

14 June 1966

MEMORANDUM FOR: RECORD

SUBJECT: Review of Alternative Plans on Avon Bypass

TO: Chief, Planning Branch

1. Reference is made to DF from Chief, Technical Engineering Section dated 18 March 1966, subject as above, copy inclosed.

2. The referenced DF summarizes study costs for the following alternatives to the Bypass: channel widening, channel deepening, raising existing levees, upstream storage, and upstream diversion. The most feasible alternative to the Avon Bypass and downstream levee and channel improvement was found to be raising of existing levees. Cost of this alternative was estimated at \$27,400,000. This cost would be \$4,682,000 less than the Avon Bypass and downstream channel improvements estimated at \$32,082,000 including interest during construction. A review of the study for raising existing levees revealed the following items that can be questioned:

a. Riprap Protection. - Channel velocities used in this study appear to be low for some reaches. A check at river mile 15.0 indicated that velocities would probably be 8 to 10 feet per second rather than 6.6 feet per second shown in the study. Riprap protection included 12 inch riprap plus 12 inch bedding. Because of numerous river bends, average velocities of 8 to 10 feet per second and maximum velocities 30 to 40% greater, a 12 inch riprap thickness does not appear adequate for some of the protected river reaches.

b. Embankment Contingencies. - Coordination with Technical Engineering Section reveals that no quantity contingencies were used. The Survey study for the levee and channel improvements included a contingency of 20% for shrinkage and 50% overall contingency. A quantity contingency of at least 25% appears to be warranted. Use of a 25% quantity contingency for 5,400,000 cubic yards of embankment would result in an additional 1,350,000 cubic yards of embankment. The additional cost at \$1.35 a cubic yard would be \$1,800,000. This cost when increased by overall contingency factor and S & A would exceed \$2,000,000.

NPSEN-PL-PS

SUBJECT: Review of Alternative Plans on Avon Bypass

c. Comparison of Unit Costs. - A cost of \$1.35 a cubic yard was used for embankment. Costs for levee and channel improvement downstream of the Avon Bypass project included \$1.75 a cubic yard for embankment. Cost of the downstream levee and channel improvements should be reduced \$800,000 to take in account the use of embankment costs of \$1.75 a cubic yard compared to embankment costs of \$1.35 a cubic yard in the alternative study of raising existing levees. Computations are as follows:

1,400,000 cubic yards @ \$.40/yd	=	\$560,000 savings
+ 25% contingency	=	140,000
+ E & D and S & A	=	<u>100,000</u>
Savings		\$800,000

d. Road Relocation. - Five miles of road relocation upstream of Sedro-Woolley were omitted. Costs for road relocation at \$50,000 a mile would be \$250,000.

e. Nookachamp Creek Area. - No pumping plant was provided for the levee along Nookachamp Creek. An assumption was made that flooding behind the levee from interior drainage would be only 3.1 feet over a five square mile area, but this flooding would be less than would occur with the Avon Bypass and downstream levee and channel improvement project. The Corps of Engineers would not build a levee system without taking care of interior drainage. A pumping plant should be included in the project. Based on coordination with Soil Conservation Service in Spokane on interior runoff for more than 40,000 acres of area, a pumping plant costing about \$2,000,000 would be required.

f. Engineering, Design, Supervision, and Administrative Costs. Our survey study of channel and levee improvements used 11.5% and 8% respectively for E & D and S & A costs. The alternate study of raising levees used 6% and 10% respectively for these costs. The E & D and S & A costs of 11.5% and 8% were based on detailed analysis of more than 30 miles of levees and the spread of the project. Use of 11.5% and 8% respectively for E & D and S & A costs would increase the costs of alternative of raising levees by about \$800,000.

4. A summation of the cost differences noted above is approximately \$6,000,000 as shown in the following table.

Embankment Contingency	-	\$2,000,000
Comparison of Unit Costs	-	800,000
Road Relocation	-	250,000
Pumping Plant for Nookachamp Creek	-	2,000,000
Effect of different E & D and S & A Costs	-	<u>800,000-</u>
Total		\$5,850,000

NPSEN-PL-PS

SUBJECT: Review of Alternative Plans on Avon Bypass

The above differences in cost would result in the Avon Bypass plus the downstream levee and channel improvement projects costing less than the alternative of raising levees. Additional costs for the alternative would result from increasing some riprap thickness to greater than 12 inch thickness utilized in the alternative study. Discussions with Lloyd Johnson, Skagit County Engineer, and George Dynes, Commissioner of Diking District No. 20, have indicated that any major raising of existing levee system in the Skagit River delta is not practicable. Any major increase in river stage by raising of the levee system would result in blowouts under the levees that could cause serious damages and loss of life to residents living in the flood plain. This matter was further discussed with George Dynes in this office approximately six weeks ago.

5. Adequate consideration may not have been given to the serious interior drainage problem that occurs during flood periods at Mount Vernon. Both the 1951 and the 1959 floods caused extensive backup in the storm drain and sewage disposal systems for the city. Any major raising of the levee at Mount Vernon would create a serious aggravation of the interior drainage problem. Similar interior drainage problems would exist at the towns of Burlington and Sedro-Woolley for a plan of raising the levees. An evaluation of interior drainage costs are difficult with the limited data available on drainage needs for these towns.

6. My review indicates that the Avon Bypass plus the downstream levee and channel improvements is a more economical development than the alternative of raising existing levees. The alternative of raising levees is a concern to the local sponsor because of possibilities of blowouts under the levee. Velocities would exceed 6 ft/sec. for flows of 180,000 to 190,000 c.f.s. for some reaches of the project area. Mr. Bardsley, Chief F&M Branch advised me by telephone on 16 June that, in his opinion, he did not think a levee system in the Skagit River delta could withstand velocities of more than 6 ft/sec. because of the large amount of bottom scour that would occur. Costs for protection against bottom scour have not been evaluated. Maintenance of adequate channel capacity, especially for the downstream portion of the project could be costly. I know of no way of predicting the amount of sediment and gravel from scour of upstream areas that would deposit in the lower channel estuary, and would require periodic removal. I would recommend that no further consideration be given at this time to the alternative of raising existing levees and that we direct future efforts towards our authorized Avon Bypass Project and the proposed downstream levee and channel improvements.

*R. Skrinde*  
R. SKRINDE

Chief, Puget Sound Basin Section