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Ex. 280-US-470

Oregon Department of Fish and Wildlife

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Stream **Sprague River**  
 Site: **SP13 (Upper Five Mile Creek)**  
 Habitat Type: **Run**

Data Files Reviewed: CD1: BIA\Lfim\60177.19\KPK\60177.13\MSQFILES\SP13RN1M.MSQ  
 CD1: BIA\Lfim\60177.19\KPK\60177.13\MSQFILES\SP13RN2M.MSQ  
 CD1: BIA\Lfim\60177.19\KPK\60177.13\MSQFILES\SP13RN3M.MSQ  
  
 CD1: BIA\Lfim\60177.19\KPK\60177.13\I4FFILES\SP13RN1M.I4F  
 CD1: BIA\Lfim\60177.19\KPK\60177.13\I4FFILES\SP13RN2M.I4F  
 CD1: BIA\Lfim\60177.19\KPK\60177.13\I4FFILES\SP13RN3M.I4F

**Data Entry:**

**For 9/23/1990 and 4/14/1991 surveys:** X-sectional data, level loop data, water surface elevation data, Benchmark, working pin, head pin were all check-marked on the worksheet of "Round 1." Errors in the Round 1 were corrected in the "Round 2" worksheets. Assumed all data were checked thoroughly with errors corrected. Therefore, data entry and checking are skipped in the current review. Performed spot-checks for cell discharge and found no errors.

**For 5/14/93 survey:** There was no complete data entry worksheet (level loop, WSE, X-section, V-D) for this survey.

**Level Loop:**

- (1) 9/23/1990: Loop was closed. Level loop survey checked.  
Elevations of BM and all HP's in the first shot were the same as those in the second shot.
- (2) 4/14/1991: Loop was closed. Level loop survey checked.  
Elevations of BM and all HP's in the first shot were the same as those in the second shot.
- (3) 5/14/1993: Loop was closed. Level loop survey checked using the field notes.  
Elevations of BM and HP-2 in the second shot were both 0.01ft lower than those in the first shot.  
Elevation of HP-3 in the second shot was 0.01ft higher than that in the first shot.  
Errors within acceptable range.

**Table: Summary of HP elevations and WSE**

Flow Regime	Survey Date	meas. left-WSE(ft)			meas. mid-WSE(ft)			meas. right-WSE(ft)			ave measured WSE(ft)		
		TR-1	TR-2	TR-3	TR-1	TR-2	TR-3	TR-1	TR-2	TR-3	TR-1	TR-2	TR-3
Low	09/23/1990	97.34	97.37	97.52				97.36	97.38	97.53	97.35	97.38	97.53
Mid	04/14/1991	97.21	97.29	97.40				97.24	97.30	97.38	97.23	97.30	97.39
High	05/14/1993	97.30	97.32	97.43				97.30	97.33	97.43	97.30	97.33	97.43

Flow Regime	Survey Date	Discharge (cfs)				WSE for calibration (ft)			Calibrated WSE (ft)		
		TR-1	TR-2	TR-3	Ave	TR-1	TR-2	TR-3	TR-1	TR-2	TR-3
Low	09/23/1990	19.3	19.7	17.5	18.8	97.35	97.38	97.53	97.20	97.25	97.34
Mid	04/14/1991	20.1	21.0	21.3	20.8	97.24	97.29	97.39	97.24	97.29	97.39
High	05/14/1993				24.0	97.30	97.33	97.43	97.30	97.36	97.46

Flow Regime	Survey Date	Calibration Error (ft)			Calibration Method			HP Elevation (ft)		
		TR-1	TR-2	TR-3	TR-1	TR-2	TR-3	TR-1	TR-2	TR-3
Low	09/23/1990	0.15	0.13	0.19	Mansq	Mansq	Mansq	98.21	98.35	98.83
Mid	04/14/1991	0.00	0.00	0.00	Mansq	Mansq	Mansq	98.17	98.32	99.67
High	05/14/1993	0.00	-0.03	-0.03	Mansq	Mansq	Mansq	98.18	98.24	99.69

TR	Channel Invert (ft)	SZF (ft)	MANSQ	
			flow	β
TR-1	96.1	96.10	Mid	-0.28
TR-2	96.1	96.10	Mid	-0.35
TR-3	95.9	95.90	Mid	-0.80

**Calibration Method:**

The WSE calibration method was MANSQ for all transects (of low-flow and mid-flow), based on following reasons.  
 --- The "Verification of the final I4F files used for flow claims" results show the above three I4F files are the final PHABSIM data decks.  
 --- There are WSL lines in all 3 I4F files. Used the three MSQ files to regenerate WSE data, and the regenerated WSEs were identical to the ones in the WSL lines of I4F files. Therefore it can be concluded MANSQ was used for WSE calibration.

**Flow:**

- (1) The three surveys conducted on 9/23/90, 4/14/91, and 5/14/93 were designated as low flow, mid flow, and high flow,

respectively.

- (2) There was no complete data entry worksheet (level loop, WSE, X-section, V-D) for the survey conducted on 5/14/93.
- (3) Calculated high flow discharge (5/14/93) was 24.68cfs for Run habitat and was 23.7cfs for Riffle habitat, and the average discharge was 24.19cfs for the two habitats. The high flow discharge used in the I4F files was 24.0cfs. There was no document explaining the origination of the 24cfs in the site folder.

**Water Surface Elevation (WSE):**

- (1) The differences between the measured WSEs of the two sides of the channel were no more than 0.03ft, which was considered reasonable.

**Headpins (HP):**

- (1) HP elevations are not consistent from one survey to another. This indicated the either HP's or BM, or both were disturbed. The disturbance certainly introduced errors into measured WSEs for some transects.

**Notes:**

- (1) WSE is the acronym for water surface elevation  
HP is the acronym for head pin. HP-x is the HP for transect x, where x=1,2, or 3.  
HI is the acronym for height of Instrument  
BM is the acronym for Benchmark  
SZF is the acronym of Stage of Zero Flow
- (2) Maximum WSE calibration error was 0.15ft for low flow condition. From the HP surveys, it showed there was a major shift of BM/HP's elevations between 9/23/90 and 4/14/91 surveys. After 4/14/91 survey, all pins stabilized, except HP-2 which had 0.08ft change from 4/14/91 to 5/14/93. Since WSE's were based on BM, the elevation change of HP-2 should not affect the measured WSEs. It is ok to use only mid flow (4/14/91) and high flow (5/14/93) along with MANSQ for WSE calibration.
- (3) A plot of calibrated WSE is provided in Sheet "EA WSE", showing no crossings between any 2 WSE lines.
- (4) The first two title lines of all three I4F files were re-arranged to match the format required by the graph program. Such re-arrangement will not affect the calibration result at all.  
EA's 30 simulation flows didn't include the measured mid and high flows. Thus the simulation flows most close to the measured flows were replaced by the measured flows in this review. In both I4F files and MSQ files, simulation flow 19.0cfs was replaced by measured flow 18.8cfs, and 20cfs was replaced by 20.8cfs.
- (5) EA modeler used energy slope=0.0025, but the site folder didn't include the information regarding the estimate of energy slope. The distance between TR-1 and TR-3 and their WSE elevation difference can be used to approximate the energy slope for this habitat.
- (6) The stages of zero flow (SZF) were 96.10ft, 96.10ft, and 95.9ft for TR-1, Tr-2, and TR-3, respectively, and they were the same as the inverts of the three transects. Though SZF of TR-3 had the lowest elevation, this was not important in this case because SZF's were indifferent when MANSQ was employed for WSE calibration.
- (7) There are HEC-2 analysis results included in the site folder, but there is no document showing when and why the HEC-2 analysis was performed, or whether the HEC-2 result was used.

**Problem Summary/Suggestions:**

- (1) Justify the energy slope=0.0025 used by the EA modeler. The measured WSE slope computed using the WSE difference and the distance between TR-3 and TR-1 can be used as the energy slope.
- (2) Provide complete 1-2-3-type data entry worksheets for the high flow survey (5/14/93).
- (3) For high flow, the calculated discharge was 24.68cfs, but 24.00cfs was used in the calibration. The difference won't impact the WSE if the WSE calibration result significantly, but recommend use the average discharge of run and riffle habitats for future re-calibration, if needed. The (calculated) discharge for riffle habitat was 23.70cfs (see Riffle habitat Excel file), and the average discharge of the two habitats was 24.19cfs.
- (4) For TR-3, Froude number decreased while flows increased at  $Q > 48$ cfs. This trend should be ok because of the shape of the transect.
- (5) This site had only two valid WSE ~ Q relationships (low-Q was considered invalid), but the WSE calibration results seem satisfactory.

Stream: **Sprague River**  
 Site: **SP13 (Upper Five Mile Creek)**  
 Habitat: **Run**  
 Transect: **1**

```

Sprague River SP13 04/14/91
RUN MID TRANSECT 1
IOC 1100000100001010100000
NMAX 0.05 0.037
QARD 10.0
QARD 11.0
QARD 12.0
QARD 13.0
QARD 14.0
QARD 15.0
QARD 16.0
QARD 17.0
QARD 18.0
QARD 18.8
QARD 20.8
QARD 22.0
QARD 24.0
QARD 26.0
QARD 30.0
QARD 32.0
QARD 34.0
QARD 36.0
QARD 38.0
QARD 40.0
QARD 42.0
QARD 44.0
QARD 46.0
QARD 48.0
QARD 50.0
QARD 52.0
QARD 54.0
QARD 56.0
QARD 58.0
QARD 60.0
XSEC1000.0 0.00 1.0 96.10 0.0025
1000.0 0.0 98.1 3.0 97.3 3.2 97.2 4.0 96.8 5.0 96.7 6.0 96.7
1000.0 7.0 96.6 8.0 96.5 9.0 96.5 10.0 96.5 11.0 96.4 12.0 96.4
1000.0 13.0 96.3 14.0 96.2 15.0 96.1 16.0 96.1 17.0 96.2 18.0 96.3
1000.0 19.5 97.2 20.0 98.8 23.3 99.3
NS 1000.0 1.0 1.0 1.2 1.2 4.3
NS 1000.0 4.3 4.3 4.3 4.3 4.3
NS 1000.0 4.3 4.3 4.3 4.3 4.3
NS 1000.0 4.3 1.0 1.0
WSL 1000.0 96.97 97.00 97.03 97.06 97.08 97.11
WSL 1000.0 97.13 97.16 97.18 97.20 97.24 97.26
WSL 1000.0 97.30 97.34 97.41 97.45 97.48 97.51
WSL 1000.0 97.54 97.57 97.60 97.63 97.66 97.68
WSL 1000.0 97.71 97.74 97.76 97.79 97.81 97.84
CAL11000.0 97.24 20.80
VEL11000.0 0.00 0.23 0.93 1.32 1.56 1.72 1.90 1.93 1.91 2.18
VEL11000.0 1.80 2.13 1.86 1.95 1.51 0.56 0.00
CAL21000.0 97.35 18.80
VEL21000.0
VEL21000.0
CAL31000.0 97.30 24.00
VEL31000.0
VEL31000.0
ENDJ

```

Stream: **Sprague River**  
 Site: **SP13 (Upper Five Mile Creek)**  
 Habitat: **Run**  
 Transect: **2**

```

                Sprague River SP13 04/14/91
RUN                MID                TRANSECT 2
IOC                1100000100001010100000
NMAX                0.08      0.041
QARD 10.0
QARD 11.0
QARD 12.0
QARD 13.0
QARD 14.0
QARD 15.0
QARD 16.0
QARD 17.0
QARD 18.0
QARD 18.8
QARD 20.8
QARD 22.0
QARD 24.0
QARD 26.0
QARD 30.0
QARD 32.0
QARD 34.0
QARD 36.0
QARD 38.0
QARD 40.0
QARD 42.0
QARD 44.0
QARD 46.0
QARD 48.0
QARD 50.0
QARD 52.0
QARD 54.0
QARD 56.0
QARD 58.0
QARD 60.0
XSEC1000.0        0.00 1.0      96.10      0.0025
  1000.0  0.0 98.2  2.0 97.9  2.2 97.3  4.0 97.0  5.0 96.8  6.0 96.8
  1000.0  7.0 96.7  8.0 96.6  9.0 96.6 10.0 96.5 11.0 96.3 12.0 96.3
  1000.0 13.0 96.2 14.0 96.3 15.0 96.1 16.0 96.1 17.0 96.1 18.0 96.1
  1000.0 19.0 96.3 20.0 96.4 21.0 96.6 22.4 97.3 23.0 98.0 27.6 99.6
NS 1000.0          1.0      1.0      1.2      1.2      1.2      3.4
NS 1000.0          4.3      4.3      4.3      4.3      4.3      4.3
NS 1000.0          3.4      3.4      3.4      3.4      3.4      3.4
NS 1000.0          9.0      2.9      2.9      2.9      1.0      1.0
WSL 1000.0         97.00    97.03    97.06    97.09    97.12    97.15
WSL 1000.0         97.18    97.20    97.23    97.25    97.29    97.32
WSL 1000.0         97.36    97.40    97.47    97.50    97.54    97.57
WSL 1000.0         97.60    97.63    97.66    97.69    97.72    97.75
WSL 1000.0         97.77    97.80    97.83    97.85    97.88    97.90
CAL11000.0         97.29    20.80
VEL11000.0          0.00 0.46 0.96 1.22 1.41 1.42 1.67 1.82 1.62 1.80
VEL11000.0  1.71 1.84 1.85 1.14 1.33 1.47 0.96 0.61 0.07 0.00
CAL21000.0         97.38    18.80
VEL21000.0
VEL21000.0
CAL31000.0         97.33    24.00
VEL31000.0
VEL31000.0
ENDJ

```

**Stream: Sprague River**  
**Site: SP13 (Upper Five Mile Creek)**  
**Habitat: Run**  
**Transect: 3**

```

Sprague River SP13 04/14/91
RUN                                MID                                TRANSECT 3
IOC                                1100000100001010100000
NMAX                                0.20    0.035
QARD 10.0
QARD 11.0
QARD 12.0
QARD 13.0
QARD 14.0
QARD 15.0
QARD 16.0
QARD 17.0
QARD 18.0
QARD 18.8
QARD 20.8
QARD 22.0
QARD 24.0
QARD 26.0
QARD 30.0
QARD 32.0
QARD 34.0
QARD 36.0
QARD 38.0
QARD 40.0
QARD 42.0
QARD 44.0
QARD 46.0
QARD 48.0
QARD 50.0
QARD 52.0
QARD 54.0
QARD 56.0
QARD 58.0
QARD 60.0
XSEC1000.0    0.00 1.0    95.90    0.0025
1000.0    0.0 99.8  4.0 97.6  4.2 97.3  5.0 96.9  6.0 96.7  7.0 96.6
1000.0    8.0 96.2  9.0 96.1 10.0 96.1 11.0 96.0 12.0 96.0 13.0 96.0
1000.0   14.0 95.9 15.0 96.0 16.0 96.2 17.0 96.4 18.0 96.4 19.0 96.4
1000.0   20.0 96.5 21.0 96.6 22.0 96.5 23.0 96.5 24.0 96.4 24.4 96.4
1000.0   25.0 97.8 40.0 97.7 45.2 99.4
NS 1000.0    1.0    1.0    9.2    9.2    9.2
NS 1000.0    2.0    2.3    2.3    2.3    9.0    9.0
NS 1000.0    9.0    9.0    9.0    9.0    3.4    3.4
NS 1000.0    3.4    3.4    3.4    3.4    3.4    3.4
NS 1000.0    1.0    1.0    1.0
WSL 1000.0   97.09  97.13  97.16  97.19  97.22  97.25
WSL 1000.0   97.27  97.30  97.33  97.34  97.39  97.42
WSL 1000.0   97.46  97.50  97.57  97.61  97.64  97.67
WSL 1000.0   97.71  97.74  97.77  97.81  97.84  97.88
WSL 1000.0   97.91  97.94  97.96  97.99  98.02  98.04
CAL11000.0   97.39   20.80
VEL11000.0    0.00 0.00 0.00 0.01 0.26 0.92 1.01 0.78 0.76 0.43
VEL11000.0  0.13 0.24 0.77 1.41 1.56 1.85 2.41 2.33 2.40 2.50 1.63 0.77
VEL11000.0
CAL21000.0    97.53   18.80
VEL21000.0
VEL21000.0
VEL21000.0
CAL31000.0    97.43   24.00
VEL31000.0
VEL31000.0
VEL31000.0

```

ENDJ

Stream **Sprague River**  
 Site: **SP13 (Upper Five Mile Creek)**  
 Habitat Type: **Riffle**

Data Files Reviewed: CD1: BIA\Lfim\60177.19\KPK\60177.13\MSQFILES\SP13RF1L.MSQ  
 CD1: BIA\Lfim\60177.19\KPK\60177.13\MSQFILES\SP13RF2L.MSQ  
 CD1: BIA\Lfim\60177.19\KPK\60177.13\MSQFILES\SP13RF3L.MSQ  
  
 CD1: BIA\Lfim\60177.19\KPK\60177.13\I4FFILES\SP13RF1L.I4F  
 CD1: BIA\Lfim\60177.19\KPK\60177.13\I4FFILES\SP13RF2L.I4F  
 CD1: BIA\Lfim\60177.19\KPK\60177.13\I4FFILES\SP13RF3L.I4F

**Data Entry:**

**For 9/23/1990 and 4/14/1991 surveys:** X-sectional data, level loop data, water surface elevation data, Benchmark, working pin, head pin were all check-marked on the worksheet of "Round 1." Errors in the Round 1 were corrected in the "Round 2" worksheets. Assumed all data were checked thoroughly with errors corrected. Therefore, data entry and checking are skipped in the current review. Performed spot-checks for cell discharge and found no errors.  
**For 5/14/93 survey:** There was no complete data entry worksheet (level loop, WSE, X-section, V-D) for this survey.

**Level Loop:**

- (1) 9/23/1990: Loop was closed. Level loop survey checked.  
 Elevation of HP-2 in the second shot was 0.02ft lower than that in the first shot. Error within acceptable range.
- (2) 4/14/1991: Loop was closed. Level loop survey checked.  
 Elevations of BM and all HP's in the first shot were the same as those in the second shot.
- (3) 5/14/1993: Loop was closed. Level loop survey checked using the field notes.  
 Elevation of HP-1 in the second shot was 0.01ft higher than that in the first shot. Error within acceptable range.

**Table: Summary of HP elevations and WSE**

Flow Regime	Survey Date	meas. left-WSE(ft)			meas. right-WSE(ft)			left WSE - right WSE (ft)			ave measured WSE(ft)		
		TR-1	TR-2	TR-3	TR-1	TR-2	TR-3	TR-1	TR-2	TR-3	TR-1	TR-2	TR-3
Mid	09/23/1990	97.76	97.86	98.17	97.75	97.88	98.19	0.01	-0.02	-0.02	97.76	97.87	98.18
Low	04/14/1991	97.69	97.79	98.17	97.61	97.81	98.11	0.08	-0.02	0.06	97.65	97.80	98.14
High	05/14/1993	97.73	97.81	98.18	97.69	97.84	98.15	0.04	-0.03	0.03	97.71	97.83	98.17

Flow Regime	Survey Date	Discharge (cfs)			Ave	WSE for calibration (ft)			Calibrated WSE (ft)		
		TR-1	TR-2	TR-3		TR-1	TR-2	TR-3	TR-1	TR-2	TR-3
Mid	09/23/1990	19.1	21.8	22.9	21.3	97.76	97.86	98.18	97.66	97.81	98.15
Low	04/14/1991	20.2	22.7	18.6	20.5	97.65	97.80	98.14	97.65	97.80	98.14
High	05/14/1993				24.0	97.71	97.83	98.17	97.71	97.85	98.18

Flow Regime	Survey Date	Calibration Error (ft)			Calibration Method			HP Elevation (ft)		
		TR-1	TR-2	TR-3	TR-1	TR-2	TR-3	TR-1	TR-2	TR-3
Mid	09/23/1990	0.10	0.05	0.03	Mansq	Mansq	Mansq	100.56	99.98	101.02
Low	04/14/1991	0.00	0.00	0.00	Mansq	Mansq	Mansq	100.47	99.90	100.93
High	05/14/1993	0.00	-0.02	-0.01	Mansq	Mansq	Mansq	100.49	99.90	100.95

TR	Channel Invert (ft)	SZF (ft)	MANSQ	
			flow	β
TR-1	96.9	97.00	Low	-0.04
TR-2	96.9	97.00	Low	-0.80
TR-3	97.2	97.30	Low	-0.80

**Calibration Method:**

The WSE calibration method was MANSQ for all transects (of low-flow and mid-flow), based on following reasons.  
 --- The "Verification of the final I4F files used for flow claims" results show the above three I4F files are the final PHABSIM data decks.  
 --- There are WSL lines in all 3 I4F files. Used the three MSQ files to regenerate WSE data, and the regenerated WSEs were identical to the ones in the WSL lines of I4F files. Therefore it can be concluded MANSQ was used for WSE calibration.

**Flow:**

- (1) The three surveys conducted on 9/23/90, 4/14/91, and 5/14/93 were designated as mid flow, low flow, and high flow, respectively.
- (2) There was no complete data entry worksheet (level loop, WSE, X-section, V-D) for the survey conducted on 5/14/93.



- (3) Calculated high flow discharge (5/14/93) was 23.70cfs for Riffle habitat and was 24.68cfs for Run habitat, and the average discharge was 24.19cfs for the two habitats. The high flow discharge used in the I4F files was 24.0cfs. There was no document explaining the origination of the 24cfs in the site folder.

**Water Surface Elevation (WSE):**

- (1) The differences between the measured WSEs of the two sides of the channel were as much as 0.08ft, which was considered too large. Photos showed the water surface was calm, and the channel was about 20ft wide.

**Headpins (HP):**

- (1) HP elevations were not consistent from 9/23/90 survey to 4/14/91 survey. This indicated either HP's or BM, or both were disturbed. (More likely, BM was disturbed, based on the relative elevations of the three HP's.) The disturbance will introduce errors into measured WSEs.

**Notes:**

- (1) WSE is the acronym for water surface elevation  
HP is the acronym for head pin. HP-x is the HP for transect x, where x=1,2, or 3.  
HI is the acronym for height of Instrument  
BM is the acronym for Benchmark  
SZF is the acronym of Stage of Zero Flow
- (2) Maximum WSE calibration error was 0.10ft for low flow condition. From HP surveys, it showed there was a major shift of BM/HP's elevations between 9/23/90 and 4/14/91 surveys. After 4/14/91 survey, all pins stabilized, which can be concluded from the relative elevations of BM and HP's. Because of the elevation shift of BM or HP's, the surveyed WSE's of 9/23/90 can not be included for WSE calibration. As a result, there were only two stage ~ flow relationships available for this habitat, and MANSQ had to be used.
- (3) A plot of calibrated WSE is provided in Sheet "EA WSE", showing no crossings between any 2 WSE lines.
- (4) The first two title lines of all three I4F files were re-arranged to match the format required by the graph program. Such re-arrangement will not affect the calibration result at all. EA's 30 simulation flows didn't include the measured mid and high flows. Thus the simulation flows most close to the measured flows were replaced by the measured flows in this review. In both I4F files and MSQ files, simulation flow 20.0cfs was replaced by measured flow 20.5cfs, and 22cfs was replaced by 21.3cfs.
- (5) EA modeler used energy slope=0.0025, but the site folder didn't include the information regarding the estimate of energy slope. The distance between TR-1 and TR-3 and their WSE elevation difference can be used to approximate the energy slope for this habitat.
- (6) The stages of zero flow (SZF) were 97.00ft, 97.00ft, and 97.30ft for TR-1, TR-2, and TR-3, respectively, and the invert of the corresponding transects were 96.9ft, 96.9ft, and 97.2ft.
- (7) There are HEC-2 analysis results included in the site folder, but there is no document showing when and why the HEC-2 analysis was performed, or whether the HEC-2 result was used.

**Problem Summary/Suggestions:**

- (1) Justify the energy slope=0.0025 used by the EA modeler. The measured WSE slope computed using the WSE difference and the distance between TR-3 and TR-1 can be used as the energy slope.
- (2) Provide complete 1-2-3-type data entry worksheets for the high flow survey (5/14/93).
- (3) For high flow, the calculated discharge was 23.70cfs, but 24.00cfs was used in the calibration. The difference won't impact the WSE calibration result significantly, but recommend use the average discharge of run and riffle habitats for future re-calibration, if needed. The (calculated) discharge for riffle habitat was 24.68cfs (see Riffle habitat Excel file), and the average discharge was 24.19cfs.
- (4) This site had only two valid WSE ~ Q relationships (low-Q was considered invalid), but the WSE calibration results seem satisfactory.
- (5) Were the profiles of all three transects based on the 9/23/90 survey or 4/14/91 survey? Since there was about 0.1ft elevation change for BM/HPs between two surveys, the bed profiles should include such change to have more reasonable hydraulics.
- (6) Since the HP elevation difference between 9/23/90 and 4/14/91 surveys was about 0.1ft for all three headpins, it may be concluded the difference was due to the BM elevation change. Using this as the argument, deduct 0.1ft from the WSE's surveyed on 9/23/90 to make all WSE have the same reference BM elevation. Once the 9/23/90 WSE's are corrected, its stage ~ flow relationship can be used as the third pair for the WSE calibration.
- (7) This site had a Run habitat and a Riffle habitat within a reach of about 450ft. The photos and field notes show no tributaries or distributaries. Therefore, it was expected the flow discharge was constant within the reach. The flow discharges used in the calibration for Run and Riffle habitat were different (though just slightly for 4/14/91 survey), it is recommend use the

the same discharge for both habitats.

Stream: Sprague River  
 Site: SP13 (Upper Five Mile Creek)  
 Habitat: Riffle  
 Transect: 1

```

Sprague River SP13 04/14/91
RUN                                MID                                TRANSECT 3
IOC                                110000001000001010100000
NMAX                                0.055                                0.022
QARD 10.0
QARD 11.0
QARD 12.0
QARD 13.0
QARD 14.0
QARD 15.0
QARD 16.0
QARD 17.0
QARD 18.0
QARD 19.0
QARD 20.5
QARD 21.3
QARD 24.0
QARD 26.0
QARD 30.0
QARD 32.0
QARD 34.0
QARD 36.0
QARD 38.0
QARD 40.0
QARD 42.0
QARD 44.0
QARD 46.0
QARD 48.0
QARD 50.0
QARD 52.0
QARD 54.0
QARD 56.0
QARD 58.0
QARD 60.0
XSEC1000.0                        0.00 1.0                                97.30 0.00250
1000.0 0.0100.9 8.0 98.5 21.0 98.7 21.9 97.8 23.5 97.7 25.0 97.7
1000.0 26.5 97.7 28.0 97.7 29.5 97.7 31.0 97.7 32.5 97.5 34.0 97.5
1000.0 35.5 97.2 37.0 97.4 38.5 97.6 40.0 97.7 41.5 97.7 42.7 98.1
1000.0 43.0 98.6 51.2100.5
NS 1000.0 1.0 1.0 1.0 4.3 4.3 4.3
NS 1000.0 4.3 4.3 4.3 4.3 4.3 4.3
NS 1000.0 4.3 4.3 4.3 4.3 4.3 4.3
NS 1000.0 1.0 1.0
WSL 1000.0 97.99 98.01 98.03 98.04 98.06 98.07
WSL 1000.0 98.09 98.10 98.11 98.12 98.14 98.15
WSL 1000.0 98.18 98.20 98.23 98.25 98.27 98.28
WSL 1000.0 98.30 98.31 98.33 98.34 98.36 98.37
WSL 1000.0 98.38 98.40 98.41 98.42 98.43 98.45
CAL11000.0 98.14 20.50
VEL11000.0 .0001 1.56 0.36 2.22 1.67 1.41 0.28 0.92 1.45
VEL11000.0 3.70 2.65 2.76 2.34 0.01.0001
CAL21000.0 98.18 21.30
VEL21000.0
VEL21000.0
CAL31000.0 98.17 24.00
VEL31000.0
VEL31000.0
ENDJ

```

Stream: **Sprague River**  
 Site: **SP13 (Upper Five Mile Creek)**  
 Habitat: **Riffle**  
 Transect: **2**

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Sprague River SP13 04/14/91
RUN                                MID                                TRANSECT 2
IOC                                1100000100001010100000
NMAX                                0.08                                0.041
QARD 10.0
QARD 11.0
QARD 12.0
QARD 13.0
QARD 14.0
QARD 15.0
QARD 16.0
QARD 17.0
QARD 18.0
QARD 18.8
QARD 20.8
QARD 22.0
QARD 24.0
QARD 26.0
QARD 30.0
QARD 32.0
QARD 34.0
QARD 36.0
QARD 38.0
QARD 40.0
QARD 42.0
QARD 44.0
QARD 46.0
QARD 48.0
QARD 50.0
QARD 52.0
QARD 54.0
QARD 56.0
QARD 58.0
QARD 60.0
XSEC1000.0                        0.00 1.0                                96.10                                0.0025
1000.0 0.0 98.2 2.0 97.9 2.2 97.3 4.0 97.0 5.0 96.8 6.0 96.8
1000.0 7.0 96.7 8.0 96.6 9.0 96.6 10.0 96.5 11.0 96.3 12.0 96.3
1000.0 13.0 96.2 14.0 96.3 15.0 96.1 16.0 96.1 17.0 96.1 18.0 96.1
1000.0 19.0 96.3 20.0 96.4 21.0 96.6 22.4 97.3 23.0 98.0 27.6 99.6
NS 1000.0 1.0 1.0 1.2 1.2 1.2 3.4
NS 1000.0 4.3 4.3 4.3 4.3 4.3 4.3
NS 1000.0 3.4 3.4 3.4 3.4 3.4 3.4
NS 1000.0 9.0 2.9 2.9 2.9 1.0 1.0
WSL 1000.0 97.00 97.03 97.06 97.09 97.12 97.15
WSL 1000.0 97.18 97.20 97.23 97.25 97.29 97.32
WSL 1000.0 97.36 97.40 97.47 97.50 97.54 97.57
WSL 1000.0 97.60 97.63 97.66 97.69 97.72 97.75
WSL 1000.0 97.77 97.80 97.83 97.85 97.88 97.90
CAL11000.0 97.29 20.80
VEL11000.0 0.00 0.46 0.96 1.22 1.41 1.42 1.67 1.82 1.62 1.80
VEL11000.0 1.71 1.84 1.85 1.14 1.33 1.47 0.96 0.61 0.07 0.00
CAL21000.0 97.38 18.80
VEL21000.0
VEL21000.0
CAL31000.0 97.33 24.00
VEL31000.0
VEL31000.0
ENDJ

```

**Stream:** Sprague River  
**Site:** SP13 (Upper Five Mile Creek)  
**Habitat:** Riffle  
**Transect:** 3

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          Sprague River SP13 04/14/91
RUN              MID              TRANSECT 3
IOC            1100000100001010100000
NMAX           0.20    0.035
QARD 10.0
QARD 11.0
QARD 12.0
QARD 13.0
QARD 14.0
QARD 15.0
QARD 16.0
QARD 17.0
QARD 18.0
QARD 18.8
QARD 20.8
QARD 22.0
QARD 24.0
QARD 26.0
QARD 30.0
QARD 32.0
QARD 34.0
QARD 36.0
QARD 38.0
QARD 40.0
QARD 42.0
QARD 44.0
QARD 46.0
QARD 48.0
QARD 50.0
QARD 52.0
QARD 54.0
QARD 56.0
QARD 58.0
QARD 60.0
XSEC1000.0      0.00 1.0    95.90    0.0025
  1000.0  0.0 99.8  4.0 97.6  4.2 97.3  5.0 96.9  6.0 96.7  7.0 96.6
  1000.0  8.0 96.2  9.0 96.1 10.0 96.1 11.0 96.0 12.0 96.0 13.0 96.0
  1000.0 14.0 95.9 15.0 96.0 16.0 96.2 17.0 96.4 18.0 96.4 19.0 96.4
  1000.0 20.0 96.5 21.0 96.6 22.0 96.5 23.0 96.5 24.0 96.4 24.4 96.4
  1000.0 25.0 97.8 40.0 97.7 45.2 99.4
NS 1000.0      1.0    1.0    9.2    9.2    9.2
NS 1000.0      2.0    2.3    2.3    2.3    9.0    9.0
NS 1000.0      9.0    9.0    9.0    9.0    3.4    3.4
NS 1000.0      3.4    3.4    3.4    3.4    3.4    3.4
NS 1000.0      1.0    1.0    1.0
WSL 1000.0     97.09  97.13  97.16  97.19  97.22  97.25
WSL 1000.0     97.27  97.30  97.33  97.34  97.39  97.42
WSL 1000.0     97.46  97.50  97.57  97.61  97.64  97.67
WSL 1000.0     97.71  97.74  97.77  97.81  97.84  97.88
WSL 1000.0     97.91  97.94  97.96  97.99  98.02  98.04
CAL11000.0     97.39  20.80
VEL11000.0      0.00 0.00 0.00 0.01 0.26 0.92 1.01 0.78 0.76 0.43
VEL11000.0  0.13 0.24 0.77 1.41 1.56 1.85 2.41 2.33 2.40 2.50 1.63 0.77
VEL11000.0
CAL21000.0     97.53  18.80
VEL21000.0
VEL21000.0
VEL21000.0
CAL31000.0     97.43  24.00
VEL31000.0
VEL31000.0
VEL31000.0
  
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ENDJ