   -   618,211.413 2,031,895.357   MT 0.99993361   +0 13 52.6
AI5070;SPC CA 2   - 2,028,248.61 6,666,310.02   sFT 0.99993361   +0 13 52.6
AI5070;UTM 10   - 4,287,812.958   618,805.946   MT 0.99977381   +0 51 19.0
AI5070
AI5070!   - Elev Factor x Scale Factor =   Combined Factor
AI5070!SPC CA 2   -   1.00000364 x   0.99993361 =   0.99993725
AI5070!UTM 10   -   1.00000364 x   0.99977381 =   0.99977745
AI5070
AI5070   SUPERSEDED SURVEY CONTROL
AI5070
AI5070 NAD 83(2007)- 38 43 51.60561(N)   121 37 59.39391(W) AD(2007.00) 0
AI5070 ELLIP H (02/10/07) -23.227 (m)   GP(2007.00)
AI5070 NAD 83(1998)- 38 43 51.60394(N)   121 37 59.39252(W) AD(2004.69) B
AI5070 ELLIP H (09/28/05) -23.249 (m)   GP(2004.69) 4 1
AI5070 NAD 83(1998)- 38 43 51.60375(N)   121 37 59.39187(W) AD(2002.53) 1
AI5070 ELLIP H (02/03/03) -23.153 (m)   GP(2002.53) 4 1
AI5070 NAD 83(1998)- 38 43 51.60353(N)   121 37 59.39048(W) AD(1999.51) 1
AI5070 ELLIP H (05/12/00) -23.191 (m)   GP(1999.51) 4 1
AI5070 NAVD 88 (02/03/03)   7.33   (m) UNKNOWN model used   GPS OBS
AI5070 NAVD 88 (05/12/00)   7.30   (m) GEOID99 model used   GPS OBS
AI5070
AI5070.Superseded values are not recommended for survey control.
AI5070
AI5070.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.
AI5070.See file dsdata.txt to determine how the superseded data were derived.
AI5070
AI5070_U.S. NATIONAL GRID SPATIAL ADDRESS: 10SFH1880587812(NAD 83)
AI5070
AI5070_MARKER: DD = SURVEY DISK
AI5070_SETTING: 2 = OBJECT DRIVEN INTO GROUND
AI5070_STAMPING: SM NO 15
AI5070_MARK LOGO: CA-113
AI5070_MAGNETIC: N = NO MAGNETIC MATERIAL
AI5070_STABILITY: C = MAY HOLD, BUT OF TYPE COMMONLY SUBJECT TO
AI5070+STABILITY: SURFACE MOTION
AI5070_SATELLITE: THE SITE LOCATION WAS REPORTED AS SUITABLE FOR
AI5070+SATELLITE: SATELLITE OBSERVATIONS - January 01, 2008
AI5070
AI5070 HISTORY   - Date   Condition   Report By
AI5070 HISTORY   - 1999   MONUMENTED   CA-113
AI5070 HISTORY   - 20020826 GOOD   FRAME
AI5070 HISTORY   - 20041005 GOOD   CADT
AI5070 HISTORY   - 20080101 GOOD   FRAME
AI5070
AI5070   STATION DESCRIPTION
AI5070
AI5070'DESCRIBED BY YOLO COUNTY CALIFORNIA 1999
AI5070'THE STATION IS LOCATED ABOUT 9 MI (14.5 KM) NORTHEAST OF WOODLAND,
AI5070'ABOUT 7 MI (11.3 KM) SOUTH OF KNIGHTS LANDING AND ALONG THE EAST SIDE
AI5070'OF THE YOLO BYPASS. TO REACH THE STATION FROM THE INTERSECTION OF
AI5070'INTERSTATE HIGHWAY 5 AND COUNTY ROAD E8, ROAD 102, ABOUT 2 MI (3.2 KM)

AI5070'EAST OF WOODLAND, GO EAST ON HIGHWAY 5 FOR ABOUT 5 MI (8.0 KM) TO THE
AI5070'ROAD 22 OFF-RAMP.TAKE THE OFF-RAMP EAST AND THEN SOUTH FOR 0.2 MI (0.3
AI5070'KM) TO A T-INTERSECTION, ROAD 118. TURN LEFT AND GO EAST FOR 0.5 MI
AI5070'(0.8 KM) TO A T-INTERSECTION, OLD RIVER ROAD. TURN LEFT AND GO
AI5070'NORTHWEST ON OLD RIVER ROAD, PASSING UNDER HIGHWAY 5, FOR 0.2 MI (0.3
AI5070'KM) TO A SIDE ROAD RIGHT, ROAD 117. TURN RIGHT AND GO NORTHERLY ON
AI5070'ROAD 117 FOLLOWING THE WEST BANK OF THE SACRAMENTO RIVER, FOR ABOUT 6
AI5070'MI (9.7 KM) TO A SIDE ROAD LEFT, ROAD 16. TURN LEFT AND GO WEST ON
AI5070'ROAD 16 FOR 2.05 MI (3.30 KM) TO THE BASE OF A LEVEE AND A FORK IN THE
AI5070'ROAD. TAKE THE LEFT FORK AND GO SOUTHWEST FOR 0.05 MI (0.08 KM) TO
AI5070'THE TOP OF THE LEVEE AND A GATE. CONTINUE SOUTH ALONG THE LEVEE ROAD
AI5070'THROUGH THE GATE FOR 1.2 MI (1.9 KM) TO A DIRT SIDE ROAD LEFT AND AN
AI5070'ABANDONED TWO STORY CONCRETE PUMPING PLANT. TURN LEFT AND GO EAST ON
AI5070'THE DIRT ROAD TO THE BASE OF THE LEVEE AND THE STATION ON THE RIGHT.
AI5070'THE STATION IS A YOLO COUNTY SURVEYOR DISK SET INSIDE A WELL CASING
AI5070'WITH THE WORD GROUND ON THE TOP OF THE WELL MONUMENT COVER. IT IS
AI5070'ABOUT 30 M (98.4 FT) EAST OF THE CENTERLINE OF THE LEVEE ROAD, 15.2 M
AI5070'(49.9 FT) NORTHEAST OF THE NORTHEAST CORNER OF THE CONCRETE BUILDING,
AI5070'13.4 M (44.0 FT) NORTH OF THE NORTHWEST CORNER OF A 3 M (9.8 FT) BY 3
AI5070'M (9.8 FT) CORRUGATED METAL BUILDING AT THE HEAD OF AN IRRIGATION
AI5070'CANAL, 7.2 M (23.6 FT) EAST OF THE CENTERLINE OF THE DIRT ROAD, SET
AI5070'ABOUT MIDWAY BETWEEM TWO 0.1 M (0.3 FT) IRON PIPES WHICH PROJECT ABOUT
AI5070'1.2 M (3.9 FT) AND INSIDE THE WELL MONUMENT.
AI5070
AI5070   STATION RECOVERY (2002)
AI5070
AI5070'RECOVERY NOTE BY FRAME SURVEYING AND MAPPING 2002 (JHF)
AI5070'RECOVERED AS DESCRIBED.
AI5070
AI5070   STATION RECOVERY (2004)
AI5070
AI5070'RECOVERY NOTE BY CALTRANS 2004 (RLM)
AI5070'THE STATION WAS RECOVERED AS DESCRIBED. THIS STATION WAS OCCUPIED AS
AI5070'PART OF A CALTRANS NORTH REGION OFFICE OF SURVEYORS GPS HEIGHT
AI5070'MODERNIZATION PROJECT.
AI5070
AI5070   STATION RECOVERY (2008)
AI5070
AI5070'RECOVERY NOTE BY FRAME SURVEYING AND MAPPING 2008 (JHF)
AI5070'RECOVERED AS DESCRIBED.

*** retrieval complete.
Elapsed Time = 00:00:07

APPENDIX B

RAS Model Results

HEC-RAS River: KNI_18020109 Reach: R1 Profile: 26DEC2005 0100

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)	
R1	3.199	26DEC2005 0100	Unstdy_Exst_v2	20000.00	18.40	37.85		37.98	0.000142	3.44	7103.61	519.59	0.14
R1	3.199	26DEC2005 0100	Unstdy_PROj_v2	20000.00	18.40	37.85		37.99	0.000142	3.44	7104.50	519.61	0.14
R1	3.199	26DEC2005 0100	PRJv2_GATESCLOSE	20000.00	18.40	37.85		37.99	0.000142	3.44	7104.50	519.61	0.14
R1	3.198	26DEC2005 0100	Unstdy_Exst_v2	20000.00	18.40	37.85		37.98	0.000142	3.45	7102.74	519.57	0.14
R1	3.198	26DEC2005 0100	Unstdy_PROj_v2	20000.00	18.40	37.85		37.99	0.000142	3.45	7103.62	519.59	0.14
R1	3.198	26DEC2005 0100	PRJv2_GATESCLOSE	20000.00	18.40	37.85		37.99	0.000142	3.45	7103.62	519.59	0.14
R1	3.197			Lat Struct									
R1	3.196			Lat Struct									
R1	3.193	26DEC2005 0100	Unstdy_Exst_v2	20000.00	17.74	37.86	26.41	37.98	0.000131	3.29	7513.23	550.83	0.14
R1	3.193	26DEC2005 0100	Unstdy_PROj_v2	20000.00	17.74	37.86	26.41	37.98	0.000131	3.29	7514.16	550.86	0.14
R1	3.193	26DEC2005 0100	PRJv2_GATESCLOSE	20000.00	17.74	37.86	26.41	37.98	0.000131	3.29	7514.16	550.86	0.14
R1	3.190			Bridge									
R1	3.186	26DEC2005 0100	Unstdy_Exst_v2	20000.00	15.14	36.99		37.12	0.000132	3.38	7381.05	539.43	0.14
R1	3.186	26DEC2005 0100	Unstdy_PROj_v2	20000.00	15.14	36.99		37.12	0.000132	3.38	7381.98	539.45	0.14
R1	3.186	26DEC2005 0100	PRJv2_GATESCLOSE	20000.00	15.14	36.99		37.12	0.000132	3.38	7381.98	539.45	0.14
R1	3.185			Lat Struct									
R1	3.184			Lat Struct									
R1	3.175	26DEC2005 0100	Unstdy_Exst_v2	20000.01	13.30	37.00		37.11	0.000094	3.00	7959.06	534.06	0.12
R1	3.175	26DEC2005 0100	Unstdy_PROj_v2	20000.00	13.30	37.00		37.11	0.000094	3.00	7959.97	534.07	0.12
R1	3.175	26DEC2005 0100	PRJv2_GATESCLOSE	20000.00	13.30	37.00		37.11	0.000094	3.00	7959.98	534.07	0.12
R1	3.018	26DEC2005 0100	Unstdy_Exst_v2	19999.99	15.25	36.90		37.02	0.000110	3.09	7695.07	541.49	0.13
R1	3.018	26DEC2005 0100	Unstdy_PROj_v2	20000.00	15.25	36.91		37.02	0.000110	3.09	7696.02	541.50	0.13
R1	3.018	26DEC2005 0100	PRJv2_GATESCLOSE	20000.00	15.25	36.91		37.02	0.000110	3.09	7696.02	541.50	0.13
R1	3.017			Lat Struct									
R1	2.814	26DEC2005 0100	Unstdy_Exst_v2	20000.00	14.68	36.82		36.91	0.000085	2.82	8502.12	537.69	0.11
R1	2.814	26DEC2005 0100	Unstdy_PROj_v2	20000.00	14.68	36.82		36.91	0.000085	2.82	8503.08	537.70	0.11
R1	2.814	26DEC2005 0100	PRJv2_GATESCLOSE	20000.00	14.68	36.82		36.91	0.000085	2.82	8503.08	537.70	0.11
R1	2.812			Lat Struct									
R1	2.643	26DEC2005 0100	Unstdy_Exst_v2	20000.00	14.72	36.72		36.83	0.000106	3.01	7718.52	529.51	0.12
R1	2.643	26DEC2005 0100	Unstdy_PROj_v2	20000.00	14.72	36.72		36.83	0.000105	3.01	7719.48	529.53	0.12
R1	2.643	26DEC2005 0100	PRJv2_GATESCLOSE	20000.02	14.72	36.72		36.83	0.000105	3.01	7719.48	529.53	0.12
R1	2.641			Lat Struct									
R1	2.453	26DEC2005 0100	Unstdy_Exst_v2	19999.99	15.35	36.61		36.72	0.000104	3.00	7854.77	545.21	0.12
R1	2.453	26DEC2005 0100	Unstdy_PROj_v2	19999.98	15.35	36.61		36.72	0.000104	3.00	7855.78	545.22	0.12
R1	2.453	26DEC2005 0100	PRJv2_GATESCLOSE	20000.01	15.35	36.61		36.72	0.000104	3.00	7855.78	545.22	0.12
R1	2.452			Lat Struct									
R1	2.261	26DEC2005 0100	Unstdy_Exst_v2	20000.00	14.73	36.50		36.61	0.000107	2.99	7724.07	542.48	0.12
R1	2.261	26DEC2005 0100	Unstdy_PROj_v2	20000.01	14.73	36.51		36.62	0.000107	2.99	7725.10	542.49	0.12
R1	2.261	26DEC2005 0100	PRJv2_GATESCLOSE	19999.99	14.73	36.51		36.62	0.000107	2.99	7725.10	542.49	0.12
R1	2.259			Lat Struct									
R1	2.084	26DEC2005 0100	Unstdy_Exst_v2	20000.00	13.74	36.39		36.51	0.000118	3.23	7415.26	522.71	0.13
R1	2.084	26DEC2005 0100	Unstdy_PROj_v2	20000.00	13.74	36.39		36.51	0.000118	3.23	7416.28	522.72	0.13
R1	2.084	26DEC2005 0100	PRJv2_GATESCLOSE	20000.01	13.74	36.39		36.51	0.000118	3.23	7416.28	522.72	0.13
R1	2.082			Lat Struct									
R1	1.887	26DEC2005 0100	Unstdy_Exst_v2	20000.02	13.88	36.25		36.38	0.000126	3.31	7225.76	511.38	0.13
R1	1.887	26DEC2005 0100	Unstdy_PROj_v2	20000.00	13.88	36.26		36.38	0.000126	3.31	7226.78	511.39	0.13
R1	1.887	26DEC2005 0100	PRJv2_GATESCLOSE	20000.00	13.88	36.26		36.38	0.000126	3.31	7226.78	511.39	0.13
R1	1.886			Lat Struct									
R1	1.885			Lat Struct									
R1	1.686	26DEC2005 0100	Unstdy_Exst_v2	19999.99	12.11	36.11		36.24	0.000133	3.49	7021.24	502.84	0.14
R1	1.686	26DEC2005 0100	Unstdy_PROj_v2	20000.01	12.11	36.11		36.25	0.000133	3.49	7022.28	502.85	0.14
R1	1.686	26DEC2005 0100	PRJv2_GATESCLOSE	20000.00	12.11	36.11		36.25	0.000133	3.49	7022.28	502.85	0.14
R1	1.684			Lat Struct									
R1	1.518	26DEC2005 0100	Unstdy_Exst_v2	20000.01	12.87	35.98		36.12	0.000140	3.60	7091.29	529.24	0.14
R1	1.518	26DEC2005 0100	Unstdy_PROj_v2	19999.99	12.87	35.99		36.13	0.000140	3.60	7092.42	529.24	0.14
R1	1.518	26DEC2005 0100	PRJv2_GATESCLOSE	19999.98	12.87	35.99		36.13	0.000140	3.60	7092.42	529.24	0.14
R1	1.466	26DEC2005 0100	Unstdy_Exst_v2	20000.00	13.04	35.94		36.08	0.000145	3.59	7046.50	532.80	0.14
R1	1.466	26DEC2005 0100	Unstdy_PROj_v2	20000.00	13.04	35.94		36.09	0.000145	3.59	7047.64	532.81	0.14
R1	1.466	26DEC2005 0100	PRJv2_GATESCLOSE	19999.99	13.04	35.94		36.09	0.000145	3.59	7047.64	532.81	0.14
R1	1.459	26DEC2005 0100	Unstdy_Exst_v2	20000.00	13.44	35.93		36.08	0.000149	3.65	7053.92	534.17	0.15
R1	1.459	26DEC2005 0100	Unstdy_PROj_v2	19999.99	13.44	35.94		36.08	0.000149	3.65	7055.06	534.18	0.15

HEC-RAS River: KNI_18020109 Reach: R1 Profile: 26DEC2005 0100 (Continued)

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)	
R1	1.459	26DEC2005 0100	PRJv2_GATESCLOSE	19999.99	13.44	35.94		36.08	0.000149	3.65	7055.07	534.18	0.15
R1	1.455			Culvert									
R1	1.451	26DEC2005 0100	Unstdy_Exst_v2	20000.00	12.01	35.84		36.00	0.000155	3.79	6736.86	523.77	0.15
R1	1.451	26DEC2005 0100	Unstdy_PROj_v2	19999.99	12.01	35.84		36.00	0.000155	3.79	6738.00	523.81	0.15
R1	1.451	26DEC2005 0100	PRJv2_GATESCLOSE	19999.99	12.01	35.84		36.00	0.000155	3.79	6738.00	523.81	0.15
R1	1.450			Lat Struct									
R1	1.449			Lat Struct									
R1	1.438	26DEC2005 0100	Unstdy_Exst_v2	20000.00	11.95	35.85		35.99	0.000134	3.49	7025.81	530.40	0.14
R1	1.438	26DEC2005 0100	Unstdy_PROj_v2	20000.00	11.95	35.85		35.99	0.000133	3.49	7026.96	530.41	0.14
R1	1.438	26DEC2005 0100	PRJv2_GATESCLOSE	19999.99	11.95	35.85		35.99	0.000133	3.49	7026.96	530.41	0.14
R1	1.322	26DEC2005 0100	Unstdy_Exst_v2	19999.99	12.52	35.78		35.90	0.000129	3.26	7339.26	557.59	0.14
R1	1.322	26DEC2005 0100	Unstdy_PROj_v2	20000.02	12.52	35.78		35.91	0.000129	3.26	7340.49	557.60	0.14
R1	1.322	26DEC2005 0100	PRJv2_GATESCLOSE	20000.01	12.52	35.78		35.91	0.000129	3.26	7340.49	557.60	0.14
R1	1.156	26DEC2005 0100	Unstdy_Exst_v2	20000.00	12.71	35.67		35.79	0.000125	3.18	7421.96	561.21	0.13
R1	1.156	26DEC2005 0100	Unstdy_PROj_v2	20000.01	12.71	35.67		35.79	0.000125	3.18	7423.22	561.22	0.13
R1	1.156	26DEC2005 0100	PRJv2_GATESCLOSE	19999.98	12.71	35.67		35.79	0.000125	3.18	7423.22	561.22	0.13
R1	1.155			Lat Struct									
R1	1.154			Lat Struct									
R1	0.962	26DEC2005 0100	Unstdy_Exst_v2	20000.00	12.62	35.54		35.66	0.000132	3.27	7418.10	560.67	0.14
R1	0.962	26DEC2005 0100	Unstdy_PROj_v2	19999.99	12.62	35.54		35.67	0.000132	3.27	7419.41	560.68	0.14
R1	0.962	26DEC2005 0100	PRJv2_GATESCLOSE	20000.00	12.62	35.54		35.67	0.000132	3.27	7419.41	560.68	0.14
R1	0.892	26DEC2005 0100	Unstdy_Exst_v2	20000.00	12.62	35.50		35.62	0.000133	3.28	7393.50	560.48	0.14
R1	0.892	26DEC2005 0100	Unstdy_PROj_v2	20000.00	12.62	35.50		35.62	0.000133	3.28	7394.89	560.49	0.14
R1	0.892	26DEC2005 0100	PRJv2_GATESCLOSE	20000.01	12.62	35.50		35.62	0.000133	3.28	7394.88	560.49	0.14
R1	0.891			Lat Struct									
R1	0.89			Lat Struct									
R1	0.810	26DEC2005 0100	Unstdy_Exst_v2	18001.92	16.29	35.50		35.58	0.000110	2.62	8106.20	646.50	0.12
R1	0.810	26DEC2005 0100	Unstdy_PROj_v2	18005.14	16.29	35.51		35.59	0.000110	2.62	8107.45	646.51	0.12
R1	0.810	26DEC2005 0100	PRJv2_GATESCLOSE	18000.31	16.29	35.51		35.59	0.000110	2.62	8107.53	646.51	0.12
R1	0.809			Lat Struct									
R1	0.808			Lat Struct									
R1	0.753	26DEC2005 0100	Unstdy_Exst_v2	16110.54	16.29	35.51		35.57	0.000083	2.27	8107.93	646.51	0.10
R1	0.753	26DEC2005 0100	Unstdy_PROj_v2	14651.39	16.29	35.53		35.59	0.000068	2.06	8125.11	646.59	0.09
R1	0.753	26DEC2005 0100	PRJv2_GATESCLOSE	14591.15	16.29	35.53		35.59	0.000068	2.05	8125.70	646.59	0.09
R1	0.726	26DEC2005 0100	Unstdy_Exst_v2	14576.27	16.60	35.53		35.57	0.000058	2.02	9148.81	657.34	0.09
R1	0.726	26DEC2005 0100	Unstdy_PROj_v2	12280.97	16.60	35.56		35.59	0.000041	1.70	9171.16	657.45	0.07
R1	0.726	26DEC2005 0100	PRJv2_GATESCLOSE	12210.25	16.60	35.56		35.59	0.000041	1.69	9171.72	657.46	0.07
R1	0.720	26DEC2005 0100	Unstdy_Exst_v2	14025.83	13.49	35.54	22.00	35.57	0.000027	1.54	11547.71	662.19	0.06
R1	0.720	26DEC2005 0100	Unstdy_PROj_v2	11672.64	13.49	35.57	21.68	35.59	0.000019	1.27	11539.18	653.21	0.05
R1	0.720	26DEC2005 0100	PRJv2_GATESCLOSE	11599.75	13.49	35.58	21.66	35.59	0.000018	1.27	11539.66	653.21	0.05
R1	0.712			Inl Struct									
R1	0.709	26DEC2005 0100	Unstdy_Exst_v2	14025.83	13.84	35.50		35.53	0.000053	2.01	9547.17	669.64	0.08
R1	0.709	26DEC2005 0100	Unstdy_PROj_v2	11672.64	20.00	35.48		35.57	0.000026	2.77	5379.71	622.56	0.12
R1	0.709	26DEC2005 0100	PRJv2_GATESCLOSE	11599.75	20.00	35.48		35.56	0.000026	2.76	5379.38	622.56	0.12
R1	0.7089			Lat Struct									
R1	0.7088			Lat Struct									
R1	0.707	26DEC2005 0100	Unstdy_PROj_v2	11672.64	15.00	35.49	23.47	35.57	0.000020	2.66	5780.07	622.57	0.11
R1	0.707	26DEC2005 0100	PRJv2_GATESCLOSE	11599.75	15.00	35.49	23.44	35.56	0.000020	2.65	5779.69	622.57	0.11
R1	0.703	26DEC2005 0100	Unstdy_Exst_v2	13907.64	13.84	35.50		35.53	0.000052	1.99	9546.77	669.64	0.08
R1	0.697	26DEC2005 0100	Unstdy_PROj_v2	11672.64	15.00	35.49		35.52	0.000036	1.64	9172.56	633.35	0.07
R1	0.697	26DEC2005 0100	PRJv2_GATESCLOSE	11599.75	15.00	35.49		35.52	0.000035	1.63	9172.48	633.35	0.07
R1	0.646	26DEC2005 0100	Unstdy_Exst_v2	13021.42	15.93	35.50		35.52	0.000043	1.63	10037.40	716.53	0.07
R1	0.646	26DEC2005 0100	Unstdy_PROj_v2	11398.34	15.93	35.49		35.51	0.000033	1.43	10035.10	716.51	0.06
R1	0.646	26DEC2005 0100	PRJv2_GATESCLOSE	11341.08	15.93	35.49		35.51	0.000033	1.42	10035.02	716.51	0.06
R1	0.570	26DEC2005 0100	Unstdy_Exst_v2	17800.64	15.39	35.43		35.48	0.000073	2.30	10733.29	758.07	0.10
R1	0.570	26DEC2005 0100	Unstdy_PROj_v2	16657.35	15.39	35.43		35.47	0.000064	2.15	10733.29	758.07	0.09
R1	0.570	26DEC2005 0100	PRJv2_GATESCLOSE	16616.67	15.39	35.43		35.47	0.000063	2.14	10733.29	758.07	0.09