I. General

Project Title: **Geomorphology Study of the Fargo, ND and Moorhead, MN Flood Risk Management Project**	Project Engineers: **Ken Puhn, CFM, and Kevin Denn**
Project No: **USAC004001**	Project Manager: **Hans Hadley, P.E., CFM**
Reviewers: **Thomas Grindeland, P.E., D.WRE, and Chris Goodell, P.E., D.WRE**	

II. Report Review

Subject: **Response to Draft Report Comments** Review Date: **May 2012**

Reviewer: **Thomas Grindeland, P.E., D.WRE**

Table 1. USACE – St Paul District Review Comments

Comment No.	USACE Comment/ WEST Evaluation/USACE Backcheck Recommendation	Resolution Acceptance (Reviewer Initial)
1	USACE Comment: Page x – Bottom of page – should mention Figure 3-1 where the study reaches are shown	TG
	WEST Evaluation: A figure was added to the Executive Summary displaying the general study reach locations.	
	USACE Backcheck Recommendation: Back check - ok. Close without additional comment.	
2	USACE Comment: Page 2-1 – Bullets – Lower Rush River – not Abercrombie	TG
	WEST Evaluation: Concur. The text was altered to correctly identify the extents of the Lower Rush River.	
	USACE Backcheck Recommendation: Back check - ok. Close without additional comment.	
3	USACE Comment: Page 3-1 – 2nd paragraph – middle – starts "The geomorphic conditions within each detailed …" sentence is wordy and a little hard to follow	TG
	WEST Evaluation: Concur. This sentence was revised.	
	USACE Backcheck Recommendation: Back check - ok. Close without additional comment.	
4	USACE Comment: Page 3-5 – Table 3-1, drainage areas listed for gages at Halstad, Fargo, and Hickson don't match those of Table 2-1	TG
	WEST Evaluation: Concur. The USGS drainage areas in Table 2-1 were corrected to match the USGS drainage areas listed in Table 3-1.	

Comment No.	USACE Comment/ WEST Evaluation/USACE Backcheck Recommendation	Resolution Acceptance (Reviewer Initial)
	USACE Backcheck Recommendation: Back check - ok. Close without additional comment.	
5a	USACE Comment: Page 4-3 - Gage zero for Fargo gage is 862.74 NAVD 88 (NGVD 29 gage zero is 861.80). Not sure where the gage zero stated in the first paragraph came from. If the wrong gage zero was used it will affect all the analyses at least for the Fargo gage. Suggest double checking all gage zeroes used and verifying the vertical datum of the gage.	TG
	WEST Evaluation: Table 4-1 and related discussion was removed from the report, per the teleconference discussion on 7 May 2012.	
	USACE Backcheck Recommendation: Back check - ok. Close without additional comment.	
5b	USACE Comment: Page 4-3 - Table 4-1 – please add the stream and location to the table.	TG
	WEST Evaluation: Table 4-1 and related discussion was removed from the report, per the teleconference discussion on 7 May 2012.	
	USACE Backcheck Recommendation: Back check - ok. Close without additional comment.	
5c	USACE Comment: Page 4-3 - General comment – Which HEC-RAS model are you referring to? Unsteady model being used for project design or the ones you created for the analyses? If you're comparing the gages to the model being used for project design, it should be noted that the project design model wasn't calibrated to flows as low as bankfull, rather the calibration focused on large flood events and as such I would suspect the model calibration is the culprit rather than the gage datum.	TG
	WEST Evaluation: Table 4-1 and related discussion was removed from the report, per the teleconference discussion on 7 May 2012.	
	USACE Backcheck Recommendation: Back check - ok. Close without additional comment.	
5d	USACE Comment: Page 4-3 - Steve Robinson with the USGS told Michelle that the rating curves for the Sheyenne River gages at Kindred and below were very poor at the lower flow ranges. I think it would be worth mentioning here too about the significant deposition that has been happening in the West Fargo area in the diversion channel. I would also check to see when you gathered the data for the West Fargo gage and discharge. Real time discharges only list the flow that is actually seen at the West Fargo gage versus average daily discharges listed on the USGS website include the West Fargo diversion flows – see the excerpt below that I copied from the USGS webpage. That brings another thought to mind regarding the rating curves provided by the USGS for the West Fargo gage – is the rating curve for just the flow in the Sheyenne River or does it include the diversion flows too? It's just something to double check on.	TG

Comment No.	USACE Comment/ WEST Evaluation/USACE Backcheck Recommendation	Resolution Acceptance (Reviewer Initial)
	WEST Evaluation: Table 4-1 and related discussion was removed from the report, per the teleconference discussion on 7 May 2012.	
	USACE Backcheck Recommendation: Back check - ok. Close without additional comment.	
5e	USACE Comment: Page 4-3 - If any of these comments change the values in Table 4-1, does it change your conclusion in the paragraph below the table?	TG
	WEST Evaluation: Table 4-1 and related discussion was removed from the report, per the teleconference discussion on 7 May 2012.	
	USACE Backcheck Recommendation: Back check - ok. Close without additional comment.	
6	USACE Comment: Page 4-5 – Table 4-3 – suggestion is to show the curves, that the table has little value	TG
	WEST Evaluation: Table 4-3 was removed from the report and the text revised for clarity.	
	USACE Backcheck Recommendation: Back check - ok. Close without additional comment.	
7	USACE Comment: Section 4.2.2.2 – Page 4-6 – The suspended sediment discharge rating curves for the 3 gages look promising that when all the data at all discharges is plotted there is a definite relationship. Can the rest of the 2011 data be added to the rating curves? Do you think that when all of the 2010 & 2011 data is included there will be enough data for rating curves to be created for the rest of the sampling locations? Joel Galloway has presented his findings at the MN Water Resources Conference and when looking at just the spring data from 2010 & 2011, he only found a good relationship for the sediment discharge rating curve for the Rush River site and the Sheyenne River sites above and below the diversion at Horace.	TG
	WEST Evaluation: The remainder of the 2011 data was not available at the time the effective discharge calculations were made. An assessment of the entire 2010 and 2011 dataset in concert with available historic data was made for all of the sites, besides the Buffalo River site. The data was assumed to provide a reasonable relationship between sediment discharge and flow. The new and revised rating curves were incorporated into the final report and the effective discharge analysis was revised. However, the inclusion of the new and revised rating curves did not change the conclusion that the effective discharge method is not able to adequately predict channel-forming discharge.	
	USACE Backcheck Recommendation: Back check - ok. Close without additional comment.	

Comment No.	USACE Comment/ WEST Evaluation/USACE Backcheck Recommendation	Resolution Acceptance (Reviewer Initial)
8a	USACE Comment: Section 4.2.2.5 - Pages 4-15 & 4-16 While I agree that the Lisbon and Kindred gages are in good agreement for determining a trend of suspended sediment concentration with discharge, I don't see the same agreement for the two downstream locations near Horace. The sampling locations upstream and downstream of Horace have a nearly consistent water discharge while there is a large range of suspended sediment concentrations. What would the rest of the 2011 summer data look like on this graph? Would the concentrations at lower discharges follow the trend that holds true for the Lisbon and Kindred gages? If so, I would agree with applying the rating to the rest of the Sheyenne River sites.	TG
	WEST Evaluation: The rest of the 2011 summer data was plotted on the graph. The concentrations were found to decrease as the discharge decreases in a manner similar to the Lisbon and Kindred gage data. A revised chart displaying all the data for all Sheyenne River gage locations was incorporated into the final report.	
	USACE Backcheck Recommendation: Back check - ok. Close without additional comment.	
8b	USACE Comment: Section 4.2.2.5 - The effective discharge plots for Sheyenne River sites 1-4 are dramatically different in comparison to sites 5-8. There seems to be a lot of noise in the graphs for sites 1-4 where there are many different discharges that have suspended sediment concentrations close to the maximum SSC. In contrast sites 5-8 have one discharge that has a very obvious maximum SSC. What is the reason for the dramatic difference? Perhaps this could be mentioned in the concluding paragraph on page 4-24.	TG
	WEST Evaluation: The peak in Sheyenne River sites 6-8 are functions of the Sheyenne River near Horace gage discharge-duration curve. This discharge-duration curve, provided by the USACE, has a slight "dip" in it. This dip is propagated into the discharge-duration curves for Sheyenne River Reaches 6-8 because the curves for these sites are an interpolation between the Sheyenne River near Horace and Sheyenne River near Kindred gages. The extraordinarily high peaks in the effective discharge chart occur where the dip has propagated into the discharge-duration curve. As this peak is the result of incorrect data, this peak was disregarded and the next highest peak was used to determine the effective discharge for Sheyenne River sites 6-8. Additional discussion was provided in the report regarding the anomaly in the Q-duration curves.	
	USACE Backcheck Recommendation: Back check - ok. Close without additional comment.	

Comment No.	USACE Comment/ WEST Evaluation/USACE Backcheck Recommendation	Resolution Acceptance (Reviewer Initial)
8c	USACE Comment: Section 4.2.2.5 - Table 4-4 on page 4-24 – The USGS gage channel forming discharge here does not match the channel forming discharge called out on figure 4-7. Is this just a typo, or does using the SSC trend line equation provides this different channel forming discharge? If it's not a typo, then explain the discrepancy and why you think it occurred.	TG
	WEST Evaluation: This was a typo in the draft report. However, the entire effective discharge section was revised, and Table 4-4 is no longer in the final report.	
	USACE Backcheck Recommendation: Back check - ok. Close without additional comment.	
9	USACE Comment: Section 4.3 page 4-28 – While I realize that bankfull indicators (soil and vegetation changes) are missing from historic topo data, the question would be how does the visual bankfull on the historic cross sections compare to the estimations for the channel forming discharge? We do have historic cross sections from 1940 and the next few years for the RRN, Sheyenne and I think even the Wild Rice River. How would the visual bankfull elevation from these cross sections compare to the current ones as far a flow area and elevation? Would the assumption of smaller historic cross sections still hold true?	TG
	WEST Evaluation: The bankfull elevations are not located at breaks in slope in the cross sections. Rather, because the channels are entrenched, the WSEs are typically fully contained within the channel bank stations at points that could not be identified based only on visual interpretations. Historic cross section plot examples were provided in the final report to show the level of incision and the lack of geometric features that could be used to identify the bankfull water surface elevation, and correspondingly, the bankfull discharge. The assumption of smaller cross sections does not hold true after a review of the historic cross section analysis. While a decrease in flow typically corresponds to a smaller channel in typical streams, the Red River of the North basin streams are highly resistant to erosion. Therefore, changes appear to occur on a geologic timescale, rather than an engineering timescale. All inferences of smaller historic cross sections were removed from the final report.	
	USACE Backcheck Recommendation: Back check - ok. Close without additional comment.	
10a	USACE Comment: Page 4-30 - We don't follow the reasoning why the curve for Sheyenne River reach 5 can be assumed to be equal to the curve of the West Fargo gage.	TG

Comment No.	USACE Comment/ WEST Evaluation/USACE Backcheck Recommendation	Resolution Acceptance (Reviewer Initial)
	WEST Evaluation: The text surrounding this comment was revised in the final report to clarify the assumption. Please note that any references to the West Fargo gage throughout the geomorphic study are related to flow only in the West Fargo channel and not a combination of the West Fargo and Diversion channels. This point was clarified in the final report text. Therefore, the discharge-duration curve at Sheyenne River – 5 can be assumed to be the same as the curve for the West Fargo gage because it is located within a protected area in which minimal flow contributions are added between the Sheyenne River – 5 point and the West Fargo gage.	
	USACE Backcheck Recommendation: Back check - ok. Close without additional comment.	
10b	USACE Comment: Page 4-30 - We are also confused about how the rating curve for the Horace diversion weir can be subtracted from the discharge-duration curve. Please explain/clarify.	TG
	WEST Evaluation: The text surrounding this comment was revised and an example calculation provided in the final report to clarify the assumption. The flow passing over the Horace diversion weir corresponding to each flow point on the discharge-duration curve for the Sheyenne River near Horace gage was calculated. These calculated flows were then subtracted from the flow at the same duration on the Sheyenne River near Horace gage curve to create a discharge-duration curve for the Sheyenne River downstream of the Horace to West Fargo Diversion inlet. The discharge-duration curve for Sheyenne River – 6 was assumed to be the same as this calculated discharge-duration curve because minimal flow contributions are assumed to be added between the point downstream of the Horace to West Fargo Diversion inlet and Sheyenne River – 6.	
	USACE Backcheck Recommendation: Back check - ok. Close without additional comment.	
11	USACE Comment: Page 4-39 – Check the gage zero for the correct vertical datum since the gage zero for the Fargo gage is 862.74 ft NAVD 88.	TG
	WEST Evaluation: Concur. The text and Table 4-10, Figure 4-22, Figure 4-23, and Figure 4-24 will be revised to reflect the corrected datums.	
	USACE Backcheck Recommendation: Back check - ok. Close without additional comment.	
12	USACE Comment: Page 4-48 – The higher variability in stage of higher discharges could also be related to increases in discharge measurements and hydraulic variability not frequency of occurrences.	TG
	WEST Evaluation: Concur. This comment was incorporated into the final report.	
	USACE Backcheck Recommendation: Back check - ok. Close without additional comment.	

Comment No.	USACE Comment/ WEST Evaluation/USACE Backcheck Recommendation	Resolution Acceptance (Reviewer Initial)
13	USACE Comment: Page 4-50 – The text accompanying Figure 4-28 – The conclusion that drops in stage at the Halstad gage being related to the Sheyenne River diversion projects is interesting. Could the drops in stage at the Halstad gage also be associated with a change in roughness and not degradation? Examining the actual discharge measurements to obtain the flow depth/ channel bottom values would indicate whether degradation is occurring.	TG
	WEST Evaluation: The USGS website does not provide flow depth or channel bottom measurement values for the actual discharge measurements. While a change in roughness could possibly explain a portion of the drop, it is not likely that the entire drop of 2+ feet is due to a roughness change. After a review of historic aerial photography for the Halstad gage site area, it was noted that the bridge on which the gage is located was realigned sometime between 1997 and 2003, which corresponds to the timeframe in which the drop of 2+ feet also occurred. Therefore, it is inconclusive as to whether the drops in stage are due to the Sheyenne River Diversion projects or the gage location alteration. The conclusion that the diversion was the cause of the stage decrease was removed from the final report.	
	USACE Backcheck Recommendation: Back check - ok. Close without additional comment.	
14	USACE Comment: Page 4-51 – Text accompanying Figure 4-29 – general question – Have all of these gages remained in the same location over time?	TG
	WEST Evaluation: As noted in comment 13, the Halstad gage was moved sometime between 1997 and 2003 and the vertical datum is assumed to have shifted. A review of the other project gages was completed to check to see if a similar shift in vertical datum occurred. No additional gage shifts were noted by the USGS.	
	USACE Backcheck Recommendation: Back check - ok. Close without additional comment.	
15	USACE Comment: Page 4-54 – Table 4-14 – Have there been roughness changes over time?	TG
	WEST Evaluation: It is possible that roughness changes have occurred over time. However, the changes in roughness likely would only impact the high flows as the channel vegetation was observed to be limited to points above the bankfull water surface elevation. As noted in the report, the high discharges in the specific gage record analysis was analyzed with caution due to the uncertainties at the higher flows, so this issue compounds the uncertainty associated with the high flows. The text was revised to discuss the possibility of roughness changes over time.	
	USACE Backcheck Recommendation: Back check - ok. Close without additional comment.	
16a	USACE Comment: Page 5-2 - First paragraph “preceding analyses” – Are you referring to the Rosgen Levels I through III as the previous analyses?	TG

Comment No.	USACE Comment/ WEST Evaluation/USACE Backcheck Recommendation	Resolution Acceptance (Reviewer Initial)
	WEST Evaluation: Yes. The final report text was revised to clarify this.	
	USACE Backcheck Recommendation: Back check - ok. Close without additional comment.	
16b	USACE Comment: Page 5-2 - It seems that the entrenchment ratio should be very high for most Red River basin streams.	TG
	WEST Evaluation: Yes, the ratios are considered to be high according to the Rosgen system. The high entrenchment ratios cause the streams to primarily be classified as E or C types. The final report text was revised to clarify this.	
	USACE Backcheck Recommendation: Back check - ok. Close without additional comment.	
17	USACE Comment: Page 5-23 – Conclusions – is the appropriate classification used for the RRN? Rosgen Level II says it is unstable. The statements at the bottom of page 5-22 mention the unstable Rosgen classification for the RRN and determine that the RRN is stable. Then on page 5-23 the conclusion says the Level III Rosgen reinforces the Level II findings of a stable channel. The contradiction is problematic.	TG
	WEST Evaluation: Yes, the appropriate classification is used. However, it is concluded that the Red River is placed into the incorrect 'box' within the Rosgen system. As a result, its classification stability was altered to reflect the more accurate channel stability rating. The final report text was revised to clarify this point.	
	USACE Backcheck Recommendation: Back check - ok. Close without additional comment.	
18	USACE Comment: Page 6-1 – How does the centerline obtained from the "collapse dual lines to centerline tool" compare to an actual digitized stream centerline?	TG
	WEST Evaluation: Centerlines obtained from the "collapse dual lines to centerline" tool are very similar and for the most part identical to what would be obtained if the stream centerline were digitized separately. Due to the significant total length of the study reaches this tool was used for reasons of efficiency and to provide a reproducible result. In theory, if one of the banks were to have been identified (and digitized) as being much further from the actual stream centerline than the other bank line, this could result in a centerline that is slightly offset from the actual stream centerline; however, for the Red River and its tributaries this situation was not an issue, nor would it make much difference in the results (certainly any differences would be well within the error range of the subsequent analyses). The final report text was revised to clarify this.	
	USACE Backcheck Recommendation: Back check - ok. Close without additional comment.	
19	USACE Comment: Page 6-11 – Table 6-4 – How does the meander amplitude change without any change in meander migration?	TG

Comment No.	USACE Comment/ WEST Evaluation/USACE Backcheck Recommendation	Resolution Acceptance (Reviewer Initial)
	WEST Evaluation: The meander amplitude was calculated for the entire length of each general study reach while the meander migration was calculated only along the length of the detailed study reaches. Accordingly, while for most study reaches there is no change in meander amplitude or meander migration, a reach may show a very small change in one measurement but not the other. Again, these few small differences are well within the error associated with the various components of the stability analysis. The final report text was revised to clarify this.	
	USACE Backcheck Recommendation: Back check - ok. Close without additional comment.	
20	USACE Comment: Page 6-16, Section 6.1.6 – What about the 2% change for RRN reach 2?	TG
	WEST Evaluation: At this location, the 2% change might be due to error associated with identification of the bank lines due to flooding and high water levels at the time the Year 2 imagery was collected. Although, it was ultimately impossible to quantify the error associated with the various parts of the stability analysis, the range of error is likely at least +/- 5%, and the 2% value falls within this range. The high water and flooding that is present in portions of the Year 2 imagery was noted in the discussion of error in Section 6.1.	
	USACE Backcheck Recommendation: Back check - ok. Close without additional comment.	
21	USACE Comment: Page 7-1, Section 7.1.2 – Is this statement correct? "The discharge-frequency and discharge duration curves for inflows to the diversion channel from the RRN and Sheyenne River were calculated by subtracting the future conditions curves from the current conditions curves …"	TG
	WEST Evaluation: Yes. It is assumed that the amount of flow in the diversion can be calculated by determining the difference between the current and future condition curves, as this is the only variable that is changing between the two conditions. No change to the report text was needed.	
	USACE Backcheck Recommendation: Back check - ok. Close without additional comment.	
22	USACE Comment: Page 7-5, Table 7-1 What is the asterisk on the average shear stress value for on Rush 1?	TG
	WEST Evaluation: A footnote was missing from this table and was added as follows: "* Does not include velocity and shear stress from XS 11119 (weir) due to significant skewing of reach average results."	
	USACE Backcheck Recommendation: Back check - ok. Close without additional comment.	
23	USACE Comment: Section 10.6 – The results discussion on the bottom of page 10-4 is not consistent with the Predicted Impacts to Geomorphology listed in Table 10-1 on page 10-5.	TG
	WEST Evaluation: Additional discussion was added to the text regarding the conclusions summarized in Table 10-1.	
	USACE Backcheck Recommendation: Back check - ok. Close without additional comment.	

Table 2. Miguel Wong Review Comments

Comment No.	Miguel Wong Comment/ WEST Evaluation/Miguel Wong Backcheck Recommendation	Resolution Acceptance (Reviewer Initial)
1	Miguel Wong Comment: First paragraph of page 3-6 indicates that "Field work recommenced on 22 October 2011, ... and was completed on 6 October 2011." My guess is that the re-start of field work happened on 2 October 2011.	TG
	WEST Evaluation: The field work recommencement date was changed to 22 September 2011.	
	Miguel Wong Backcheck Recommendation: Back check - ok. Close without additional comment.	
2	Miguel Wong Comment: When comparing Tables 3-2 and 3-3, it is evident that the bank material is significantly finer than the bed material for the Sheyenne River. Any comments on the reasons for this, and more importantly, the potential implications in the assessment of project impacts?	TG
	WEST Evaluation: The reason for this is likely due to the fact that bank material was collected from the surface of the bank. In part, these materials were deposited during overbank events. The depositional material is likely fine sands, silts, and clays. This would cause the bank materials to be smaller than the bed materials. Downstream of the diversion alignment alternatives, the amount of sand supplied to the banks will decrease. Additionally, the sand within the system will move more as bedload rather than suspended load. These points were discussed in greater detail in the future conditions effects section of the report.	
	Miguel Wong Backcheck Recommendation: Back check - ok. Close without additional comment.	
3	Miguel Wong Comment: Third paragraph of page 4-2 indicates that "In general, the Rush and Lower Rush Rivers, ..., appear to have aggraded and narrowed during the time between the 2010 and 2011 surveys." Providing additional context and qualification of statements like this would be beneficial to evaluate whether the referred change or impact is significant or not.	TG
	WEST Evaluation: The last three sentences from the third paragraph were removed from this section in order to not confuse the reader. Additionally, further assessment of the 2010 and 2011 surveys indicates that the cross sections are in general agreement with each other so this discussion was removed from the report in its entirety.	
	Miguel Wong Backcheck Recommendation: Back check - ok. Close without additional comment.	

Comment No.	Miguel Wong Comment/ WEST Evaluation/Miguel Wong Backcheck Recommendation	Resolution Acceptance (Reviewer Initial)
4	Miguel Wong Comment: Section 4.2.1 presents the methodology to estimate bankfull discharges, which relies on the calibration of HEC-RAS models to water surface elevations recorded during field measurements, followed by verification against USGS gage data. Such verification showed differences of a few feet between modeled and gaged values (see Table 4-1), and it is argued that "It is suspected that the gage datum elevations for several USGS gages are not sufficiently accurate to use for calibration of the hydraulic models." I wonder if the HEC-RAS models utilized in this study are an extension of the HEC-RAS models built, calibrated and validated as part of the feasibility study and initial stages of final design. If that is not the case, I would strongly recommend revisiting this very important component of the geomorphology study. Using the more extensively tested HEC-RAS models would offer more defensible basis for definition of key design considerations, including estimation of the design flows for Low-Flow Channel as well as for the Sheyenne and Maple aqueducts.	TG
	WEST Evaluation: Table 4-1 and related discussion was removed from the report, per the teleconference discussion on 7 May 2012	
	Miguel Wong Backcheck Recommendation: Back check - ok. Close without additional comment.	
5	Miguel Wong Comment: Second paragraph of page 4-6 indicates that "Because the channel bed of the Red River and its tributaries is primarily composed of silt and clay, the bed-material load cannot be distinguished from the suspended sediment load that, by definition, is composed primarily of clay- and silt-sized particles." Wouldn't the bed-material load include sediment that is moved as bedload as well as in suspension? And couldn't sand-sized particles be mobilized in suspension? I think I understand what is meant (most of the sediment carried by these riverine systems correspond to washload, not to bed-material load, and sediment transport is predominantly in suspension). Please comment, and modify the sentence if needed.	TG
	WEST Evaluation: The paragraph was modified to clearly state that distinguishing between the bed-material load and suspended load is not possible based upon their similar grain sizes and that sufficient bedload data does not exist to create a bedload transport rating curve.	
	Miguel Wong Backcheck Recommendation: Back check - ok. Close without additional comment.	
6	Miguel Wong Comment: In Figures 4-2 to 4-4, and Figure 4-8 too, would it make a difference if the correlation is between suspended sediment associated with bed-material load only (not with washload) and discharge? I am asking this question because differentiating bed-material load from washload could offer a more appropriate picture of the river channel dynamics, hence a better baseline to measure potential project impacts.	TG

Comment No.	Miguel Wong Comment/ WEST Evaluation/Miguel Wong Backcheck Recommendation	Resolution Acceptance (Reviewer Initial)
	WEST Evaluation: It is not possible to distinguish between the bed-material load and suspended load. If it were possible to distinguish between the two, yes, it would preferable to use bed-material load only for our calculations. The text was revised to clarify this situation.	
	Miguel Wong Backcheck Recommendation: Back check - ok. Close without additional comment.	
7	Miguel Wong Comment: Section 4.2.3 introduces the recurrence interval method and includes a summary Table 4-5 of the return period associated with the previously calculated bankfull and effective discharges. Although the two recent studies in the Upper Midwest offer a good, initial context for the estimates in the study area, it would be equally helpful and insightful to gain some additional perspective on the reasons for the relatively frequent events serving as a proxy of the channel forming discharge. For example, does it matter that the largest floods are driven by snowmelt, with low flow velocities across a very wide floodplain? Or, what role plays the fact that these rivers primarily mobilize washload of very fine material (most likely picked up from the adjacent floodplains) instead of bed-material load, that the rivers are sediment supply-limited, and that channel migration rates are almost negligible?	TG
	WEST Evaluation: The transport of sediment is not a significant driver of channel morphology for this system. This was addressed in further detail in the final report.	
	Miguel Wong Backcheck Recommendation: Back check - ok. Close without additional comment.	
8	Miguel Wong Comment: Last paragraph of page 4-28 indicates that "... it could also be assumed that the historic channels may have been smaller than they are currently." Could you please expand on the reasons for this? What type of basin-scale factors may have contributed to the increase in river channel cross section? And is there any expectation that current conditions provide a good baseline condition for the project span of 50 years, or would it be anticipated that even without a project, river channel cross sections would change in the future?	TG
	WEST Evaluation: While the hydrology has changed, sufficient time has not passed for the channels to respond to this change, as demonstrated in the historic cross sections analysis. As a result, references in the text to smaller historic cross sections were removed.	
	Miguel Wong Backcheck Recommendation: Back check - ok. Close without additional comment.	
9	Miguel Wong Comment: Adding a discussion of comparing historical, surveyed cross sections to the information presented in Figures 4-19 to 4-21 could provide a more complete picture of potential project impacts.	TG

Comment No.	Miguel Wong Comment/ WEST Evaluation/Miguel Wong Backcheck Recommendation	Resolution Acceptance (Reviewer Initial)
	WEST Evaluation: The change in hydrology from historic to current conditions has not yet caused a change in the cross section shape. This is indicative of the geologic timescales that are required before channel geometry changes can be observed to have occurred. Discussion of the potential project impacts was incorporated into the future conditions effects chapter.	
	Miguel Wong Backcheck Recommendation: Back check - ok. Close without additional comment.	
10	Miguel Wong Comment: Fourth paragraph of page 4-39 indicates that "... water surface elevations have increased from historic to current conditions." Is this because flows have increased? Or the cross sections have changed? And what would be an accurate representation of future baseline conditions?	TG
	WEST Evaluation: It is assumed to be due to an increase in flow. The text was revised to make this point more clear. The historic cross section comparison shows that not much change has occurred within the cross sections. Therefore, the increase in flow is assumed to be the driver behind the increase in water surface elevations. It is noted that the USACE defined the current and future baseline hydrology as being equal for the purposes of this study; therefore, the only hydrologic changes will be a reduction of flow within areas protected by the proposed diversion alternative alignments. As noted in the response to comment 9, time differences on the order of geologic timescales is required before channel geometry are likely to have occurred. It is assumed that over the 50-year life of the project, significant geometric change will not occur within the channels experiencing flow reductions.	
	Miguel Wong Backcheck Recommendation: Back check - ok. Close without additional comment.	
11	Miguel Wong Comment: First paragraph of page 4-49 indicates that "... although the Red River at Halstad gage shows a decreasing trend in stage, ...? Are there reasons beyond those suggested in page 4-50 pertaining to flow and sediment impacts of the Sheyenne diversions? I am particularly curious after learning that the channel morphology at the other two gages is somewhat controlled by existing dams, so the immediate question is what happens at places without man-made structures. Or alternatively and perhaps more relevant to this project, what would happen in the Red River after a larger amount of water and sediment is conveyed through an artificial diversion system?	TG
	WEST Evaluation: After a review of historic aerial photography for the Halstad gage site area, it was noted that the bridge on which the gage is located was realigned sometime between 1997 and 2003, which corresponds to the timeframe in which the drop of 2+ feet also occurred. Therefore, it is inconclusive as to whether the drops in stage are due to the Sheyenne River Diversion projects or the gage location alteration. The conclusion that the Diversion was the cause of the stage decrease was removed from the final report.	

Comment No.	Miguel Wong Comment/ WEST Evaluation/Miguel Wong Backcheck Recommendation	Resolution Acceptance (Reviewer Initial)
	Miguel Wong Backcheck Recommendation: Back check - ok. Close without additional comment.	
12	Miguel Wong Comment: An erosion rate of 0.165 ft/yr is presented in Table 5-2 for almost all rivers and reaches; the exception is Wolverton Creek 1-0.64. What is the basis for this estimate?	TG
	WEST Evaluation: This is based on the estimate provided by the Rosgen assessment. The text describing these results was revised to more clearly explain how this erosion rate is determined.	
	Miguel Wong Backcheck Recommendation: Back check - ok. Close without additional comment.	
13	Miguel Wong Comment: Chapter 5 is descriptive only, and perhaps that is the intent. However, I would appreciate if you could expand a bit on the statement in page 5-21 that "Rather the width/depth ratios are higher than 10 as a result of geotechnical instabilities rather than from fluvial processes." Would these geotechnical instabilities explain the river channel evolution in both geologic and engineering time scales? And, could we anticipate if these geotechnical instabilities would lead to significant changes in river channel geometry in the future?	TG
	WEST Evaluation: Yes, the geotechnical instabilities would explain the river channel evolution at an engineering timescale and can be assessed using the historic cross section comparison analysis. However, historic cross section data does not exist to make that same conclusion on a geologic timescale. It is anticipated that the geotechnical instabilities will continue in the unprotected areas and may slow in the protected areas within the context of an engineering timescale. The text was revised to clarify this statement.	
	Miguel Wong Backcheck Recommendation: Back check - ok. Close without additional comment.	
14	Miguel Wong Comment: There is an incredible amount of valuable information presented in Appendix K that, in my opinion, is not adequately summarized and interpreted in Chapter 5. By this I am not necessarily questioning the results provided in Table 5-2, however some of the information in Appendix K could, for instance, provide informed guidance about critical issues to consider during the detailed design of the hydraulic structures such to minimize potential, localized impacts on the affected rivers.	TG
	WEST Evaluation: Concur. The results of each Rosgen worksheet were summarized and discussed in the text of the final report and figures were included where appropriate.	
	Miguel Wong Backcheck Recommendation: Back check - ok. Close without additional comment.	

Comment No.	Miguel Wong Comment/ WEST Evaluation/Miguel Wong Backcheck Recommendation	Resolution Acceptance (Reviewer Initial)
15	Miguel Wong Comment: Last sentence of page 6-13 indicates that "The calculated areas for the belt width polygons were divided by the centerline length to provide an average belt width for each detailed study reach (Table 6-6)." Is there a chance with this methodology of not capturing channel migration that does not affect the meander belt width? And in more general terms, for riverine systems with very small to negligible channel migration rates, where fluvial erosion does not appear to be a driving factor, I wonder if the reach scale is the relevant scale. I am not advocating to change the scope of work agreed at the very beginning, but perhaps identifying and tracking localized areas where the channel morphology has changed due to factors other than fluvial erosion (e.g., bank failure due to sediments depositing near the channel bank during large and/or long flood events) could provide more insights on potential impacts.	TG
	WEST Evaluation: Yes, when comparing a reach averaged belt width between multiple years, it is possible that migration could have occurred but might not be represented in the results (i.e. there could be localized areas that have experienced lateral migration, but that averaged out to zero in terms of belt width). To avoid mischaracterizing actual channel migration, it is important to consider average belt width results in conjunction with other analyses, in particular meander migration rates calculated in section 6.1.2. Additionally, although the belt width and meander migration calculations only considered the detailed study reaches, the entire length of each study river was inspected using GIS in order to identify areas in which significant erosion might have occurred outside of the detailed study reaches (this is discussed on page 6-24 in the bank erosion section). It is agreed that tracking specific areas in the future (such as location of bank failures as you mentioned) could be useful to gain a better understanding of the time scales involved with the bank deposition/failure cycle.	
	Miguel Wong Backcheck Recommendation: Back check - ok. Close without additional comment.	
16	Miguel Wong Comment: In Table 6-8 density of large woody debris (per mile) is presented. Do these values characterize the study rivers as low, medium or high in large woody debris?	TG
	WEST Evaluation: The observed values of 0-3 LWD/mile can be considered to be low. In general, very little LWD was observed through the study area and that which was observed tended to be single pieces/trees, or small clusters. Where found, the LWD were rarely in quantities large enough to block significant portions of the channel. This characterization was added to the final report.	
	Miguel Wong Backcheck Recommendation: Back check - ok. Close without additional comment.	

Comment No.	Miguel Wong Comment/ WEST Evaluation/Miguel Wong Backcheck Recommendation	Resolution Acceptance (Reviewer Initial)
17	Miguel Wong Comment: Figures 6-8 to 6-10 are perfect illustrations of changes in the river planform over long time scales, but these scales are not that long enough for being irrelevant compared to the project life scale. Any thoughts on what may have led to these changes, and how the project could trigger (or not) similar impacts?	TG
	WEST Evaluation: In the examples provided, 2 of the 3 cases had already cut-off to some extent, and had simply matured over the time between the photos. The 3rd example does appear to have cut off during the time between photos. Based on all available data, the evolution of these cut-offs appears to progress very slowly; however, as the neck between the upstream and downstream side of the bends narrow, it is possible that the bank failures discussed previously and the significant flooding that occurs on a regular basis provide the mechanism or catalyst for the final cut-off to occur. It would be expected that in unprotected areas this natural evolution would continue as before; however in the protected areas, the possible mechanisms that cause the final cutoff to occur (bank failure and flooding) would be reduced and/or eliminated, thereby slowing the final cut-off of the bend(s). The report text was revised to incorporate this response.	
	Miguel Wong Backcheck Recommendation: Back check - ok. Close without additional comment.	
18	Miguel Wong Comment: Although I agree with one of the main conclusions and interpretation presented in Section 6.1.8, I would appreciate if you could expand a bit on the fourth paragraph of page 6-24, in which it is indicated that "It appears that the characteristics of the clay soils, saturation of the bank material during long periods of flooding, and the added weight of the overbank sediment deposits, results in bank slumping and subsequent long-term erosion of the failed bank material within the channel." Would this process slow down within the protected area where flooding will be of a smaller magnitude and shorter duration for the largest events? Or are the more frequent events that still result in channel overtopping the ones driving this type of failures?	TG
	WEST Evaluation: Please refer to Sections 9 and 10 for more detailed discussion on how this process might be affected in either of the future conditions scenarios.	
	Miguel Wong Backcheck Recommendation: Back check - ok. Close without additional comment.	

Comment No.	Miguel Wong Comment/ WEST Evaluation/Miguel Wong Backcheck Recommendation	Resolution Acceptance (Reviewer Initial)
19	Miguel Wong Comment: Similar to comment 14 above, there is an incredible amount of valuable information presented in Appendix L that, in my opinion, is not fully digested and interpreted in Section 6.2.1. For example, while Figure 6-14 shows approx. 4.5 ft of bed aggradation in the Maple River upstream of Dam 2, the Appendix L figure presenting the Historic XS Comparison at M1 shows approx. 2 ft of bed degradation in the Maple River upstream of Dam 1. Why the response at M1 is different? Because it is a considerably smaller dam? Or because the sediment transported by the Maple River is way finer downstream than upstream? I am using this as an example of why a more detailed discussion of these differences and the potential implications for the proposed project could be worthwhile.	TG
	WEST Evaluation: Concur. The cross sections exhibiting significant changes were identified in the text and the discussion evaluated potential causes of the changes.	
	Miguel Wong Backcheck Recommendation: Back check - ok. Close without additional comment.	
20	Miguel Wong Comment: The first paragraph of page 6-57 indicates that "the Simons and Albertson method results were used to determine whether the channels are moving either toward or away from their idealized regime channel geometry or whether the channels were in relative equilibrium." I question the validity of this statement because it assumes that the regime theory could be applicable to the study rivers, which are sediment supply-limited and with a channel geometry that could have been defined in the geologic time scale, with very little changes over the engineering time scale (for which the regime theory would apply). Consistent with this, but for different reasons, the last paragraph of page 6-57 indicates that "the Simons and Albertson method is not considered to be fully applicable to the study streams." If so, I would suggest removing Tables 6-21 and 6-22.	TG
	WEST Evaluation: Concur. Tables 6-21 and 6-22 were removed and the text altered to reflect the inadequacy of the Simons and Albertson method to predict channel geometry. Data and discussion regarding changes to cross sections irrespective of the regime method results was moved to the historic cross section analysis section.	
	Miguel Wong Backcheck Recommendation: Back check - ok. Close without additional comment.	
21	Miguel Wong Comment: The last sentence of page 7-2 indicates that "The lower shear stresses would be expected to result in a reduction in the channel size over time as it adjusts itself toward a new equilibrium condition." Is this also true in a sediment supply-limited riverine system?	TG

Comment No.	Miguel Wong Comment/ WEST Evaluation/Miguel Wong Backcheck Recommendation	Resolution Acceptance (Reviewer Initial)
	WEST Evaluation: Over a geologic timescale, it is believed that the lower shear stresses would result in a reduction in channel size. However, over the engineering timescale, the geometric characteristics of the cross sections are not expected to significantly change. The text was revised to clarify the timescale to which is being referred.	
	Miguel Wong Backcheck Recommendation: Back check - ok. Close without additional comment.	
22	Miguel Wong Comment: Section 7.3 presents the reasons for having doubts about the reliability of the Sediment Impact Assessment Model (SIAM) results. Given that the Corps is planning to use the Laursen-Copeland relationship in the HEC-RAS sediment transport modeling of the existing Sheyenne diversions, I would recommend having a working session to qualify differences, if any, in the computational methodology used by SIAM and HEC-RAS.	TG
	WEST Evaluation: We are happy to discuss this issue with you; however, we don't believe that applying Laursen-Copeland using the sediment transport module of HEC-RAS should be an issue. Ultimately, the primary issue with applying SIAM is the assumption that an unlimited supply of sediment can be obtained from the bed. Fortunately, this is a non-issue in the sediment transport module in RAS as the user has the ability to manually set how the model deals with cohesive sediments (by setting erosion rates) and the user can also set a minimum elevation below which the model cannot erode. This allows the modeler to overcome some of the primary problems that were identified while applying SIAM to the Red River system. Lastly, while the erosion and deposition volumes/trends were found to be unreliable due to the unlimited bed assumption, another table and/or figure(s) will be added to the discussion to provide a comparison of transport capacity (ignoring supply from the bed) for the Sheyenne River, as calculated by SIAM.	
	Miguel Wong Backcheck Recommendation: Back check - ok. Close without additional comment.	
23	Miguel Wong Comment: Similar to comment 3 above, providing additional context and qualification of statements like the ones in the first paragraph of Section 9.5.3 would be beneficial to evaluate whether the referred change or impact is significant or not. The write-up, or the summary tables of impacts assessment (like in Chapter 10), sometimes suggest big problems but the main conclusions do not.	TG
	WEST Evaluation: The text was revised to further explain significance of impacts.	
	Miguel Wong Backcheck Recommendation: Back check - ok. Close without additional comment.	

III. QA/QC Certification

Title	Name	Signature	Date
Project Engineer	**Ken Puhn, CFM**		5/25/2012
Project Engineer	**Kevin Denn**		5/25/2012
Project Manager	**Hans Hadley, P.E., CFM**		5/25/2012
Reviewer	**Thomas Grindeland, P.E., D.WRE**		5/25/2012
Reviewer	**Chris Goodell, P.E., D.WRE**		5/25/2012

I. General

Project Title: **Geomorphology Study of the Fargo, ND and Moorhead, MN Flood Risk Management Project**	Responders: **Ken Puhn, CFM, and Kevin Denn**
Project No: **USAC004001**	Project Manager: **Hans Hadley, P.E., CFM**
Reviewers: **Thomas Grindeland, P.E., D.WRE, and Chris Goodell, P.E., D.WRE**	

II. Comments and Responses

Subject: **Response to Agency Technical Review Comments** Review Date: **October 2012**

Reviewer: **Thomas Grindeland, P.E., D.WRE**

Table 1. USACE – Omaha District Review Comments

Comment No.	USACE Comment/ WEST Evaluation/USACE Backcheck Recommendation/WEST Backcheck Response/USACE Second Backcheck Recommendation	Resolution Acceptance (Reviewer Initial)
1	USACE Comment: I've examined the main report. It reads well and is informative with useful plates, figures and tables that support the text and conclusions. I have no changes to recommend.	TG
	WEST Evaluation: Comment noted.	
	USACE Backcheck Recommendation: Ok. Closed.	
2	USACE Comment: No comments on report or appendices.	TG
	WEST Evaluation: N/A	
	USACE Backcheck Recommendation: No comments noted, so this can be closed.	
3	USACE Comment: Page xiii. It is difficult to discern the reach numbers when printed in black and white (or for those who may be color-blind when viewed on-screen). Please consider adding numbers to help differentiate the reach numbers. (same comment applies to Fig. 3-1).	TG
	WEST Evaluation: Numbers have been added to denote each reach for both Figure 2 and Figure 3-1.	
	USACE Backcheck Recommendation: Thank you	
4	USACE Comment: Page 3-2. Text indicates that some drainage areas from USGS were not used; some values in Table 3-1 on p. 3.5 appear to differ significantly. Does this impact your results significantly (if you used the USGS values instead)? Please address.	TG

Comment No.	USACE Comment/ WEST Evaluation/USACE Backcheck Recommendation/WEST Backcheck Response/USACE Second Backcheck Recommendation	Resolution Acceptance (Reviewer Initial)
	WEST Evaluation: The discrepancy between the USGS-defined and WEST-delineated values for drainage area was previously noted and brought to the attention of the District (personal correspondence with Dan Reinartz, P.E., 12/14/2011). The District indicated that the discrepancy between the two values was the result of the differing definitions of 'contributing drainage area' defined by the USGS and the District. Therefore, to maintain consistency with the Districts definition, the WEST-delineated contributing drainage areas were developed from the District's drainage basin mapping and were subsequently used for all calculations requiring the use of drainage area. While it is noted that using the USGS-defined values would alter the results of any calculation, the results would be erroneous in many cases. For example, the USGS Gage 05054000 - Red River at Fargo has a drainage area of 6,800 square miles, according to the USGS, while a drainage area of 5,718 square miles was determined by the WEST delineation. Detailed study reach Red River - 3 - 440.57, located downstream of USGS Gage 05054000, has a drainage area of 5,763 square miles, as determined by the WEST delineation, which is smaller than the USGS drainage area of USGS Gage 05054000, even though the detailed study reach is downstream of the gage and should have a larger drainage area. Therefore, if calculations were completed using the USGS-defined drainage area for the gage but the WEST-delineated drainage area for the detailed study reach, erroneous results would be calculated (i.e., lower flows in the downstream direction) due to the drainage area inconsistencies. Therefore, using the WEST-delineated drainage areas rather than the USGS-defined drainage areas is considered the most reasonable method and is consistent with work conducted by the District.	
	USACE Backcheck Recommendation: Thank you	
5	USACE Comment: Page 3-6. Since nearly all of the cross-sections were collected following the Flood of 2011, do you address anywhere in the report of the 2011 flood may have impacted the various reaches in a way that would impact your analyses? Please address.	TG

Comment No.	USACE Comment/ WEST Evaluation/USACE Backcheck Recommendation/WEST Backcheck Response/USACE Second Backcheck Recommendation	Resolution Acceptance (Reviewer Initial)
	WEST Evaluation: It is noted that the Lower Rush River is channelized and has a densely vegetated channel bottom. The dense vegetation is efficient at trapping suspended sediment that would otherwise flow through the stream as wash load. In contrast, the channels of the Sheyenne River and Rush River do not contain vegetation and therefore allow the majority of the suspended sediment load to be transported downstream. Because the vegetation characteristics of the Sheyenne River and Rush River channels are much more representative of the streams for which overlapping 2010 and 2011 survey data does not exist (Buffalo River, Maple River, Red River, Wild Rice River, and Wolverton Creek), it is assumed that these streams likely did not experience notable changes in channel geometry due to the spring 2011 flooding. Therefore, with the exception of the Lower Rush River, it is concluded that single, large flood events are unlikely to cause notable changes to the shape and size of the channels within the study area. The response to this comment has been incorporated into the report in Section 6.2.1.	
	USACE Backcheck Recommendation: Thanks	
6	USACE Comment: Page 3-4. It would be helpful to have the USGS gage locations on this Figure for easier cross-referencing of which detail study area is near which gage.	TG
	WEST Evaluation: The gage locations have been added to the figure.	
	USACE Backcheck Recommendation: Thanks	
7	USACE Comment: Page 4-31. With no data below 100 cfs, how confident are we that this relationship is linear and at the magnitude shown? If the relationship is non-linear, or lower than assumed, than the effective discharge on Fig. 4-24 through 4-29 may be too low.	TG
	WEST Evaluation: Agreed, the limited amount of data may not reveal all of the data trends that could be seen with a well-populated data set. However, the curve is assumed applicable for all flows both within and outside of the range of measured values. As exhibited in Sections 4.2.2.1 and 4.2.2.2, the Red River and Sheyenne River datasets are reasonably represented by the derived relationships throughout a very wide range of flows. Therefore, it is assumed that the Wild Rice River does so as well and that the curve can be extrapolated outside of the range of measured values. This discussion has been incorporated into the text of the final report in Section 4.2.2.4.	
	USACE Backcheck Recommendation: Thank you	
8	USACE Comment: Page 4-42. Should 'Maple' be 'Lower Rush'?	TG
	WEST Evaluation: Yes, the text has been changed.	
	USACE Backcheck Recommendation: Thank you	

Comment No.	USACE Comment/ WEST Evaluation/USACE Backcheck Recommendation/WEST Backcheck Response/USACE Second Backcheck Recommendation	Resolution Acceptance (Reviewer Initial)
9	USACE Comment: Page 4-51. Just out of curiosity, what is the return interval of 2380 cfs from the 1901-1941 period? This would help the reader gain more insight as to the changes in hydrology from one period to the next.	TG
	WEST Evaluation: Based on a statistical analysis using HEC-SSP, the return interval of 2,380 cfs from the 1901-1941 period is approximately 2.4 years. This was added to the final report to help characterize the hydrologic changes that have occurred in the Red River basin.	
	USACE Backcheck Recommendation: Thank you	
10	USACE Comment: Page 4-69. Please clarify - if a trend in stage is neither upward nor downward, would it or would it not be in equilibrium? The way this is worded would make it sound as if any trend over time is non-equilibrium.	TG
	WEST Evaluation: The words 'increasing or decreasing' was added between the words 'Consistent' and 'trends' for clarification with regard to consistently increasing or decreasing trends.	
	USACE Backcheck Recommendation: Thanks	
11	USACE Comment: Section 4.5. The specific gage analysis described in section 4.5 relied on the USGS rating tables. Several trends were apparent, especially in the higher flow events. Specific gage analysis at both the Red River at Fargo and the Sheyenne River at West Fargo show increasing stages. A few gages, such as the Red River at Halstad, show a definite degradational trend with decreases of 2 ft or more during the record. Establishment of any flood trends related to extreme event stages is warranted for project design and possible impact (both aggradation and degradation) on flood control project features. Have actual USGS gage measurements and peak flow / stages for flood events been evaluated? Please consider the need for further stage trend analysis and identify whether this is included in the Geomorph Study scope or will be evaluated as part of the hydraulic design of project features, perhaps as a component of determining the risk based project design elevations.	TG

Comment No.	USACE Comment/ WEST Evaluation/USACE Backcheck Recommendation/WEST Backcheck Response/USACE Second Backcheck Recommendation	Resolution Acceptance (Reviewer Initial)
	WEST Evaluation: Being that the USGS rating curves used in the specific gage analysis were constructed from and are modified based on actual field measurements, an in-depth evaluation of actual gage measurements and peak flows/stages was not conducted. However, a brief review of the field measurement records at the gaged sites indicates that measurements are taken on average once a month. Therefore, it is assumed that if large changes occurred because of large flood events, the USGS would have data available that could be used to update the curves. In most instances, the curves were not updated by the USGS following flood events, signifying that notable stage changes did not occur. In the instances that the curves were updated closely following a flood event, notable differences in the stage were not exhibited. Therefore, it was concluded that the occurrence of large flood events exceeding the 10% annual chance discharge does not appear to influence the specific gage stage trends.	
	USACE Backcheck Recommendation: While it is true that the USGS will often revise rating curves with a sufficient number of measurements indicate a change, this may not always be the case for a variety of reasons. Defining stage degradation or aggradation risk is a critical component of the study. Reviewing measured discharge data would appear warranted in addition to gage rating curves.	TG
	WEST Backcheck Response: It is agreed that reviewing measured discharge data is warranted. However, this task falls outside of the given scope of work. It is recommended that this analysis be conducted as part of the hydraulic design of project features.	
	USACE Second Backcheck Recommendation:	
12	USACE Comment: Chapter 6. Section 6.1.8 documents the results of the calculated bank erosion rates as 0 for most locations. Further on, the text notes that a large number of bank erosion areas were observed in the field. What is the source of this contradiction? Can summary statements be added to this section and the Chap 6 summary? Is there any history of bank erosion protection construction projects within the study reach?	TG
	WEST Evaluation: A large number of bank failures were indeed observed in the field. However, these failures do not necessarily indicate lateral bank migration. As shown in Figure 6-13, the bank slumping and rebuilding mechanisms do not cause the bank to migrate laterally; rather, the bank stays in the same position while it is building, slumping, and rebuilding over time. The statement regarding the large number of bank failure areas has been revised to indicate that bank failure does not necessarily equate to lateral bank movement.	

Comment No.	USACE Comment/ WEST Evaluation/USACE Backcheck Recommendation/WEST Backcheck Response/USACE Second Backcheck Recommendation	Resolution Acceptance (Reviewer Initial)
	USACE Backcheck Recommendation: Can relevant statements regarding aerial photo bank movement rates be added to further support the conclusion that bank failure does not equate bank movement? The above statement regarding bank slumping and rebuilding would also suggest a sediment rich system. Any concerns with possible aggradation impacts?	TG
	WEST Backcheck Response: The text on page 6-24 in Section 6.1.8 was revised to further support the conclusion that bank failure does not equate to bank movement. It is agreed that bank slumping and rebuilding suggests a sediment-rich system. The system transports relatively high amounts of suspended sediment but lacks significant bedload transport. Therefore, because the suspended sediment does not drop out of suspension within the channel banks in large volumes and bedload transport rates are low, channel aggradation is unlikely. This conclusion was previously stated in Section 9.1 of the report, so no revisions to the report were made in regards to the possible aggradation impacts.	
	USACE Second Backcheck Recommendation:	
13	USACE Comment: Section 9.5. Section 9.5 summarizes minor impacts as a result of the project. However, it does not indicate the level of confidence or if additional evaluation is required during a detailed hydraulic modeling phase. Primary concerns are if the diversion affects or causes long term degradation or aggradation within either the depleted flow reach or the augmented flow reach. Is additional study needed to define the amount of sediment and where it goes for the project condition? The text does identify potential floodplain aggradation problems. Can definitive statements be provided about the conclusions and need for additional effort during hydraulic design?	TG
	WEST Evaluation: The site observations and geomorphic analyses conducted indicate that there are likely to be only minor impacts to the sedimentation conditions along the stream channels of the protected reaches. The reaches within the staging area will see sedimentation impacts in the overbanks but again likely only minor impacts in the channel. Therefore, no additional sedimentation analyses are recommended for these reaches. The portion of the diversion channel downstream of the Sheyenne River is likely to have the greatest potential to be impacted by sedimentation (potentially similar to what has been observed in the Horace to West Fargo Diversion). As a result, sediment transport modeling is recommended along the diversion channel to further understand the potential amounts and extents of sedimentation as well as probable maintenance requirements. Additional text was added to Section 9.5.10.	

Comment No.	USACE Comment/ WEST Evaluation/USACE Backcheck Recommendation/WEST Backcheck Response/USACE Second Backcheck Recommendation	Resolution Acceptance (Reviewer Initial)
	USACE Backcheck Recommendation: This study should either identify a numeric value for the amount of aggradation to be included in the project design, conclude that none is needed, or recommend the additional study needed to define.	TG
	WEST Backcheck Response: As seen in the previously provided report, the following text was added to the end of the last paragraph in Section 9.5.10: "Additional sediment transport analysis is recommended to further understand the potential amounts and extents of sedimentation as well as probable maintenance requirements along the LPP Diversion channel." Sedimentation impacts in the natural channels within the protected areas are expected to be minimal (within the natural variability of the system and very likely within the error of any sediment transport modeling results). In the protected areas, overbank deposition will likely be reduced and therefore bank stability is likely to improve somewhat. Sedimentation impacts in the staging area will likely increase overbank deposition rates in the affected portions of Red and Wild Rice Rivers. This will likely exceed the natural variability. Additional analysis would be required to estimate the expected amount of overbank deposition. Additional text was added to Sections 9.5.4 and 9.5.7.	
	USACE Second Backcheck Recommendation:	
14	USACE Comment: Section 9.5. Section 9.5 does not appear to consider analysis of future performance for a single event. What consideration was given to extreme flood events, identifying stability impacts as a result of the project, what kind of maintenance may be required, other responses to a single event?	TG

Comment No.	USACE Comment/ WEST Evaluation/USACE Backcheck Recommendation/WEST Backcheck Response/USACE Second Backcheck Recommendation	Resolution Acceptance (Reviewer Initial)
	WEST Evaluation: The reviewer is correct. No specific analyses were conducted to evaluate a single flood event. Geomorphic analyses are generally conducted as a means to understand long-term trends in channel location and geometry. This is used to understand the relative stability of the system and the potential for changes to channel location and geometry as a result of modification to the hydrology, hydraulics and sediment supply. No data were available to reliably compare pre- and post-flood changes in channel geometry and to make specific conclusions regarding the susceptibility of the channels to changes resulting from flooding. However, the available data indicates that there is a lack of significant changes over an extended period of time which would suggest that either significant past flood events have had relatively minor or no measureable impact to the channel morphology or that the impacts are temporary. Localized impacts may occur during flood events as a result of the project. These impacts are likely to be located immediately upstream or downstream of the diversion points as well as at locations of hydraulic structures. Hydraulic and sediment transport modeling for single events for these specific areas would provide specific information on the possible channel responses and associated maintenance requirements.	
	USACE Backcheck Recommendation: Concur.	
15	USACE Comment: Section 9.5. Section 9.5 contains a thorough review of the future condition project impact by reach. In general, it seems as though the conclusion is that impacts on stream stability are minor. The Chap 10 summary and the executive summary does not appear to provide the same definitive conclusion. Recommend that text in these sections be revised to include a few paragraphs summary similar to Section 9.5.	TG
	WEST Evaluation: Modifications to the Executive Summary and Section 10 were made in order to be more consistent with the conclusion in Section 9.5	
	USACE Backcheck Recommendation: Concur.	
16	USACE Comment: Page 6-43. Should '1978' be '1983', since earlier text indicates that the 1978 surveys are considered erroneous?	TG
	WEST Evaluation: Yes, the text has been changed from 1978 to 1983.	
	USACE Backcheck Recommendation: Thanks	

Comment No.	USACE Comment/ WEST Evaluation/USACE Backcheck Recommendation/WEST Backcheck Response/USACE Second Backcheck Recommendation	Resolution Acceptance (Reviewer Initial)
17	USACE Comment: Pages 6-37 and 6-38. Text indicates that U/S Maple River x-sec (M3) is immediately upstream of Maple River Dam 2, while the other 2 sections are some distance downstream. Since M3 is showing significant aggradation, and the M1 and M2 are showing degradation (as shown in main report and App. L), is it possible that the dam is responsible for both (i.e. aggradation upstream, degradation reach downstream), in spite of the dam downstream of M1? Please address.	TG
	WEST Evaluation: While this is a possibility, it is believed that the distance between cross sections M1 and M2 and Maple River Dam 2 is too great to strongly conclude that Dam 2 is responsible for the degradation of these cross sections. The degradation of cross sections M1 and M2 could potentially be attributed to a notch in the crest of Maple River Dam 1, located downstream of cross sections M1 and M2. Unfortunately, no records have been found that indicate when the notch in Maple River Dam 1 developed; therefore, it also cannot conclusively be tied to the degradation of these cross sections.	
	USACE Backcheck Recommendation: Can we include some text to briefly discuss this issue?	TG
	WEST Backcheck Response: Yes, text has been added to the discussion on page 6-40 to briefly discuss this issue.	
	USACE Second Backcheck Recommendation:	
18	USACE Comment: Page 6-3. Last sentence of first full paragraph indicates that banklines were only modified where it was fairly clear that bank location had moved. Can you quantify how much movement was necessary in order for it to be fairly clear?	
	WEST Evaluation: The threshold used varied somewhat depending on the location and the year of imagery being used in the analysis. Typically, the minimum threshold was approximately 15-20 feet. It is important to note that while this threshold was used to help overcome some of the uncertainties with bank identification due to the random feature identification and digitization component of the error (such as vegetation hiding bank locations), the identified movement is still subject to the systematic, image registration component of the error. In some locations, the amount of error in image registration could easily exceed the 15-20 foot threshold used. Ultimately, since the total error could not be quantified, the threshold was based on judgment of limiting factors that contributed to uncertainty in bank identification, such as image quality and vegetation. The report text was modified to include this discussion.	
	USACE Backcheck Recommendation: Thank you	

Comment No.	USACE Comment/ WEST Evaluation/USACE Backcheck Recommendation/WEST Backcheck Response/USACE Second Backcheck Recommendation	Resolution Acceptance (Reviewer Initial)
19	USACE Comment: Pages 6-5 to 6-8. Even though migration is small, it may be useful to understand how many meanders were measured in each detailed reach for which average meander is computed. It would also be helpful to understand a little better how the circles were inscribed along the arc of the centerlines (having done similar work, this can be very subjective with radii differing substantially for the same bend if done by different people).	TG
	WEST Evaluation: A column has been added to Table 3 which identifies the numbers of meanders used in the calculation for each detailed study reach. We agree that this work can be very subjective. In order to provide consistency in the comparison between years, all work was completed by one technician and reviewed by one engineer.	
	USACE Backcheck Recommendation: Thank you	
20	USACE Comment: Page 6-13. Was there evidence from the historic imagery of even wider meander belts? If so, can you quantify the historic meander belt (although the date of meander is unknown)?	TG
	WEST Evaluation: Per the SOW, we completed the analysis using 3 years of imagery for each reach; however, additional imagery is available for some reaches which could provide additional information on the historic meander belt. Additionally, the available LiDAR data for the study area could provide useful information on the historic meander belt for years prior to the available imagery; however, this exercise was not included in our SOW.	
	USACE Backcheck Recommendation: Could you include something to this effect in the report, to indicate that we're not discounting the possibility of a wider meander belt?	TG
	WEST Backcheck Response: Yes, additional text was incorporated into the discussion on pages 6-13 and 6-14 to indicate that we're not discounting the possibility of a wider meander belt.	
	USACE Second Backcheck Recommendation:	
21	USACE Comment: Pages 8-1 and 8-2. While the monitoring methods listed should be adequate for the existing reaches, it should also be equally important to monitor the proposed diversion channel with the same means, as it will be equally important to assess the diversion channels stability over the long-term in response to each flood event. Consider adding the diversion channel to the monitoring plan, as it is not specifically mentioned here.	TG
	WEST Evaluation: The report was modified to incorporate monitoring recommendations for the diversion channel.	
	USACE Backcheck Recommendation: Thank you	

Comment No.	USACE Comment/ WEST Evaluation/USACE Backcheck Recommendation/WEST Backcheck Response/USACE Second Backcheck Recommendation	Resolution Acceptance (Reviewer Initial)
22	USACE Comment: Page 10-2. It is interesting to note that the one reach shown as (maybe) aggrading (Sheyenne River at West Fargo) is located in a reach by-passed by a diversion flow. Although sediment transport has a great deal of variability, does this reach suggest the possibility that we may see a similar situation occur on the Red River through the protected area once the diversion is in place?	TG
	WEST Evaluation: While the Sheyenne River at West Fargo Reach is protected by an existing diversion, it is not protected in the same manner as the reaches that will be protected by the proposed diversion. The Sheyenne River at West Fargo Reach is protected from both the downstream end and the upstream end and can be completely isolated from the Sheyenne River. When this occurs, the discharge and velocity in the channel are near zero. This likely induces sedimentation and the apparent aggradation. However, the reaches that will be bypassed by the proposed diversion will not be fully isolated. The protected reaches of the Red River and Wild Rice River will convey discharges up to the 3.6-year event while the protected reaches of the Sheyenne and Maple Rivers will convey up to the 2-year event. Flows of this magnitude are likely to preclude any significant sedimentation within the protected reaches.	
	USACE Backcheck Recommendation: Thanks	

III. Response Certification

Title	Name	Signature	Date
Project Engineer	**Ken Puhn, CFM**		10/25/2012
Project Engineer	**Kevin Denn**		10/25/2012
Project Manager	**Hans Hadley, P.E., CFM**		10/25/2012
QA/QC Manager	**Thomas Grindeland, P.E., D.WRE**		10/25/2012
Reviewer	**Chris Goodell, P.E., D.WRE**		10/25/2012