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Memorandum

To: Chehalis River Basin Flood Authority
From: Larry Karpack, WATERSHED Science & Engineering (WSE)
Date: March 8, 2012
Re: **Satsop River Channel and Cross Section Comparisons**

WATERSHED Science & Engineering (WSE) and WEST Consultants (WEST) are currently working with the Chehalis River Basin Flood Authority to develop a hydraulic model of the Lower Chehalis River (from Grand Mound to Aberdeen). This model will be used to evaluate the effects of potential flood relief alternatives in the basin. In addition to work on the mainstem hydraulic model the Flood Authority authorized WSE to collect data and/or refine portions of the model on significant Chehalis River tributaries, including the Satsop River.

The lower Satsop River, from just upstream of the SR 12 Highway Bridge to its mouth is included as a branch in the lower Chehalis River hydraulic model. Cross sections for the Satsop River were field surveyed in 2001 as part of a Corps of Engineers floodplain restoration project. Gray's Harbor County has indicated that there are several potential projects on the Satsop River that could benefit from hydraulic modeling using the combined Satsop/Chehalis River hydraulic model. However, anecdotal information suggests that there has been significant lateral movement of the Satsop River channel since the 2001 surveys and it is unclear whether the existing model accurately depicts current river conditions. The following tasks were completed to evaluate changes in the Satsop River channel geometry and the potential effect of these changes on the hydraulic model's accuracy:

Collection of channel survey data for the Satsop River downstream of SR 12:

Twenty (20) cross sections were surveyed along the main stem of the Satsop River downstream of SR 12. The survey locations were selected to reoccupy data collected in 2001 and to facilitate refinement of the Satsop River reach within the Chehalis River hydraulic model. The in-channel portion of each cross section (from vegetation line to vegetation line) was field surveyed in February 2012 using bathymetric and topographic survey techniques.

Comparison of new channel survey data to previous surveys: The new cross section surveys were graphically compared to the earlier survey data using Excel. Comparisons of the channel location (as estimated from the LiDAR data at the time of the earlier survey and a recent aerial photograph) were also made. The results of these comparisons are described below.

Figures 1 through 4 show the Satsop River study reach at four different points in time, 1990, 2005, 2007, and 2009. An aerial photograph for 2001, the time of the previous Corps study, was not available but based on the cross section surveys and the available 2002 LiDAR data it is apparent that at the time of the 2001 survey the channel was in a similar location to the 2005 photo (Figure 2). The 1990 photo (Figure 1) shows a mostly single thread channel with narrower meander bends and several large gravel bars. The 2005 aerial photo (Figure 2) shows significant areas of newly exposed channel bed indicating that the channel probably shifted considerably in the years immediately preceding this photo. The 2007 aerial photo (Figure 3) shows the channel becoming somewhat stabilized at its new location while the 2009 aerial photo (Figure 4) shows some additional lateral movement of the 2007 channel as well as reforestation of portions of the floodplain where the 1990 channel was located.

Figures 5 and 6 compare the channel location at the time of the 2001 survey to the channel location in 2009. Figure 5 shows the 2001 channel location as estimated by WSE based on the 2002 LiDAR data. Figure 6 shows this same channel overlaid on a 2010 aerial photo. As shown in Figure 6 the channel has remained in much the same location at the upstream bridges and in the middle portion of the reach (along a revetted bank) while the section between the bridges and the revetment and the lower half of the study reach has seen significant lateral migration. Of the four major bends in the Satsop study reach two have eroded substantially wider (Bends A and C) while two have retreated considerably (Bends B and D).

The remaining figures below compare the channel cross sections surveyed in 2001 to those surveyed in February 2012. The layout map on the left of each page shows the 2001 survey layout (red lines and labels PR01 through PR36) as well as the current survey data points (yellow points). The cross section plots on the right of each page compare the old and new survey data. The solid green lines show the field surveyed portions of the 2001 cross sections, the solid red lines show the current field surveyed sections, and the dashed blue lines show the HEC-RAS model cross sections as extended using the 2002 LiDAR data. As can be seen in these figures, with the exception of Sections PR-31, PR-29, and PR-16, which are stable, there has been significant lateral migration of the channel. There has also been channel bed degradation at Sections PR-01, PR-08, and PR-13 and aggradation at Sections PR-14 and PR-24.

While it is obvious there has been substantial change in the Satsop River channel since 2001 it is not possible to conclude based on the survey data alone whether the channel has gained or lost conveyance capacity. To evaluate the hydraulic effects of the channel changes would require detailed hydraulic analysis. Considering the extensive changes in channel form and cross section characteristics documented herein it is recommended that a revised model be constructed before conducting any detailed evaluation of flood control or habitat enhancement projects within the lower reach of the Satsop River. Note, however, that channel changes on the lower Satsop River would not have a very significant effect on simulations of hydraulic characteristics of the mainstem Chehalis River. As such, development of a refined model of the Satsop is not imperative for the evaluation of mainstem flood impacts.



Figure 1: Satsop River near Satsop (SR 12 to Chehalis River) – Photo Date: 1990



Figure 2: Satsop River near Satsop (SR 12 to Chehalis River) – Photo Date: 2005

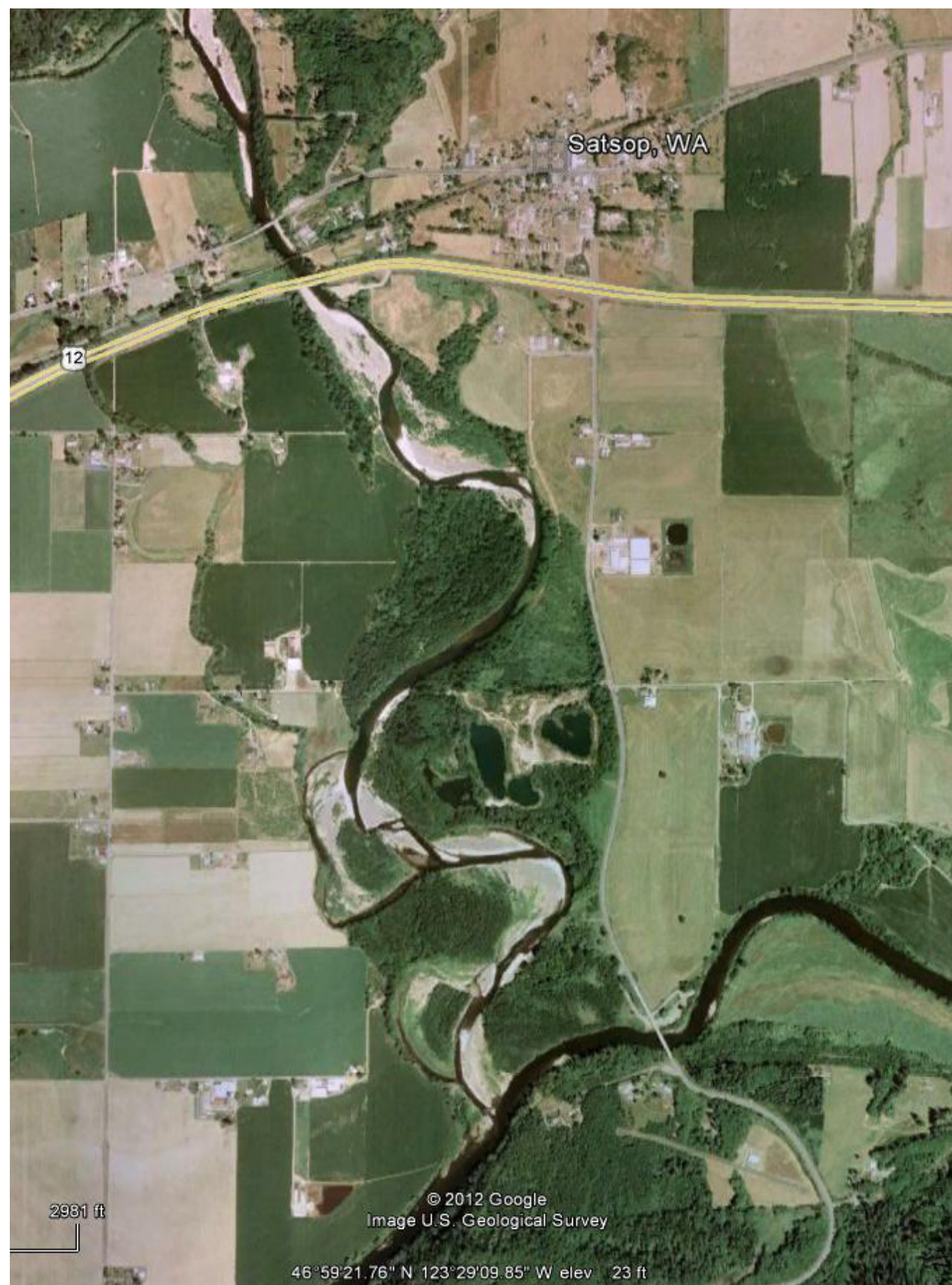


Figure 3: Satsop River near Satsop (SR 12 to Chehalis River) – Photo Date: 2007



Figure 4: Satsop River near Satsop (SR 12 to Chehalis River) – Photo Date: 2009

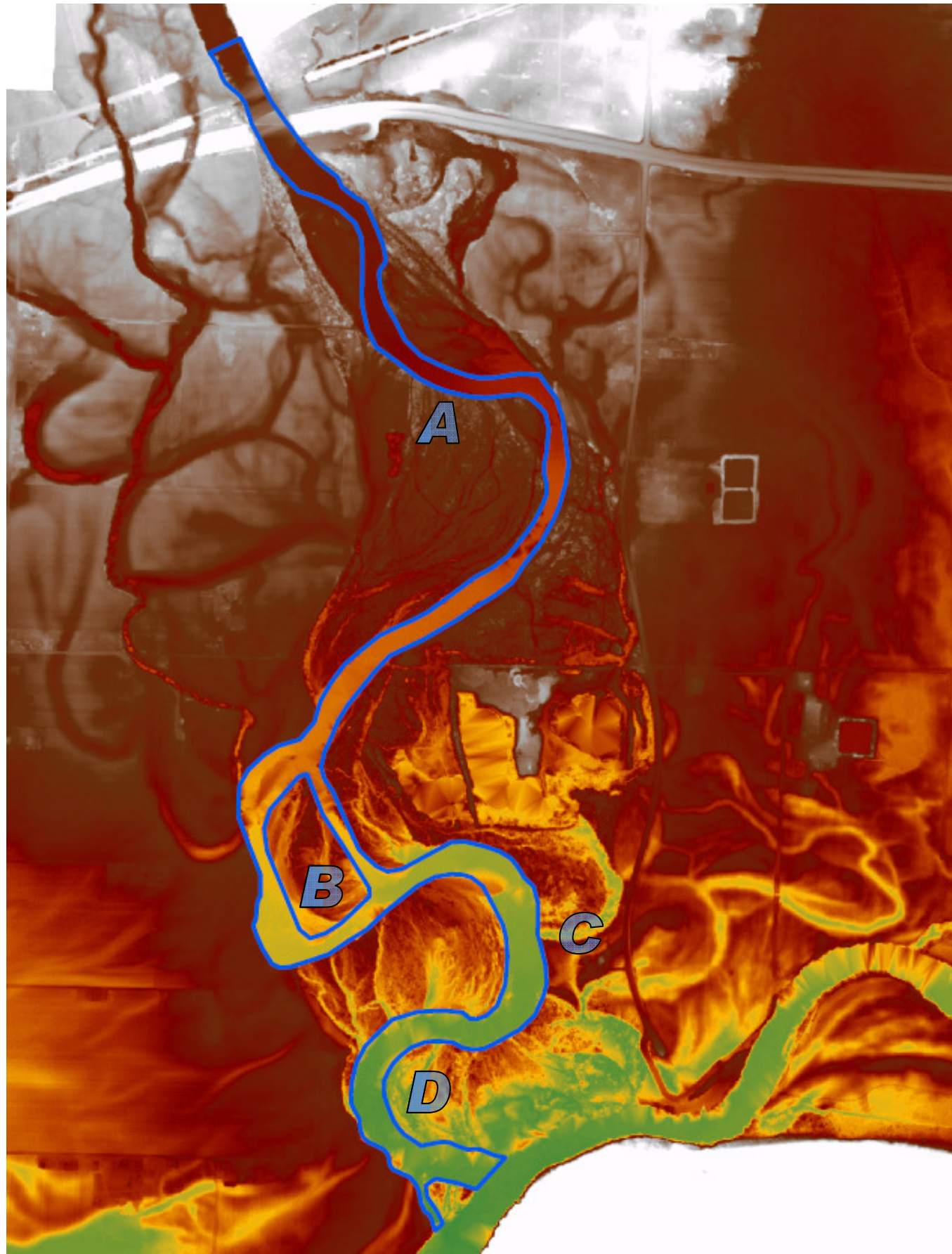


Figure 5: Satsop River near Satsop 2002 LiDAR Data with 2001 Channel Delineation



Figure 6: Satsop River near Satsop 2010 Photo with 2001 Channel Delineation

