

Fir Island Farm Estuary Restoration Project

Lessons Learned

Washington State Department of Fish and Wildlife



Image: Julie Morse, The Nature Conservancy

Fir Island Farm: Estuary Restoration Project Overview



- Restored 132 acres of estuary habitat
- Constructed 5,800 feet of setback dike designed to improve coastal resiliency
- Completed pump station, tidegates and outfall structure

Fir Island Farm Estuary Restoration Project

Lessons Learned

- Landowner Agreements
- Pre-Project Data Collection
 - Construction planning
 - Water Quality compliance
 - Cost of in-water work
- Dike Analysis and Design
 - Climate Change
 - Settlement and Construction
 - Monitoring and Change Orders
 - Cost
- Off-site Drainage Concerns
 - Mitigation



Lessons Learned: Landowner Agreements

Landowner Agreements are Important.

Diking/Flood Control Districts have easements for levees/dikes

They maintain the flood protection system and flood fight

Without an agreement in place you will be responsible for long term O&M of setback levees/dikes



Lessons Learned: Pre-Project Data Collection

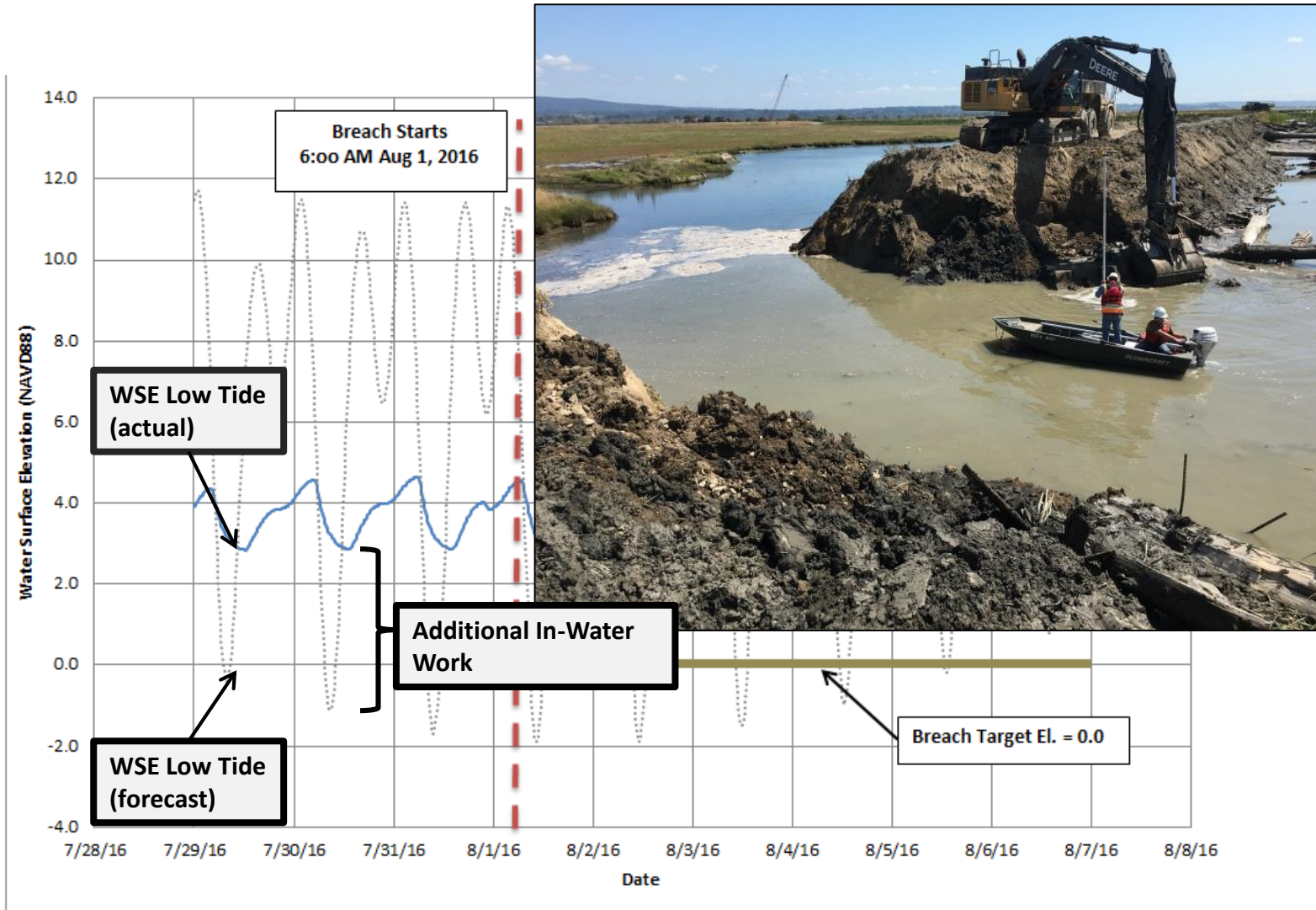
Construction Planning

- Site specific water Levels let us better understand how much in-water work would be required during the breach.
- Allowed for better coordination with Ecology for WQ compliance
- Allowed for better cost estimating
- Protected us from a large dewatering claim



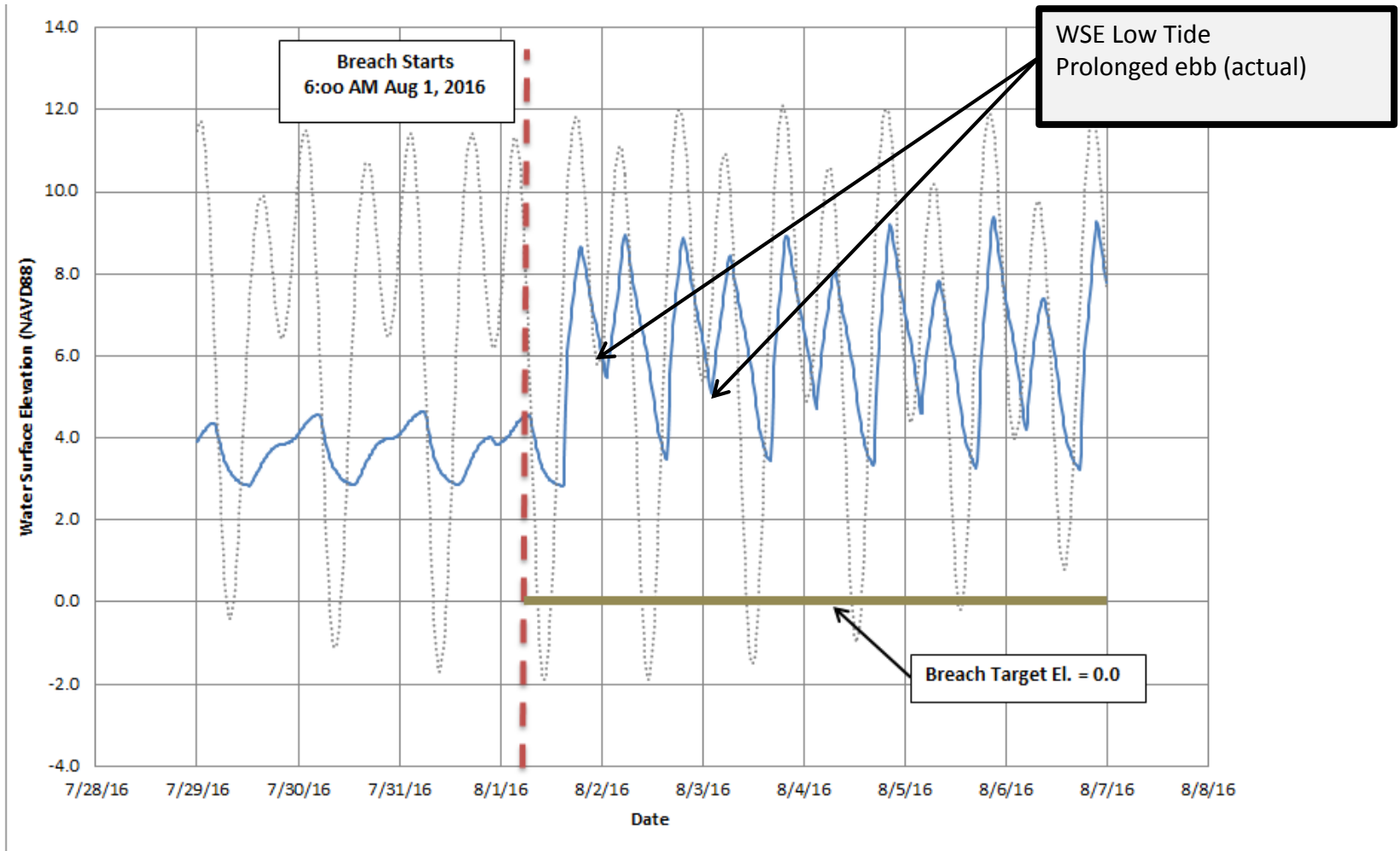
Lessons Learned: Pre-Project Data Collection Construction Planning

Lesson Learned: The site specific low tide was significantly higher than the closest tide station



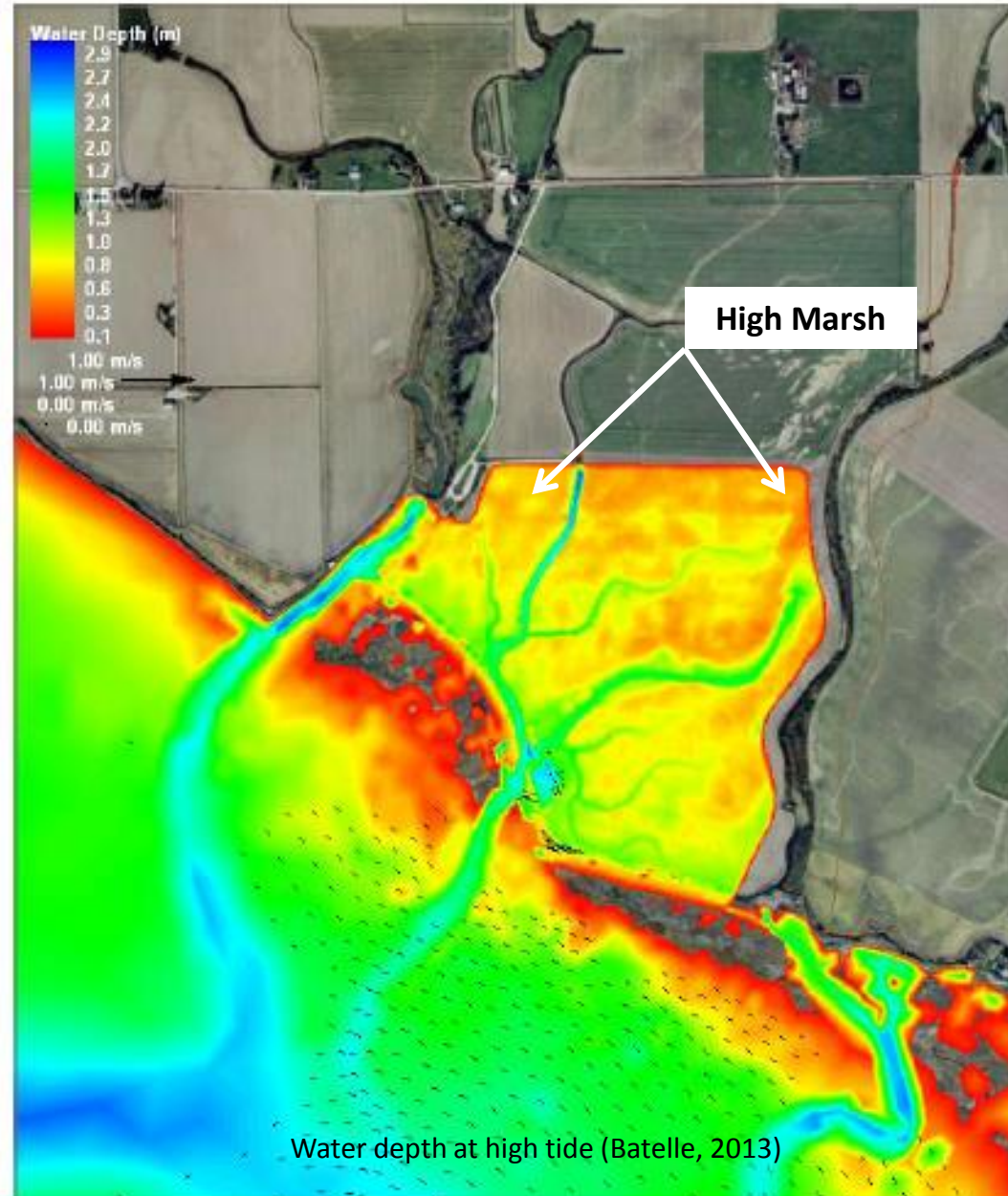
Lessons Learned: Pre-Project Data Collection Construction Planning

Lesson Learned: The site did not drain following the breach, resulting in additional in-water work



Lessons Learned: Off-Site Drainage Impacts

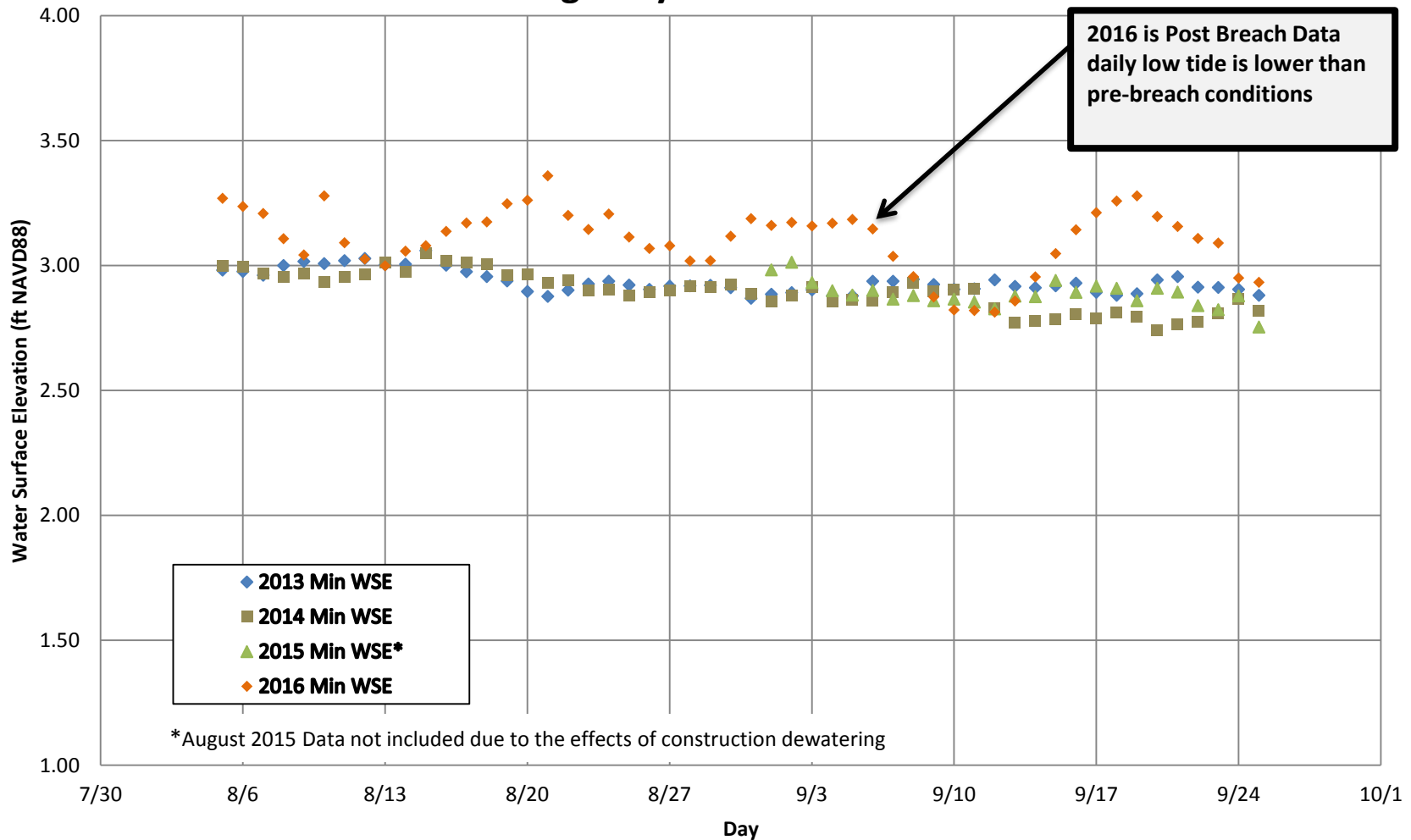
- Hypotheses:
 - Increases in tidal prism on the site after a dike setback result in a prolonged ebb tide.
 - Small changes (0.1 ft) can have a big impact on upstream “interior drainage”
- Analysis tools:
 - hydrodynamic modeling
 - data loggers
- Results: model predicted changes water surface elevations due to changes in local hydrodynamics/prolonged ebb tide



Lessons Learned: Off-Site Drainage Impacts

Lesson Learned: downstream ebb tides were muted as predicted in the HDM

Fir Island Farm Estuary Restoration Project No Name Slough Bayside Water Surface Elevations



Lessons Learned: Off-site Drainage Impacts

Mitigation Measures

- Pump Station
 - Three 3,000 gpm pumps
 - Cost = 1.2 M/appx. 14% overall construction cost
- Tidegates
 - 6 tidegates (three new tidegates)
 - Cost = 1.1M/appx. 13% overall construction cost



Lessons Learned: Dike Design, Construction, and Settlement

- Level of Protection/Storm surge/climate change
- Constructability
- Settlement



Lessons Learned: Lessons Learned Dike Design



- Understand the current levee system, what level of protection is currently provided
 - This is not always as simple as matching an elevation
- Understand current engineering analysis and design standards
- Understand existing deficiencies on the site- You can't just push existing problems on to adjacent landowners

Lessons Learned: Storm Surge/Climate Change

- Between Year 1 and Year 2 construction the existing dike was overtopped
- Dike is approximately 2-ft higher than existing dike
 - Will withstand large storm events without damage
 - Small percentage of the overall project cost



Lessons Learned: Constructability

- It's hard to construct 5,800 LF of dike in one summer
 - 80 to 90 workers on site
 - Averaged about 4,000 tons of dike material each day – roughly 28 trucks running 1-hour round trips for 10-hours a day
 - Material is very weather sensitive



Lessons Learned: Settlement

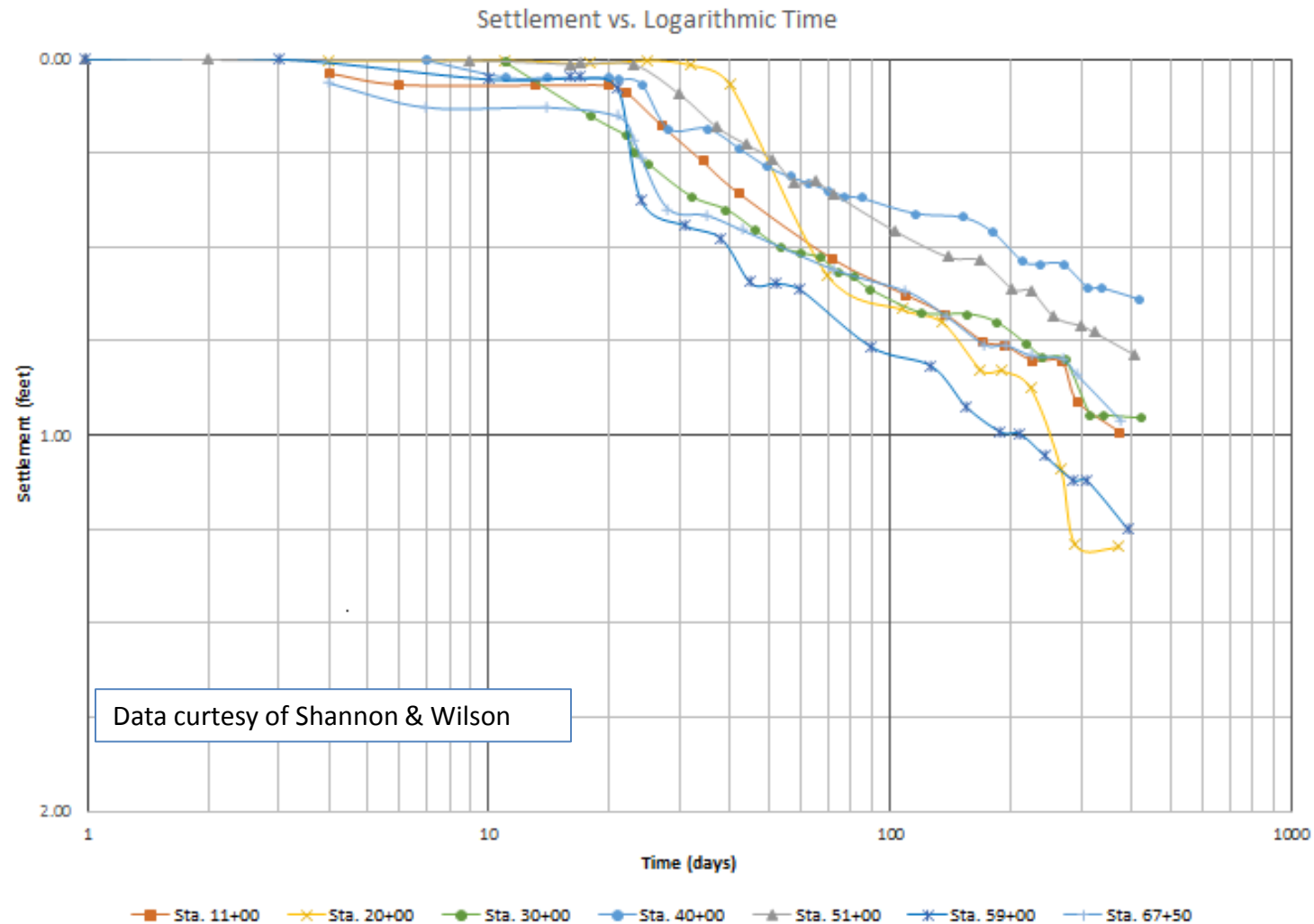
- Geotechnical investigation predicted 5 to 7 inches of settlement occurring over 20 years' time
- Settlement monitoring stations were installed along the entire length of the dike
 - Measure the top of the dike select fill
 - Top layer of gravel does not “count” for protection



Lessons Learned: Settlement

Lessons Learned:

- 1. Settlement that occurred between Year 1 and Year 2 was greater than predicted rates**
- 2. Settlement curves did not flatten out after a year**
- 3. Addition 0.5 ft safety factor was built into the Year 2 design**





Photos: Jenny Baker: TNC

Project Partners

- Diking and Drainage District 22
- Skagit Watershed Council
- NOAA
- Skagit Conservation District
- Seattle City Light
- Western Washington Agricultural Association
- The Nature Conservancy
- Skagit River System Cooperative

Funding Partners

- Salmon Recovery Funding Board
- Puget Sound Partnership/Recreation & Conservation Office (PSAR Grant)
- NOAA/TNC (Coastal & Marine Habitat Restoration Program Grant)
- USFWS (National Coastal Wetland Conservation Grant)

