Tidal Filtering of Pumping Test Data in the Downtown Seattle and Elliot Bay Area

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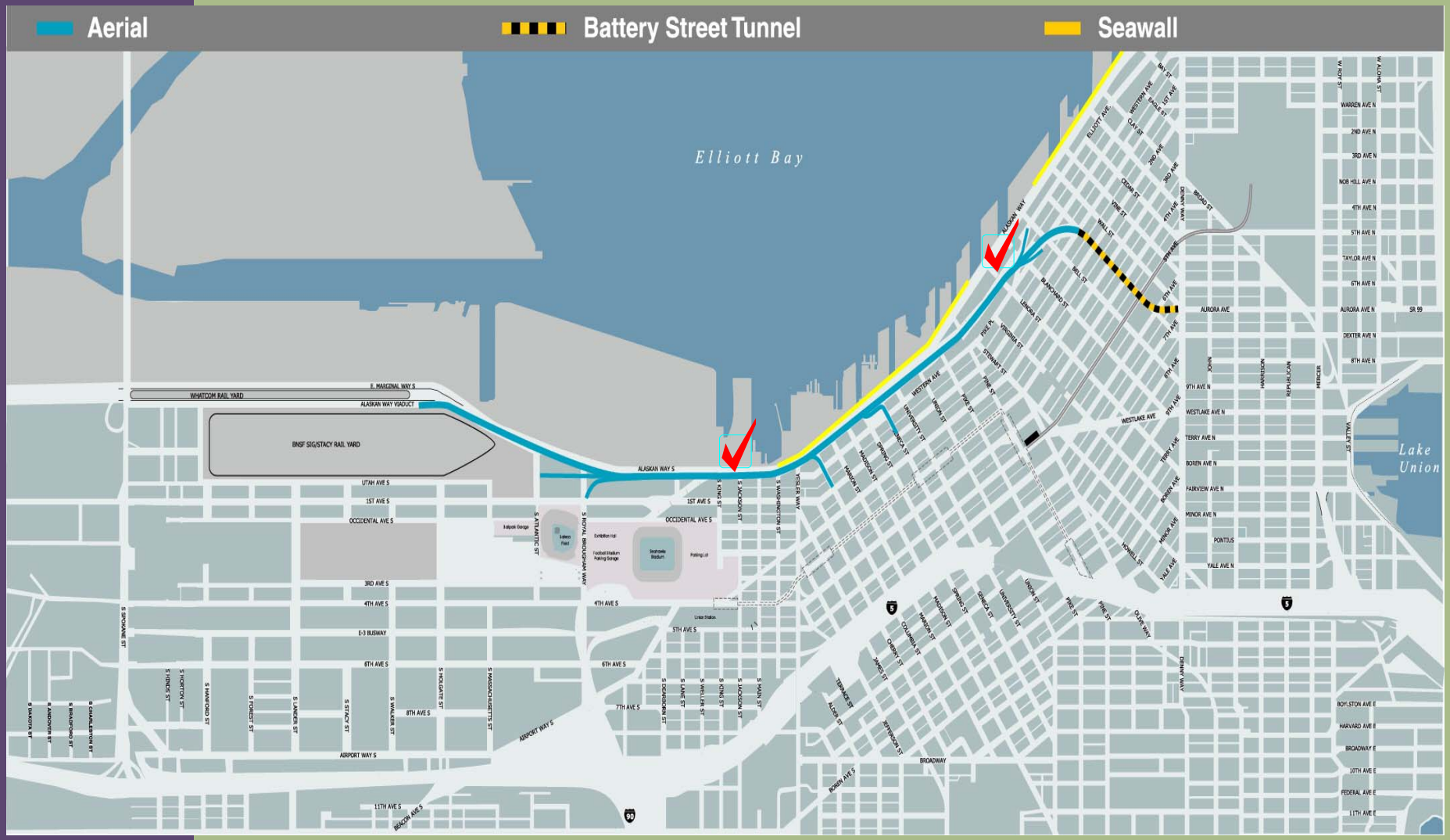
Presentation Overview

- Project Background
- Objectives of Hydrogeologic Investigation
- Data Collection and Pumping Tests
- Data Reduction
- Tidal Correction
- Discussion of Results and Recommendations

Project Background

- SR 99: Alaskan Way Viaduct Project

Project Location

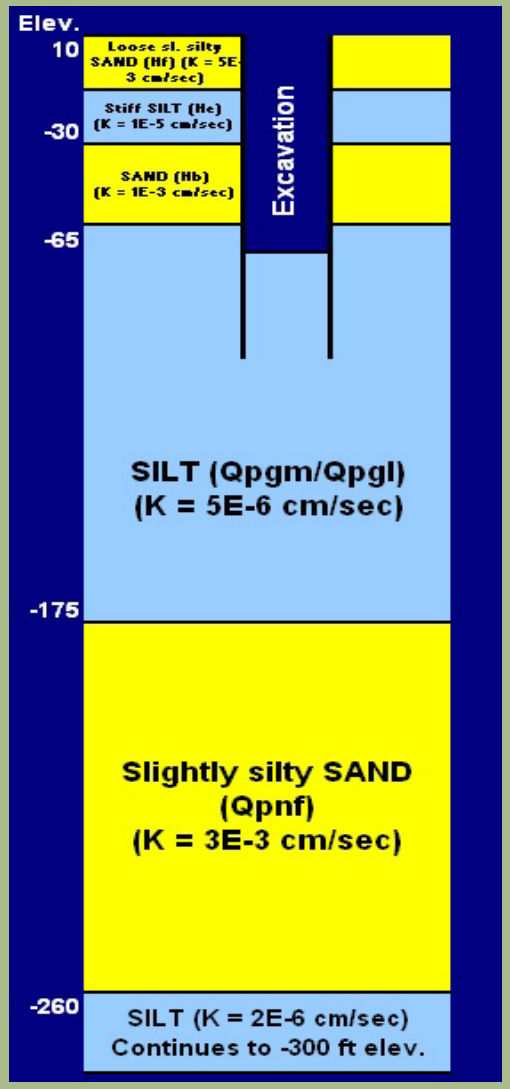


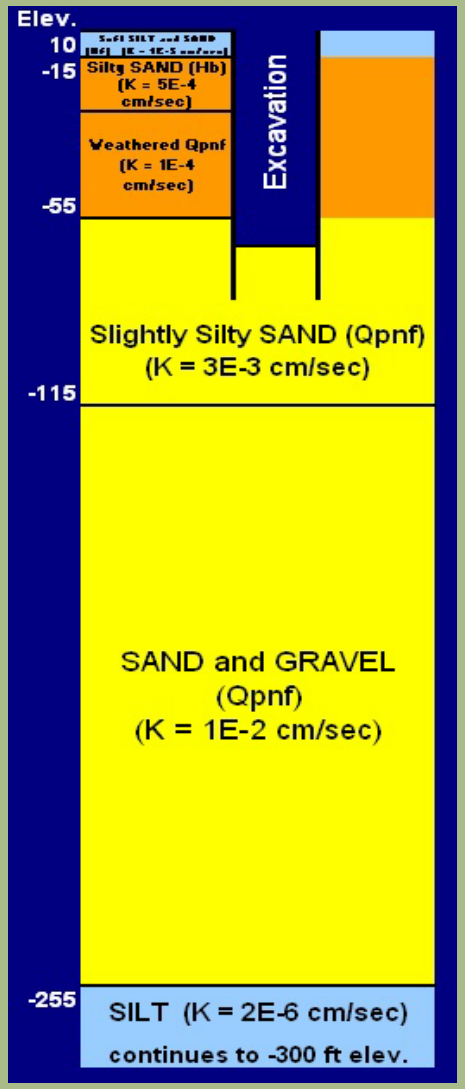
Hydrogeologic Investigation

- Perform subsurface exploration and aquifer testing
- Estimate groundwater conditions and aquifer parameters
- Perform dewatering analysis
- Input and calibration for groundwater modeling

Geology

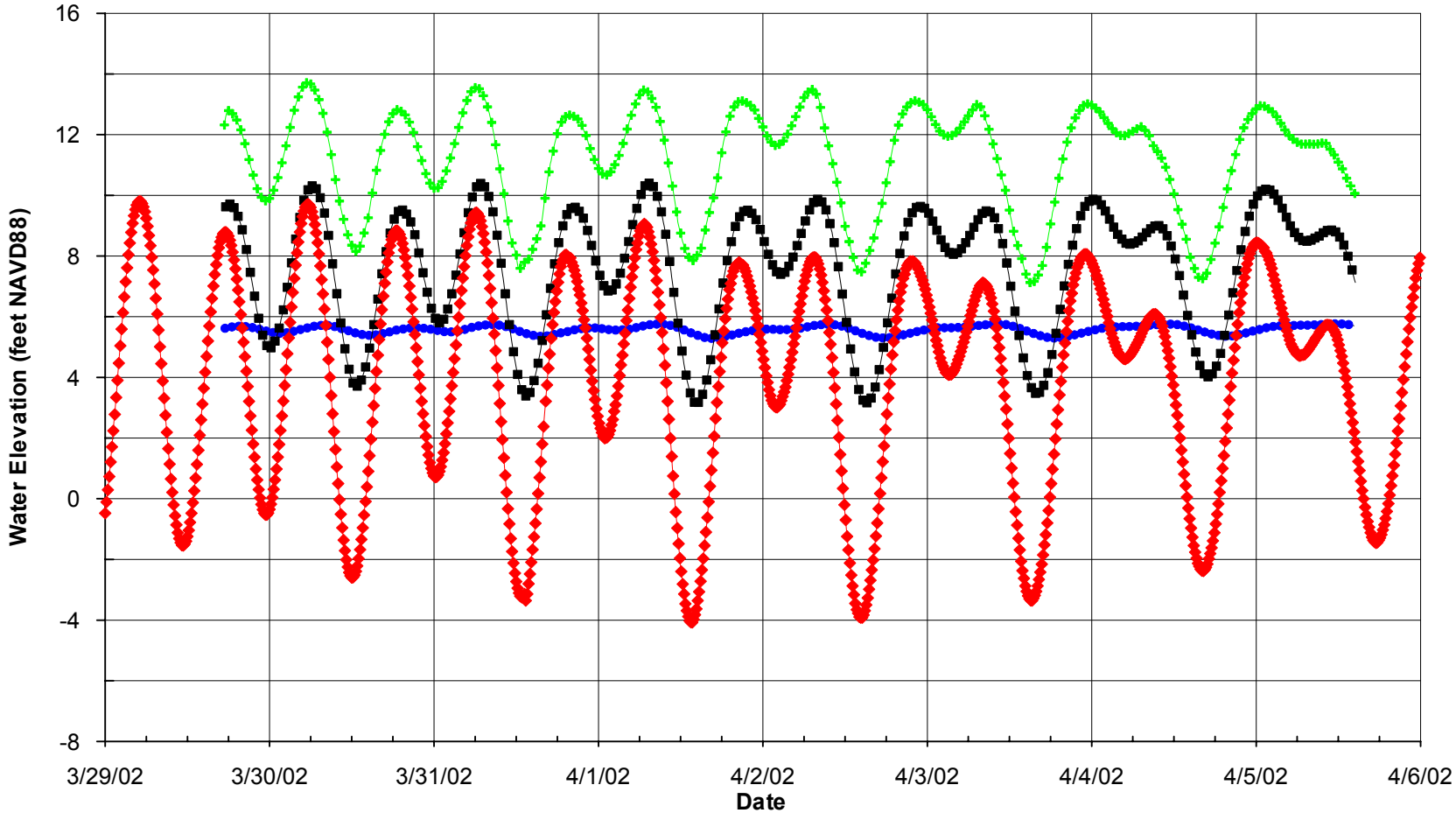
- Holocene - fill, estuarine and beach deposits
- Quaternary - alternating silt and sand/gravel layers





Data Collection

- Perform drilling, well installations, lab tests, slug tests
- Collect groundwater levels, tidal changes, barometric changes (prior to pumping tests)
- Perform two 5-day pumping tests



Notes:
1. Tide data downloaded from NOAA website. Tide gauge is located at Colman Dock.
2. Datum is NAVD88.

- Elliott Bay Tide
- EB-8A OW1 Groundwater Elevation (screen depth = 5 - 25 feet bgs)
- EB-8B OW1 Groundwater Elevation (screen depth = 68 - 78 feet bgs)
- EB-8B VWP1 Groundwater Elevation (depth = 125 feet bgs)

Alaskan Way Viaduct and Seawall Project
Seattle, Washington

EB-8 TIDE EVALUATION

June 2002 21-1-09490-820

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. B.2-5

WSDOT Agreement No. Y-7888

FIG. B.2-5

Data Reduction

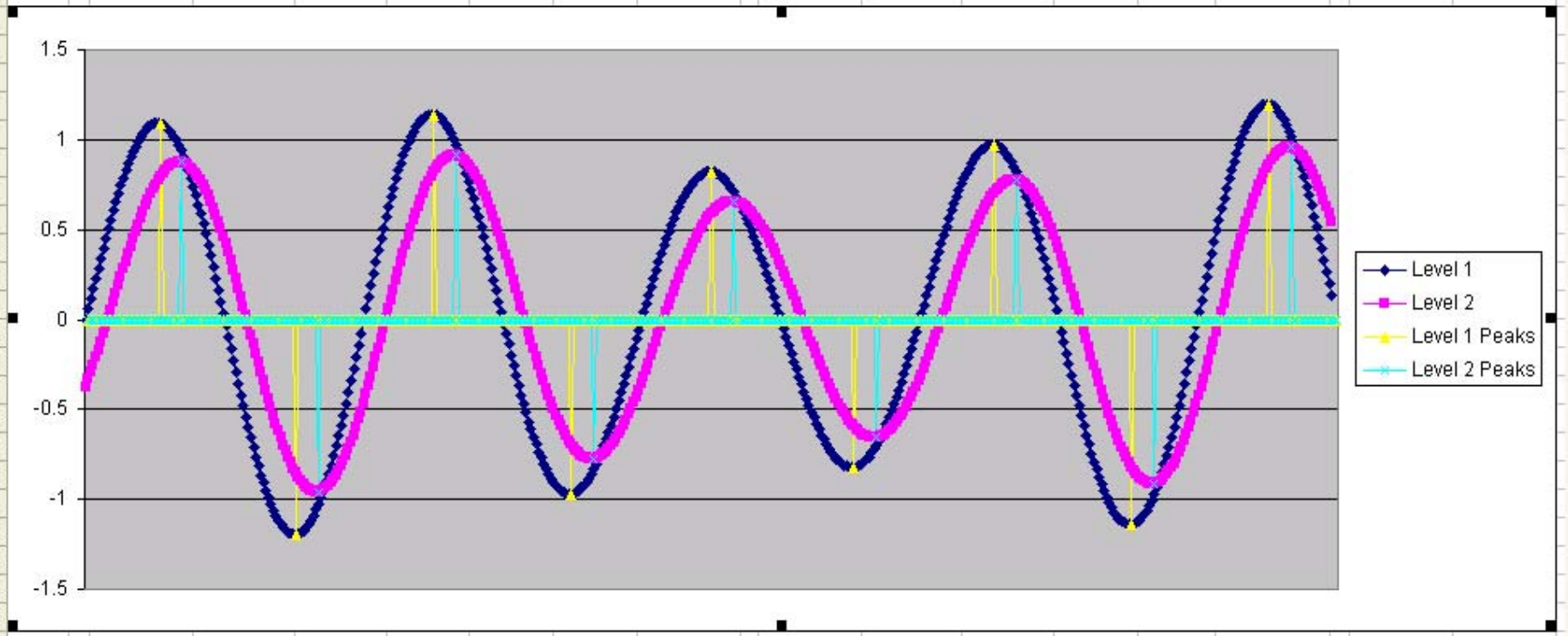
- Compare water levels in multiple geologic units with tide changes
- Look for other trends
- Determine tidal efficiency and time lag
- Spreadsheet calculations

Microsoft Excel - data

File Edit View Insert Format Tools Chart Window Help

Chart Area

AUTOMATIC TIME LAG AND TIDAL EFFICIENCY USING EXCEL (SEE EXPLANATIONS TAB FOR MORE DETAILS)



Time	Water Level 1	Difference	Product	Peaks	Last Peak		Last Peak Time	Water Level 2	Difference	Product	Peaks	Last Peak	Last Peak Time	Time Lag	Tidal Efficency
0:00	0	0	0		0		0:00	-0.37208	0	0		-0.372	0:00		
0:06	0.05671	0.05671	0		0	0	0:00	-0.33414	0.037936	0		-0.372	0:00		
0:12	0.113622	0.056912	0.00323		0	0	0:00	-0.29487	0.039276	0.00149		-0.372	0:00		
0:18	0.170551	0.056929	0.00324		0	0	0:00	-0.25437	0.040499	0.00159		-0.372	0:00		

Calculations & Chart / Explanations / Sheet3

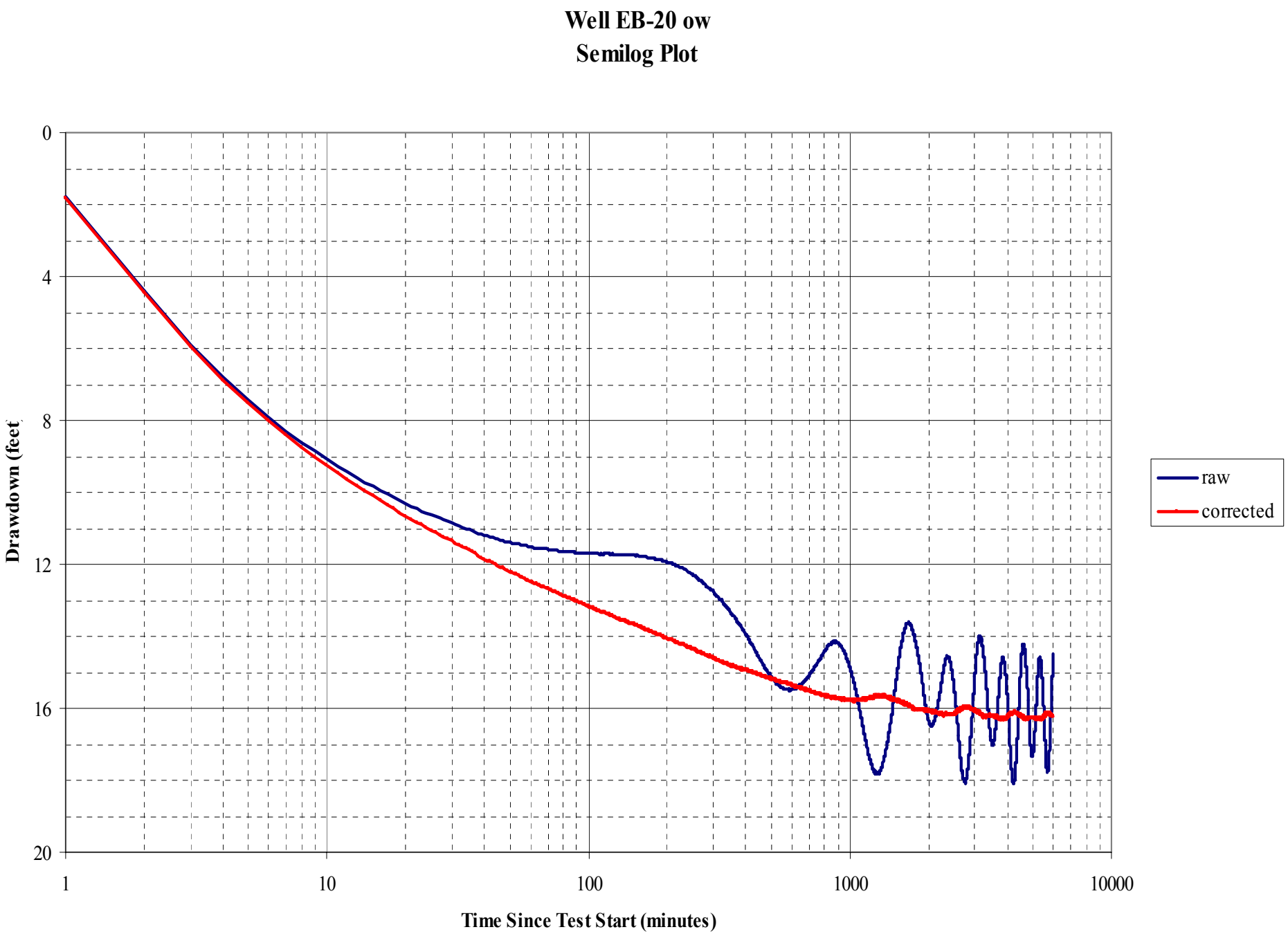
Ready

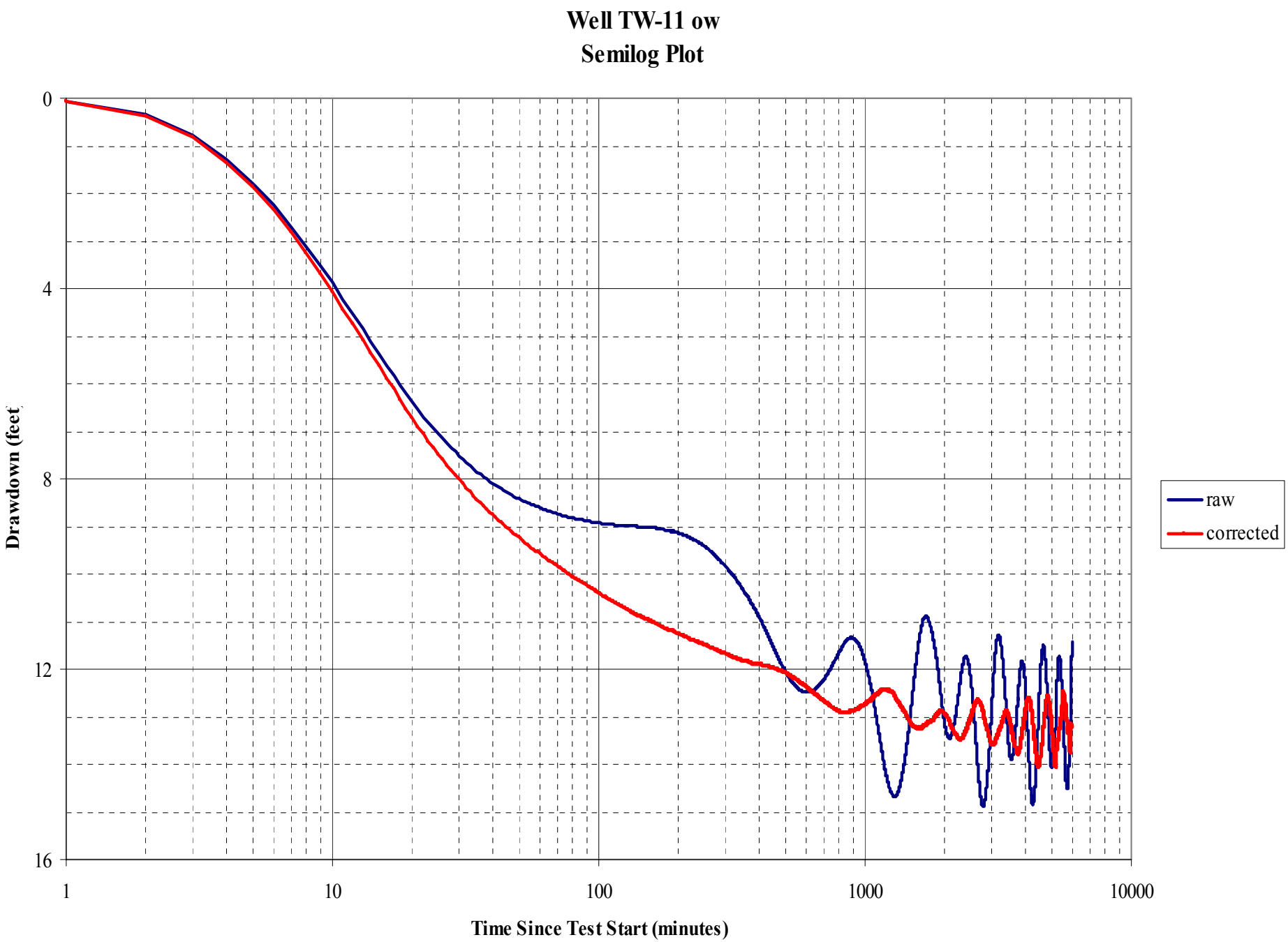
Tidal Correction

- Record water levels and tide during pumping tests
- Organize data into spreadsheet format
- Apply tidal efficiency and time lag
- Filter tide effect from water level data

Tidal Correction

Date/Time	Elapsed Time (minutes)	Water Above Sensor (feet)	Time Since Test Start (minutes)	Drawdown (feet)	Water Level Change (feet)	Tidal Correction (feet)	Corrected Water Level Change (feet)	Drawdown Accumulation (feet)
9/18/02 12:50	290	47.38						
9/18/02 12:51	291	47.393						
9/18/02 12:52	292	47.409						
9/18/02 12:53	293	47.423						
9/18/02 12:54	294	47.431						
9/18/02 12:55	295	47.443						
9/18/02 12:56	296	47.45						
9/18/02 12:57	297	47.466						
9/18/02 12:58	298	47.486						
9/18/02 12:59	299	47.499						
9/18/02 13:00	300	47.509	0	0				
9/18/02 13:01	301	47.523	1	-0.014	0.014	0.01044	0.00356	-0.00356
9/18/02 13:02	302	47.539	2	-0.03	0.016	0.01044	0.00556	-0.00912
9/18/02 13:03	303	47.548	3	-0.039	0.009	0.01044	-0.00144	-0.00768
9/18/02 13:04	304	47.558	4	-0.049	0.01	0.01044	-0.00044	-0.00724
9/18/02 13:05	305	47.576	5	-0.067	0.018	0.01044	0.00756	-0.0148
9/18/02 13:06	306	47.584	6	-0.075	0.008	0.01044	-0.00244	-0.01236
9/18/02 13:07	307	47.594	7	-0.085	0.01	0.01044	-0.00044	-0.01192
9/18/02 13:08	308	47.607	8	-0.098	0.013	0.01131	0.00169	-0.01361
9/18/02 13:09	309	47.619	9	-0.11	0.012	0.01131	0.00069	-0.0143
9/18/02 13:10	310	47.621	10	-0.112	0.002	0.01131	-0.00931	-0.00499
9/18/02 13:11	311	47.631	11	-0.122	0.01	0.01131	-0.00131	-0.00368
9/18/02 13:12	312	47.639	12	-0.13	0.008	0.01131	-0.00331	-0.00037
9/18/02 13:13	313	47.641	13	-0.132	0.002	0.01131	-0.00931	0.00894
9/18/02 13:14	314	47.641	14	-0.132	0	0.00957	-0.00957	0.01851
9/18/02 13:15	315	47.641	15	-0.132	0	0.00957	-0.00957	0.02808
9/18/02 13:16	316	47.647	16	-0.138	0.006	0.00957	-0.00357	0.03165
9/18/02 13:17	317	47.643	17	-0.134	-0.004	0.00957	-0.01357	0.04522
9/18/02 13:18	318	47.641	18	-0.132	-0.002	0.00957	-0.01157	0.05679
9/18/02 13:19	319	47.643	19	-0.134	0.002	0.00957	-0.00757	0.06436
9/18/02 13:20	320	47.641	20	-0.132	-0.002	0.01044	-0.01244	0.0768
9/18/02 13:21	321	47.645	21	-0.136	0.004	0.01044	-0.00644	0.08324
9/18/02 13:22	322	47.641	22	-0.132	-0.004	0.01044	-0.01444	0.09768
9/18/02 13:23	323	47.637	23	-0.128	-0.004	0.01044	-0.01444	0.11212
9/18/02 13:24	324	47.637	24	-0.128	0	0.01044	-0.01044	0.12256
9/18/02 13:25	325	47.635	25	-0.126	-0.002	0.01044	-0.01244	0.135
9/18/02 13:26	326	47.656	26	-0.147	0.021	0.01044	0.01056	0.12444
9/18/02 13:27	327	47.631	27	-0.122	-0.025	0.01044	-0.03544	0.15988
9/18/02 13:28	328	47.623	28	-0.114	-0.008	0.01044	-0.01844	0.17832
9/18/02 13:29	329	47.617	29	-0.108	-0.006	0.01044	-0.01644	0.19476
9/18/02 13:30	330	47.609	30	-0.1	-0.008	0.01044	-0.01844	0.2132
9/18/02 13:31	331	47.607	31	-0.098	-0.002	0.01044	-0.01244	0.22564
9/18/02 13:32	332	47.603	32	-0.094	-0.004	0.0087	-0.0127	0.23834
9/18/02 13:33	333	47.595	33	-0.086	-0.008	0.0087	-0.0167	0.25504
9/18/02 13:34	334	47.591	34	-0.082	-0.004	0.0087	-0.0127	0.26774
9/18/02 13:35	335	47.582	35	-0.073	-0.009	0.0087	-0.0177	0.28544
9/18/02 13:36	336	47.58	36	-0.071	-0.002	0.0087	-0.0107	0.29614
9/18/02 13:37	337	47.572	37	-0.063	-0.008	0.0087	-0.0167	0.31284
9/18/02 13:38	338	47.562	38	-0.053	-0.01	0.0087	-0.0187	0.33154


Well EB-20 ow
Semilog Plot
Drawdown (feet)
0
4
8
12
16
20
1
10
100
1000
10000
Time Since Test Start (minutes)
raw
corrected


Well TW-11 ow
Semilog Plot
Drawdown (feet)
0
4
8
12
16
1
10
100
1000
10000
Time Since Test Start (minutes)
raw
corrected

Discussion of Results

- Correction does not completely remove tide effects
- Error accumulates
- Better results at some well locations
- Method used was effective overall
- Other methods may be more effective, also more time consuming

Recommendations

- Perform appropriate corrections
- Collect plenty of pre-test data
- Explore other correction techniques

Summary

- Tidal filtering necessary
- Several methods
- Choose method based on objectives