# APPENDIX F

# WATER SURFACE ELEVATION MODELS

# TECHNICAL MEMO

Date: 25 August 2016 (Synopses added 24 October 2016)
To: Jviation, Inc.
From: Raymond Walton
RE: **Harvey Field Airport Master Plan: Task 4 – Alternatives - Simulate Airport Way Relocation and Runway Clear Approaches, 8-2016 Proposed Conditions**

## PURPOSE

This memo describes our analysis, showing that relocating both Airport Way and the runway/taxiway at Harvey Field would have no measurable (0.00') impact on the 100-year base flood elevation (BFE).

## BACKGROUND

**Synopsis: FEMA and the Corps of Engineers rely on the flood studies and modeling for the Snohomish River that WEST Consultants (WEST) prepared in 2001. Harvey Field lies entirely within a flood water "storage area", and not within any area where a flooding Snohomish River might significantly flow ("reaches").**

In 2001, WEST completed a detailed Flood Insurance Re-Study of the Snohomish River. The study was conducted for the Seattle District, Corps of Engineers, with funding provided by FEMA Region 10. The study became "effective" on September 16, 2005.

The 2001 hydraulic modeling was based on the Corps' model, UNET, a one-dimensional, unsteady-flow model which is FEMA-approved. The Snohomish River was modeled as a combination of "reaches" (the Snohomish River and distributaries, and Marshlands) and "storage areas" (Figure 1). Figure 2 shows the "storage areas" near Harvey Field. Harvey Field, Airport Way, and the area south of Airport Way (where Airport Way is proposed to be re-located) lie entirely within Storage Area #9 (SA#9), which is outlined in purple. Figures 1 and 2 also include information for Storage Areas SA#2 and SA#3, which lie to the east and north, respectively (Figure 1), because they represent overflow pathways from the Snohomish River and therefore directly influence water levels at Harvey Field.

In the UNET model, "storage areas" are treated using only conservation of mass (or water). The change of storage, and therefore water surface elevation, equals flows into the area minus flows leaving. The assumption in treating storage areas in this manner is that water at a given elevation is connected to all waters at the same elevation throughout the storage area.

# SIMULATION OF PROPOSED ALTERNATIVE

**Synopsis: To calculate the project's impact on BFEs, WEST used the volume of fill needed to build the Airport Way and the runway/taxiway projects. WEST found that the projects would not cause any increase to BFEs. Making sure that fill does not block stored floodwater from flowing from one area to another is important. Further, the proposed projects do not increase the amount of floodwater that would otherwise enter this storage area when the Snohomish River experiences a major flood.**

As part of the masterplan process, WEST was tasked with running a numerical model to simulate the hydraulic effects of proposed land changes. Jviation, Inc. provided WEST a spreadsheet of potential earthwork quantities for a proposed condition in which Airport Way is moved to the south, and embankment fill placed to meet County criteria for roadway drainage, and the existing runway and taxiway of Harvey Field were extended towards the south (Table 1 and Figure 3):

**Table 1. Cumulative Earthwork Volumes for Airport Way and Runway Relocation**

| Elevation Range (NAVD) | | Incremental Volume | Cumulative Net Volume |
|---|---|---|---|
| Min Elevation | Max Elevation | | |
| FT | FT | CU YD | CU YD |
| 7 | 8 | 0.64 | 0.64 |
| 8 | 9 | 14.69 | 15.33 |
| 9 | 10 | 29.97 | 45.30 |
| 10 | 11 | 46.01 | 91.31 |
| 11 | 12 | 747.48 | 838.79 |
| 12 | 13 | 1898.00 | 2736.79 |
| 13 | 14 | 1542.70 | 4279.49 |
| 14 | 15 | 2025.71 | 6305.20 |
| 15 | 16 | 2604.07 | 8909.27 |
| 16 | 17 | 903.15 | 9812.42 |
| 17 | 18 | -825.70 | 8986.72 |
| 18 | 19 | 1003.32 | 9990.04 |
| 19 | 20 | 3508.77 | 13498.81 |
| 20 | 21 | 6291.98 | 19790.79 |
| 21 | 22 | 6713.00 | 26503.79 |
| 22 | 23 | 6275.77 | 32779.56 |
| 23 | 24 | 4534.20 | 37313.76 |
| 24 | 25 | 2644.65 | 39958.41 |
| 25 | 26 | 1751.75 | 41710.16 |
| 26 | 27 | 617.93 | 42328.09 |
| 27 | 28 | 31.86 | 42359.95 |
| 28 | 29 | 0.00 | 42359.95 |

Both the existing conditions and proposed conditions models to evaluate the impact of the relocation of Airport Way. The results showed no increases in flood elevations during the 100-year flood, when compared to two decimal places.

The biggest factor controlling water surface elevations in this area (including SA#2, SA#3, SA#9 and Marshlands) is the amount of water that would overtop the Snohomish River levees during a flood event. As the proposed project has no effect on water levels in the Snohomish River from Monroe to Snohomish, the amount of water entering SA#9, which includes Harvey Field and Airport Way, would be unchanged. Water can exit SA#9 through bridges to Marshlands, and the small loss of storage in SA#9 would be spread out over a much larger area that includes SA#2, SA#3 and Marshlands.

The model results show that the proposed project on its own would cause negligible changes in water surface elevations (0.00 ft rise) during the 1% annual exceedance (100-year) event. Provided the storage area remains hydraulically connected by openings in the roadway embankment, the project would work hydraulically.

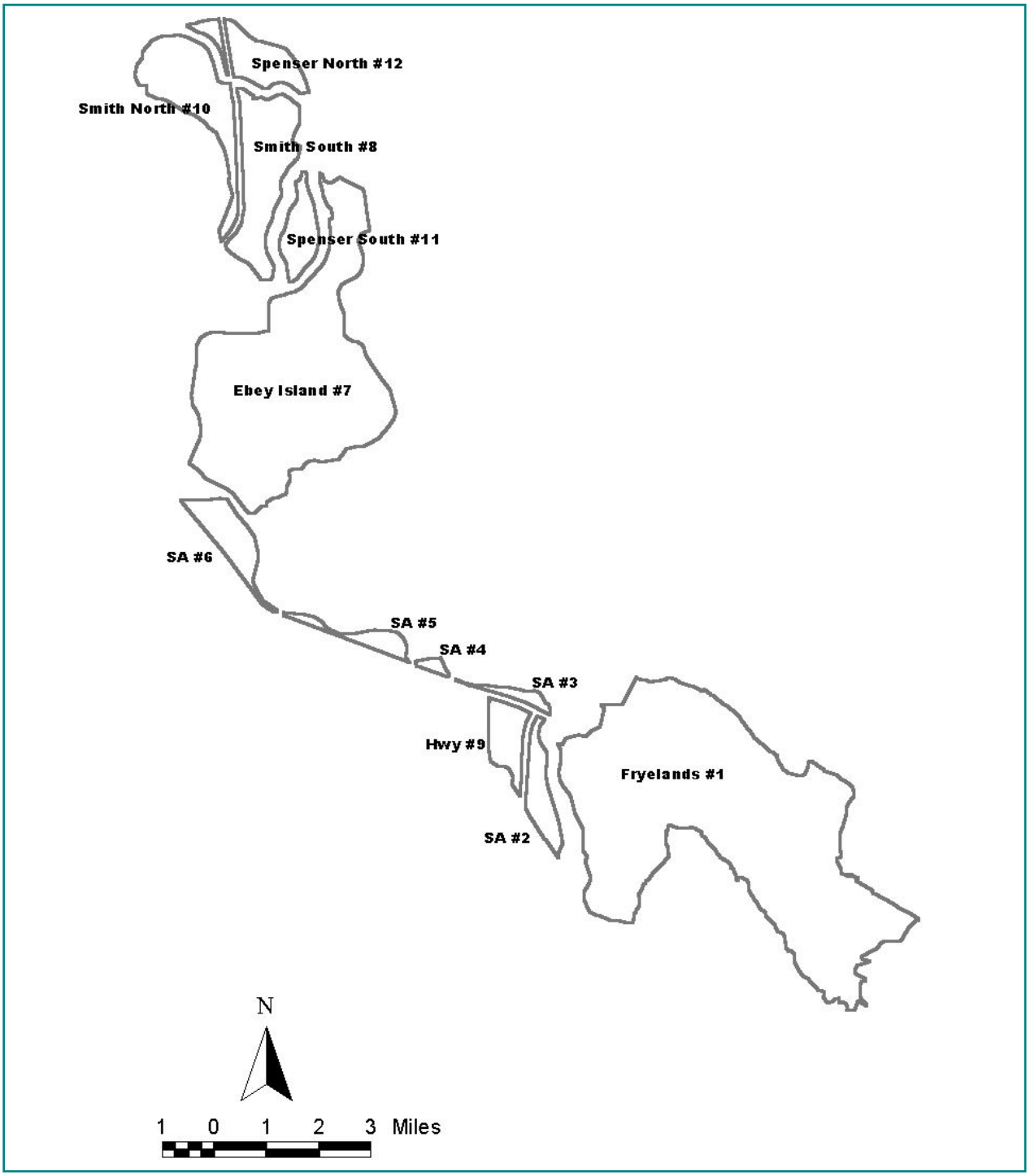


**Figure 1. Storage Areas in Snohomish River UNET Model**

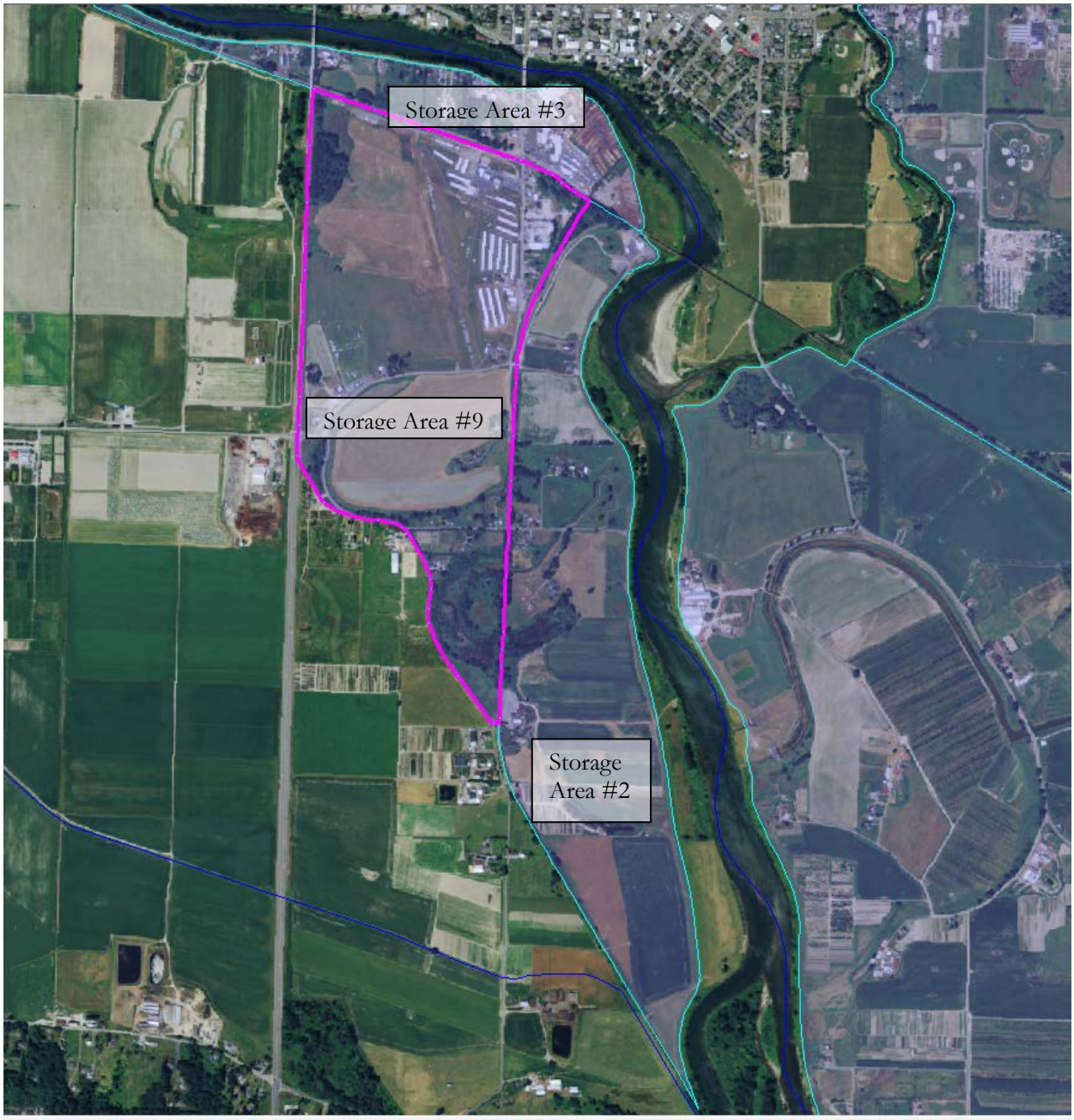


**Figure 2. Storage Areas near Harvey Field**

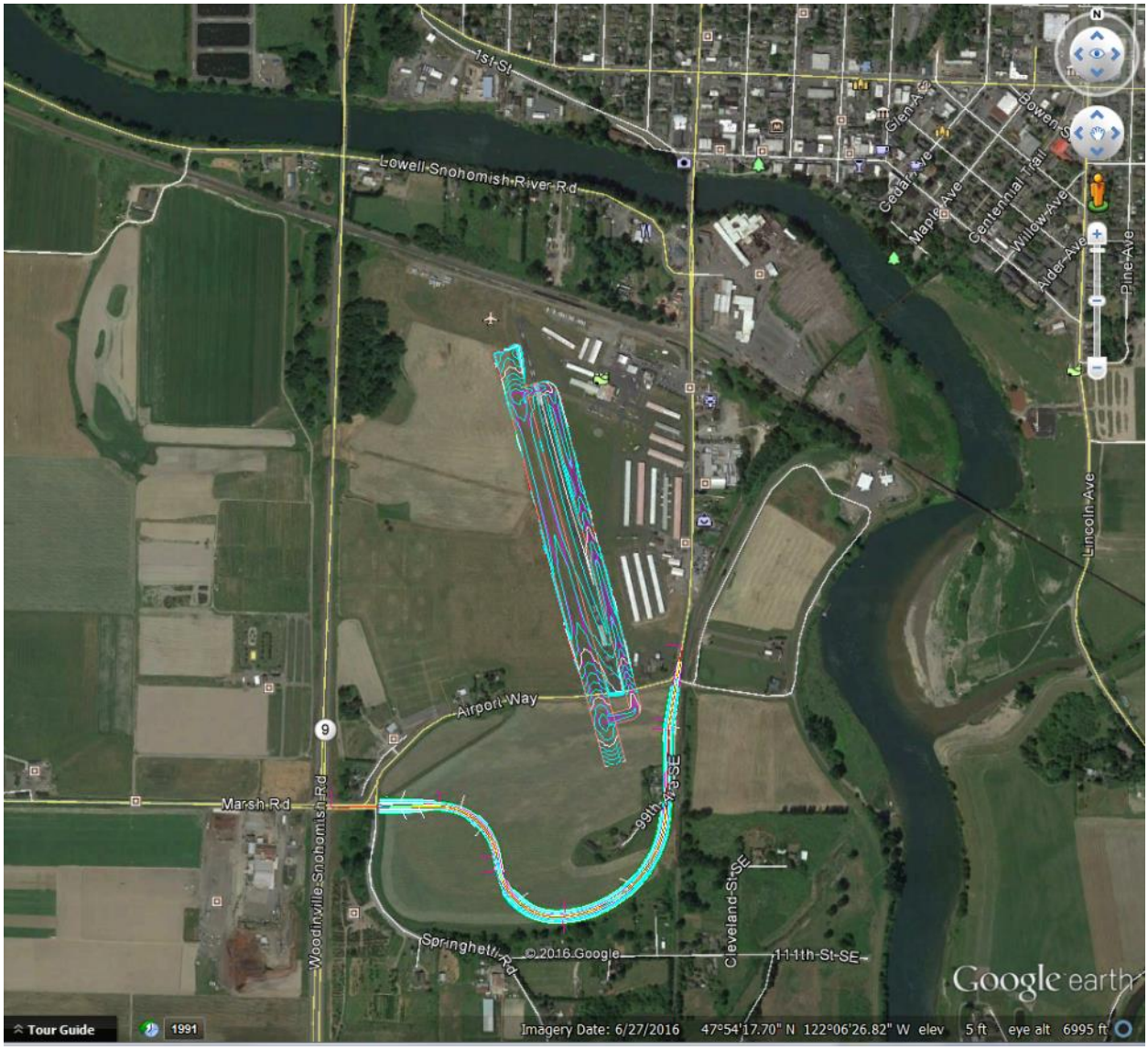


**Figure 3. Proposed Layout of Airport Way and Runway Extensions**