

## APPENDIX A: SUSITNA RIVER UPPER RIVER RECONNAISSANCE PHOTOGRAPHS

# 1. PHOTOGRAPHS OF THE SUSITNA RIVER UPSTREAM OF THE MACLAREN CONFLUENCE (PRM 291.8 TO PRM 261.3)

## 1.1. PRM 291.8 to PRM 278.9



Figure A.1-1 – View upstream towards Denali Highway Bridge at PRM 292 (P5580)<sup>1</sup>.



Figure A.1-2 – View east of Denali Highway Bridge at PRM 292. Susitna River, flow from right to left (P5582).

<sup>1</sup> Photo number is listed in parenthesis. Photo numbers are marked spatially in Upper River Mapping in Study 6.5 2014 Study Implementation Report Figures 5.1-1 through 5.1-9.



**Figure A.1-3 – Surface material on mid-channel bar near PRM 291. Largest bar head particle diameter (b-axis) approximately 22mm (P774).**



**Figure A.1-4 – View of mid-channel bar near PRM 291 (P775).**



Figure A.1-5 – View of flow expansion zone and low relief mid-channel sand bars near PRM 288 (P805).



Figure A.1-6 – Local sediment source (sand) at PRM 286– terrace erosion (P871).



**Figure A.1-7 – View upstream near PRM 281. Note very wide channel and extensive sandy braid bars (P5570).**

## 1.2. PRM 278.9 to PRM 266.7



Figure A.1-8 – View upstream towards constriction in the area of PRM 278.9 (P5560).



Figure A.1-9 – Fine gravel lobes at PRM 276.2. Grab sample location - median bed material diameter ( $D_{50}$ ) is 4.2 mm (P927).



Figure A.1-10 – Sand and fine gravel dunes on alternate bar surface at PRM 276.2 (P928).



Figure A.1-11 – Sand and fine gravel dunes on alternate bar surface at PRM 276.2 (P929).



Figure A.1-12 – Ice pushed ridges and deposits on alternate bar at PRM 276.2 (P931).



Figure A.1-13 – Subsurface material on alternate bar at PRM 276.2. Grab sample location - median bed material diameter ( $D_{50}$ ) is 4.2 mm (P935).





Figure A.1-14 – Active landslide in till near PRM 276. Failure may be due to melting of permafrost (P937).



Figure A.1-15 – Active landslide near PRM 274.8 – sands and fine gravel in glacio-deltaic deposits (P956).



Figure A.1-16 – View upstream at PRM 274. Forced sinuosity due to presence of tills and bedrock (P5559).



Figure A.1-17 – Bank effects of ice processes – tree scars and some erosion, vegetation push near PRM 272.5 (P992).



Figure A.1-18 – Mid-channel bar near PRM 270. Bar composed of primarily sands and fine gravels (P5557).



Figure A.1-19 – Exposed glacial outwash terrace surface near PRM 269.5. It is a source of sands as well as gravels and cobbles (P028).



Figure A.1-20 – Ice scarred tree and eroding moraine at PRM 269 (P038).



Figure A.1-21 – Local sediment source – rill erosion moraine surface near PRM 269 (P040).



Figure A.1-22 – Eroding glacio-deltaic deposits moraine surface – view downstream near PRM 269 (P042).



Figure A.1-23 - View upstream from PRM 268 of valley floor expansion zone and mid-channel bars (P5556).



Figure A.1-24 – Pop out slide in till at PRM 267.8, probably due to melting permafrost (P062).



Figure A.1-25 – View upstream from PRM 267.5 of expansion zone and mid-channel and alternate bars (P5555).



Figure A.1-26 – View upstream from PRM 267 of expansion zone and mid-channel braid bars (P5554).

### 1.3. PRM 266.7 to PRM 261.3



Figure A.1-27 – Ice-deposited sand on floodplain near PRM 266.5 (P074).



Figure A.1-28 – Very large gravel bar and first observed mid-channel island in expansion zone near PRM 266 (P080).





Figure A.1-29 – Gravel on mid-channel bar in expansion zone near PRM 266. Most gravel observed on the mid-channel bar ranged from 32 mm to 45 mm in diameter with some gravel sized at 64 mm to 90 mm (P082).



Figure A.1-30 – Eroding terrace near PRM 266 – source of fine grained material and fine gravels (P090).



Figure A.1-31 – Ice pushed ridges in gravel deposits on mid-channel bar near PRM 265. Presence of vegetated bars not observed upstream where bars were composed of sand (P112).



Figure A.1-32 – Gravel-covered mid-channel island near PRM 264 (P138).



Figure A.1-33 – View upstream of expansion zone and mid-channel bars and islands near PRM 264 (P5551).



Figure A.1-34 – View upstream of large mid-channel bar in backwater zone upstream of constriction near PRM 263 (P5553).



Figure A.1-35 – View upstream near PRM 262 (P5548).



Figure A.1-36 – First observed boulders near PRM 261.7 (P165).



Figure A.1-37 – Angular boulder formed lateral weir upstream of Maclaren River confluence near PRM 261.7 (P167).



Figure A.1-38 – Eroding outwash terrace surface near PRM 261.5– topsets visible in profile (P176).



**Figure A.1-39 – Mass failure of till near PRM 261.5 (P177).**

## 2. PHOTOGRAPHS OF SUSITNA RIVER UPPER RIVER SEGMENT (PRM 261.3 TO PRM 187.1)

### 2.1. UR-1 (PRM 261.3 to PRM 248.6)



Figure A.2-1 –View down Maclaren River towards confluence with Susitna River at PRM 261.1. Source of gravels to Susitna River (P5547).



Figure A.2-2 – Eroding outwash terrace near PRM 260 (P213).



Figure A.2-3 – Eroding moraine – active landslide zone near PRM 259.5 (P219).



Figure A.2-4 – Pop out slide in moraine near PRM 259.5, probably due to melting of permafrost (P220).





Figure A.2-5 – Surface and subsurface material at sediment sampling site at PRM 258.6. Median particle diameter ( $D_{50}$ ) of surface sediment is 40.5 mm. Median particle diameter ( $D_{50}$ ) of subsurface sediment is 10.1 mm (P821).



Figure A.2-6 – View upstream of channel expansion zone at PRM 257. Note presence of vegetated islands (P5540).



Figure A.2-7 – Active landslide area above constriction at PRM 256 (P245).



Figure A.2-8 – Eroding outwash terrace in constriction at PRM 256 – presence of larger boulders in deposit previously not observed upstream (P258).



Figure A.2-9 – Bedrock outcrop in right bank at PRM 255.5 (P272).



Figure A.2-10 - Bedrock sill across the river at PRM 255.4 (P273).



Figure A.2-11 – Armored, ice driven side channel at PRM 254.5 (P293).



Figure A.2-12 – Large boulders in ice driven side channels near PRM 254.5 (P314).



Figure A.2-13 – Sand lobe at downstream end of ice-driven side channel near PRM 254.5 (P315).



Figure A.2-14 – View of sand bar at bottom end of ice-driven side channel at PRM 254 (P5539).



Figure A.2-15 – Terrace elevation mid-channel islands in expansion zone at PRM 254 are typical terrace heights – note person standing in foreground for scale (P319).



Figure A.2-16 – View upstream of vegetated islands and bars upstream of constriction near PRM 254 (P5538).



Figure A.2-17- Active landslide in till near PRM 251.8 (P400).



Figure A.2-18 – View upstream of vegetated islands and bars in expansion zone near PRM 250 (P5536).



Figure A.2-19 – Surface material on bar surface at PRM 250.9. Median particle diameter ( $D_{50}$ ) is 30.0 mm (P425).



Figure A.2-20 – Slab failures along outwash surface near PRM 250. Note lateral moraine along the skyline (P440).



## 2.2. UR-2 (PRM 248.6 to PRM 234.5)



Figure A.2-21 – View upstream near PRM 247 illustrating forced sinuosity at UR-2/UR-3 reach break and Tyone River confluence at lower end of photo (P5529).



Figure A.2-22 – Tyone River confluence with Susitna at PRM 247.3 (P5530).



Figure A.2-23 – Eroding glacio-lacustrine deposits at PRM 248 (P898).



Figure A.2-24 – Vegetation unable to establish on very actively eroding unstable bank face (P903).



**Figure A.2-25 – Fine-grained materials and gravel sourcing from eroding outwash terrace surface near PRM 247.7 (P918).**



**Figure A.2-26 – Active landslide zone in till near PRM 245.5 (P973).**



Figure A.2-27 – Eroding supply of fine grained sediment and gravels from glacio-lacustrine sediments at PRM 245.2 (P448).



Figure A.2-28 – Typical ice scraped bank with large cobble and boulder deposits and ice pushed vegetation near PRM 244.5 (P458).



**Figure A.2-29 – Bedrock outcrop in right bank near PRM 243.5 (P473).**



**Figure A.2-30 - Active landslide in till supplying fine sediment, gravels, cobbles, and large wood near PRM 242.5 (P507).**



Figure A.2-31 – Pop out slide in till – local gravel source near PRM 240 (P554).



Figure A.2-32 – Confined channel with no islands or bars at PRM 240. Note large ice-deposited boulders in channel (indicated by surface disturbance in flow) (P5526).



Figure A.2-33 – Ice paved bank on high island surface with mowed vegetation near PRM 238.2 (P618).



Figure A.2-34 – Ice deposited material on top of high island surface near PRM 238.2 (P611).



Figure A.2-35 – Ice deposited boulders on top of bank near PRM 237.6 (P650).



Figure A.2-36 – Large, primarily fine grained (sand) sediment source near PRM 235.6 (P699).





Figure A.2-37 - Course grained sediment (cobbles and boulders) source (till) near PRM 235.6 (P701).



Figure A.2-38- High eroding lateral moraine with large cobbles and boulders at PRM 235 (P714).

### 2.3. UR-3 (PRM 234.5 to PRM 224.9)



Figure A.2-39- Fine to medium gravel storage in mid-channel bar in expansion zone near PRM 233.5 (P782).



Figure A.2-40 – View upstream near PRM 233.5 to first expansion zone with mid-channel bar since UR-1 (P5516).



Figure A.2-41 – View upstream at PRM 230.5 – ice paved bank-attached gravel bars – vegetated bedrock banks. Old fan surface observed on left bank (P5512).



Figure A.2-42 – Typical vegetated hillslope (PRM 229.5) observed throughout reach. Note height of ice trim line about 10-20 feet above water surface (P033).



Figure A.2-43 – Shallow slide in colluvial materials overlying bedrock on hillslope near PRM 229.5 (P032).



Figure A.2-44 – Bedrock right bank near PRM 232.5 (P829).



Figure A.2-45 - Eroding outwash terrace near PRM 229 – local fine and coarse grain sediment supply (P069).



Figure A.2-46 – View downstream at PRM 226 of bedrock outcrop and vegetated bedrock slopes on right and left banks in Vee Canyon (P750).



**Figure A.2-47 – View upstream near PRM 226 at right bank colluvial cones in Vee Canyon – local bedrock source of large sediment (P757).**

## 2.4. UR-4 (PRM 224.9 to PRM 208.1)



Figure A.2-48 – View upstream of the expansion zone in UR-4 at the bottom end of Vee Canyon (UR-3/UR-4 reach break) (P5498).

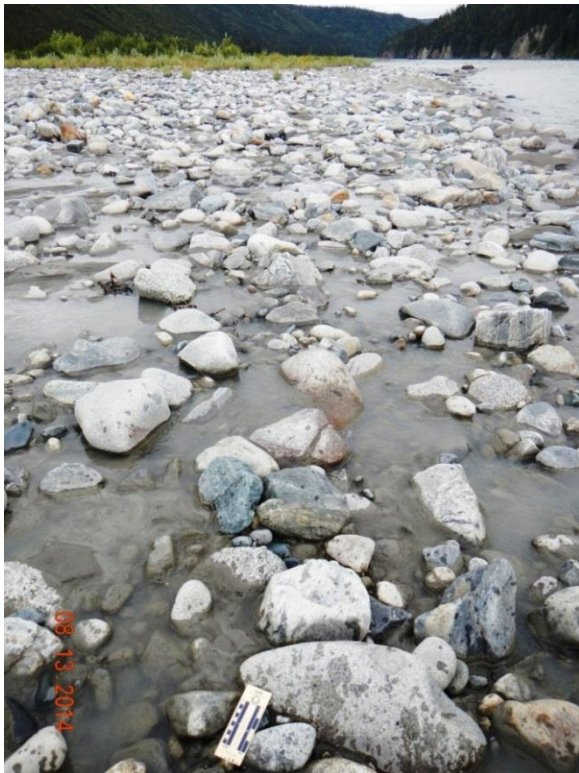


Figure A.2-49 – Armored surface material at head of gravel bar just downstream of Vee Canyon (P871).



Figure A.2-50 – Imbricated surface material on gravel bar (PRM 224.6) in expansion zone downstream of Vee Canyon. Site of surface and subsurface sampling. Median particle diameter ( $D_{50}$ ) of surface bed material is 68.3 mm. Median particle diameter ( $D_{50}$ ) of subsurface bed material is 27.3 mm (P877).



Figure A.2-51 – View upstream at PRM 223 of an expansion zone and vegetated island (P223).





Figure A.2-52 – Active slide in till near PRM 221 (P114).



Figure A.2-53 – Ice pushed ridges on fan surface of Unnamed Tributary at PRM 221.2 (P121).



Figure A.2-54 – Sand deposits and ice scared trees on top of high fan surface at Unnamed Tributary PRM 221.2 (P131).



Figure A.2-55 – Fine grained material on top of ice-deposited coarse grained deposits on high fan surface at PRM 221.2 (P130).



Figure A.2-56 – View upstream at PRM 220.7 of ice paved gravels and ice-sheared vegetation. Trim line about 15 feet above water surface (P161).



Figure A.2-57 – Bedrock outcrop near PRM 220.2. Ice shear line present on vegetated surface and outcrop surface on right bank (P177).



Figure A.2-58 – View upstream at PRM 220. Old fan surface illustrated on left bank (P5491).



Figure A.2-59 – Aerial view of lateral bedrock controlled channel at PRM 219 (P5490).



Figure A.2-60 - Active landslide in till at PRM 217 (P964).



Figure A.2-61 – View upstream of mid-channel bars at PRM 215. Bedrock outcrop along right bank (P5484).



Figure A.2-62 – View upstream at PRM 215 of vegetated hillslopes in wider valley (P996).



Figure A.2-63 – View upstream near PRM 212 of large gravel bars in expansion zone (P5481).



Figure A.2-64 – Active landslide zone on bend near PRM 209 – till over bedrock (P371).



Figure A.2-65 – View upstream near PRM 208.5 of terrace height island and side channel. Lateral weir at head of channel and vegetating side channel bed. Active landslide zone and local sediment supply on outside bend (river right) (P5473).

## 2.5. UR-5 (PRM 208.1 to PRM 203.4)



Figure A.2-66 – Surface material at head of bar at sediment sampling site at PRM 208.0. Bedrock outcrop on river right. Median particle diameter ( $D_{50}$ ) is 47.5 mm (P127).



Figure A.2-67 – Ice shear line along vegetated bank typical throughout Geomorphic Reach UR-5 (photo near PRM 207.6) (P134).





**Figure A.2-68 – Hydrothermally-altered rock at PRM 207.4 (P142).**



**Figure A.2-69 – View upstream at PRM 207. Bedrock controlled single channel. Outcrop in P142 seen on outside of bend (P5471).**



Figure A.2-70 – Bedrock underlain strath terrace near PRM 207.2 (P145).



Figure A.2-71 – Surface material at PRM 206.8. Average median particle diameter ( $D_{50}$ ) in reach (UR-5) is 47.5 mm (P165).



Figure A.2-72 – Bedrock outcrop with overlying strath deposits at PRM 205.5 on right bank (P188).



Figure A.2-73 – View upstream near PRM 205 (P5466).



**Figure A.2-74 – Bedrock outcrop on right bank at PRM 204.1 (P210).**



**Figure A.2-75 – High island surfaces (typical terrace height) with lateral weir and vegetating side channel near PRM 203.9. View looking downstream at inlet to side channel (P218).**

## 2.6. UR-6 (PRM 203.4 to PRM 187.1)



Figure A.2-76 - View upstream towards UR-5/UR-6 boundary of expansion zone in UR-6 (P5462).



Figure A.2-77 - Susitna River right bank at PRM 202.7. Ice line on vegetation present in addition to eroded bedrock and outwash material (P250).



Figure A.2-78 – View upstream of expansion zone near PRM 202 (P5461).



Figure A.2-79 – View of Susitna River left bank near PRM 202. Wide bedrock bound valley floor with vegetated overlying outwash or till (P268).



**Figure A.2-80 – Active Landslide in till near PRM 200 – Susitna River right bank (P5459).**



**Figure A.2-81 – View upstream of active landslides in till near PRM 200 – Susitna River right bank (P5456).**



Figure A.2-82 - Active landslide in till near PRM 199.5 – Susitna River right bank (P5454).



Figure A.2-83 – View of active landslide in till near PRM 199.5 (P325)





**Figure A.2-84 - View upstream of expansion zone near PRM 199. Vegetated landslide material evident on Susitna river right bank (left side of photo) (P5453).**



**Figure A.2-85 – Active landslide in till near PRM 197.5 – Susitna River right bank (P5451).**



Figure A.2-86 – Ice effects on floodplain erosion near PRM 196.6 (P430).



Figure A.2-87 – Bank stratification at PRM196.6. Note – This was the first observed occurrence of a relatively low floodplain in the Upper River Segment typical of those common in the Middle River Segment (approximately 6' from water surface on 8/16/14) (P432).



Figure A.2-88 – Surface material at sediment sample location at PRM 196.5 – first exposed mid-channel bar downstream of Watana Creek. Median particle diameter ( $D_{50}$ ) is 26.1 mm (P374).



Figure A.2-89 – View upstream of expansion zone near PRM 195.5 (P5444).



Figure A.2-90 – View upstream near PRM 191 of bedrock bounded channel (P5438).



Figure A.2-91 – Surface material sediment sampling site at PRM 190.1. Median particle diameter ( $D_{50}$ ) is 56.7 mm (P484).



Figure A.2-92 – Ice ramping and vegetation scarring at head of island at PRM 190.1. Similar ice effects observed at the head of other islands within the UR-6 Geomorphic Reach (P486).



Figure A.2-93 – View upstream from expansion zone upstream of Deadman Creek near PRM 190 (P5435).