A Hydraulic Study of the Chesapeake and Delaware Canal

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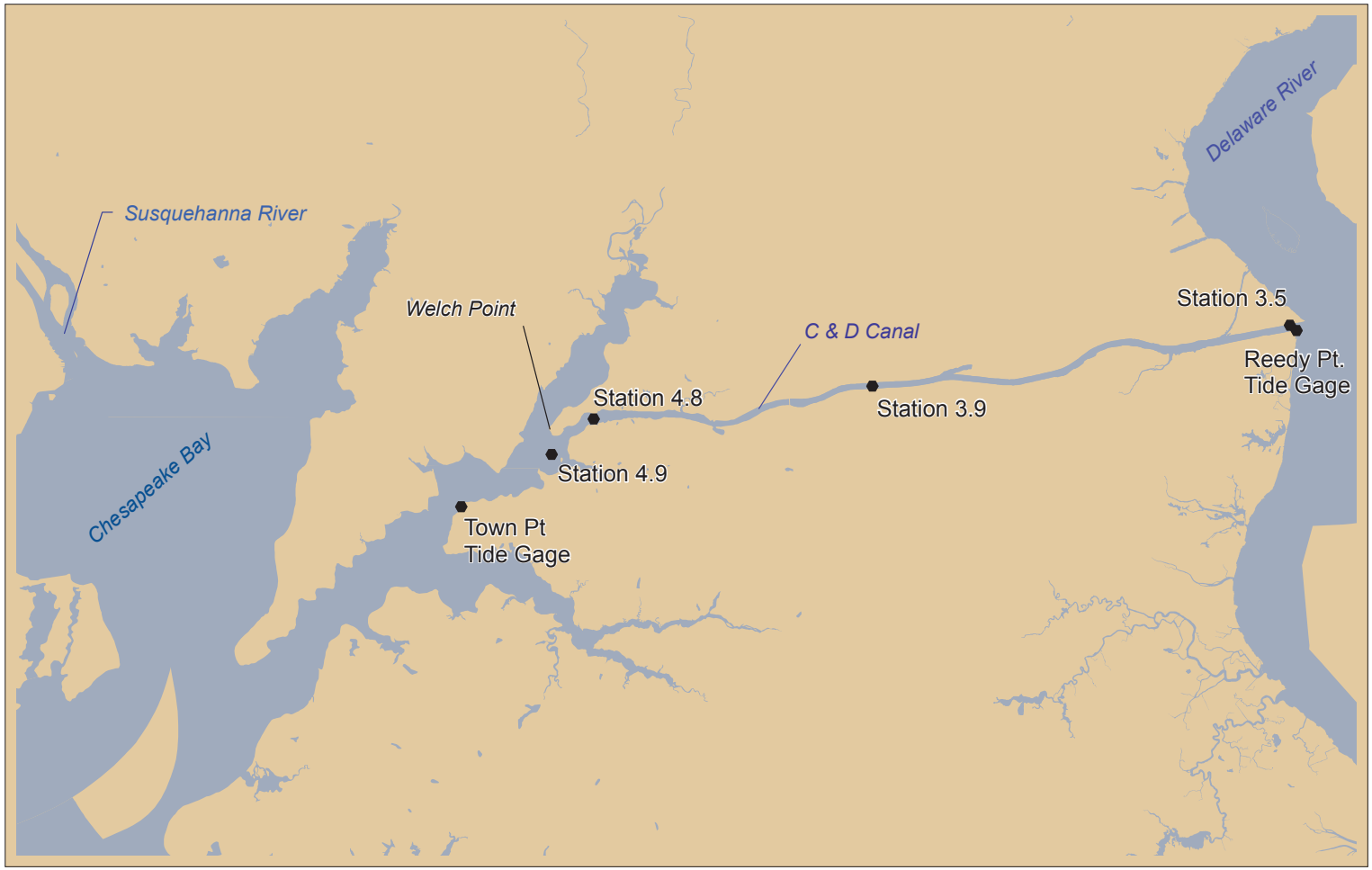
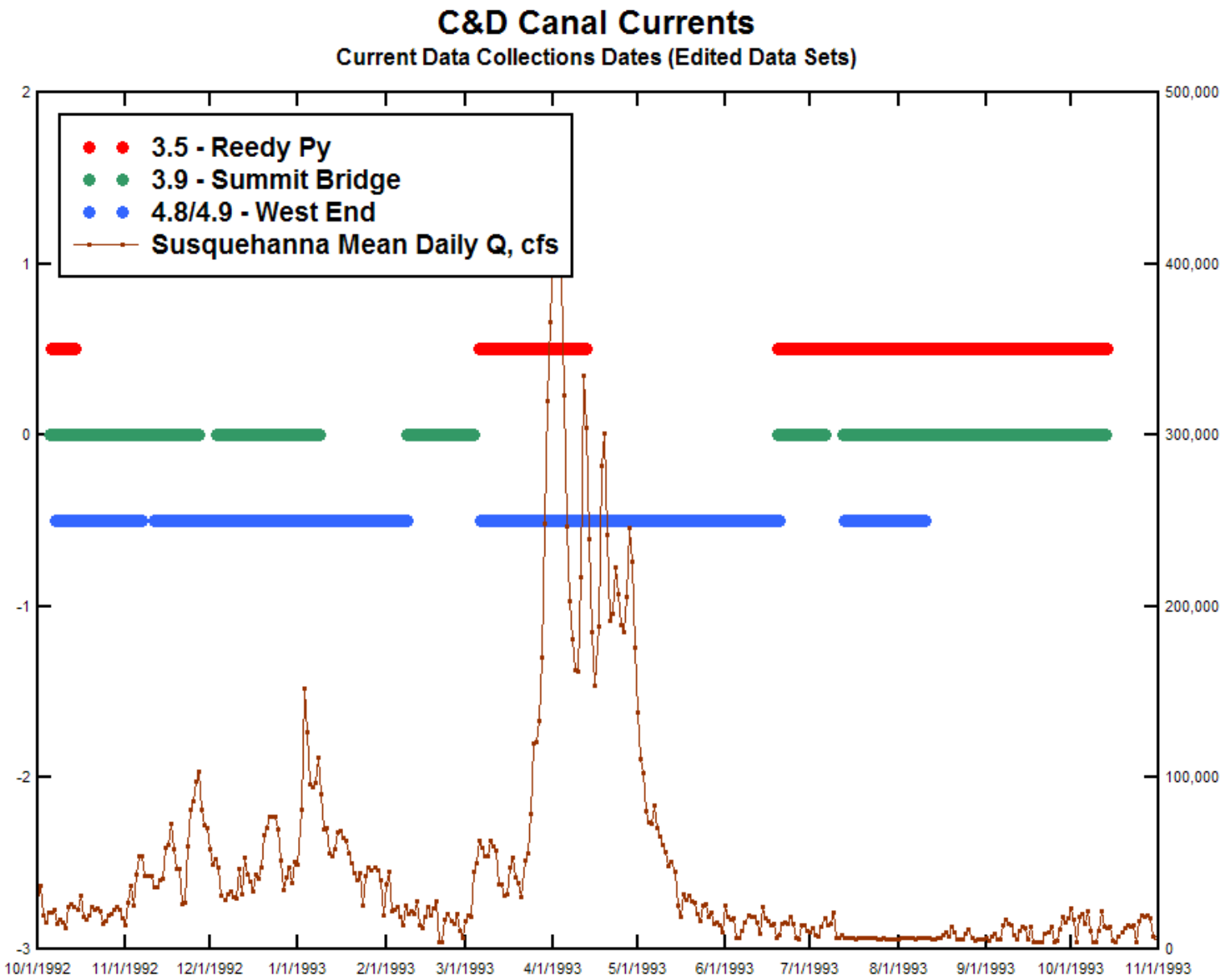
Chesapeake and Delaware Canal



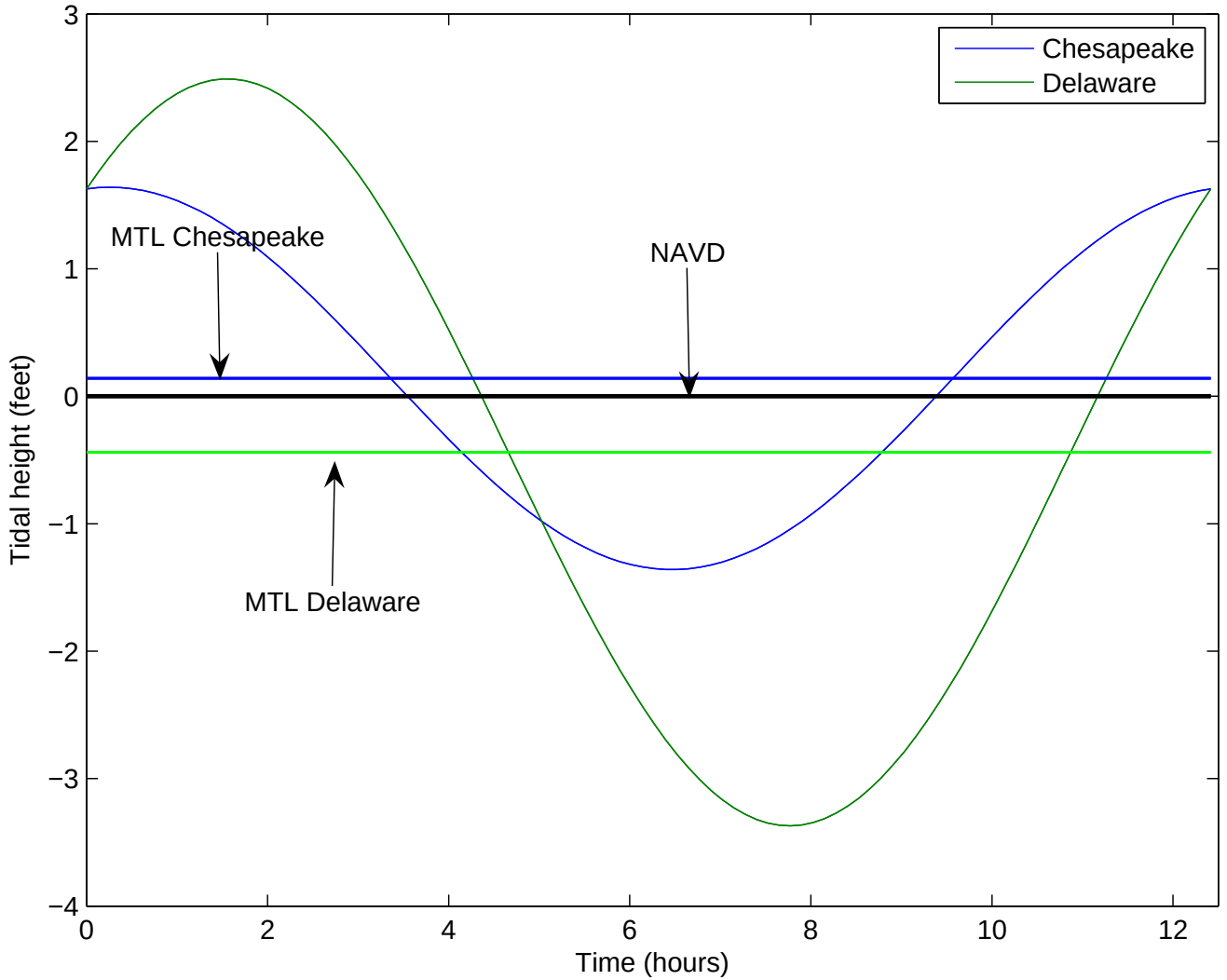
Background

- Corps made current observations October 1992 through October 1993
- Part of Delaware River deepening study

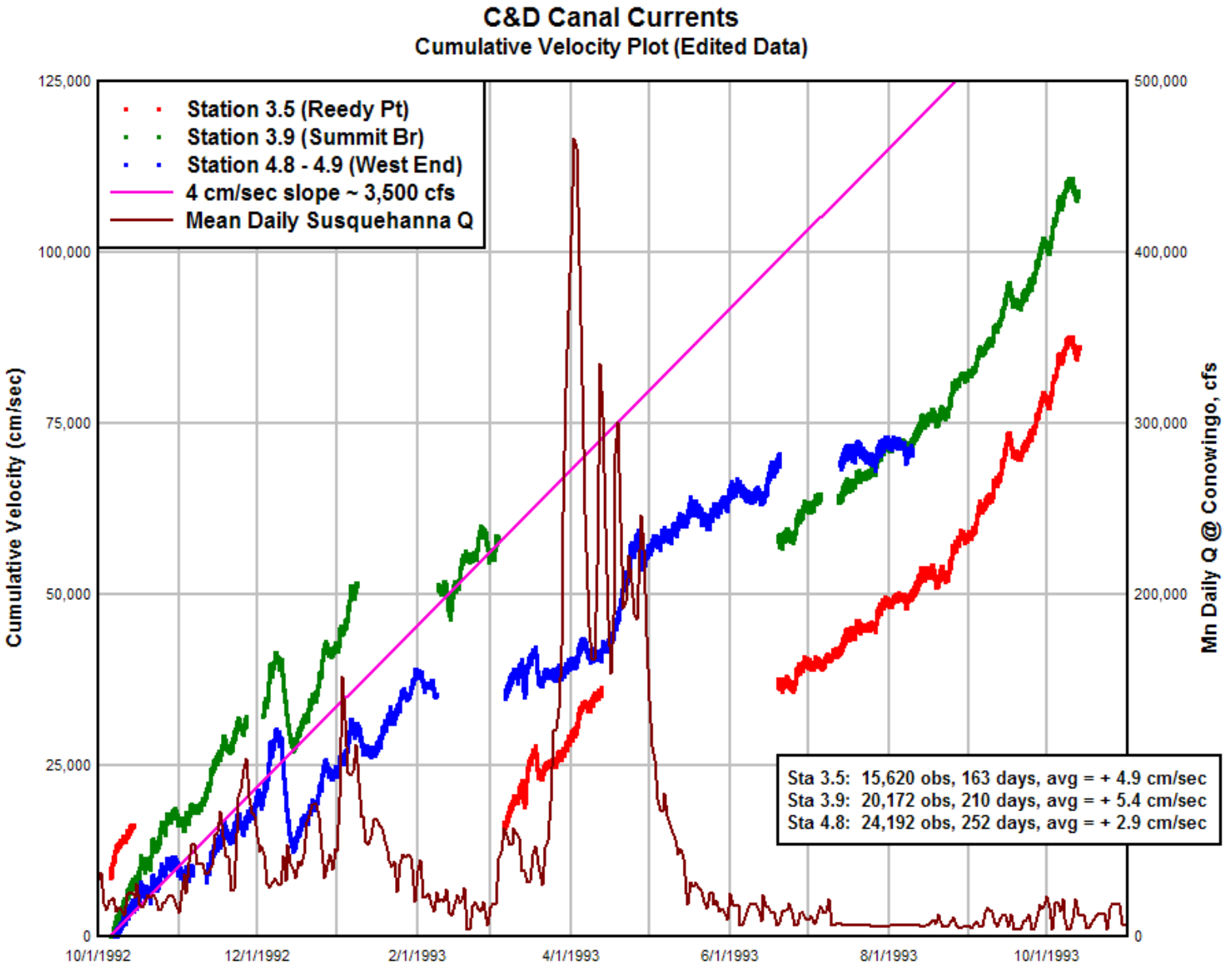
Current data collection dates



Tidal variation



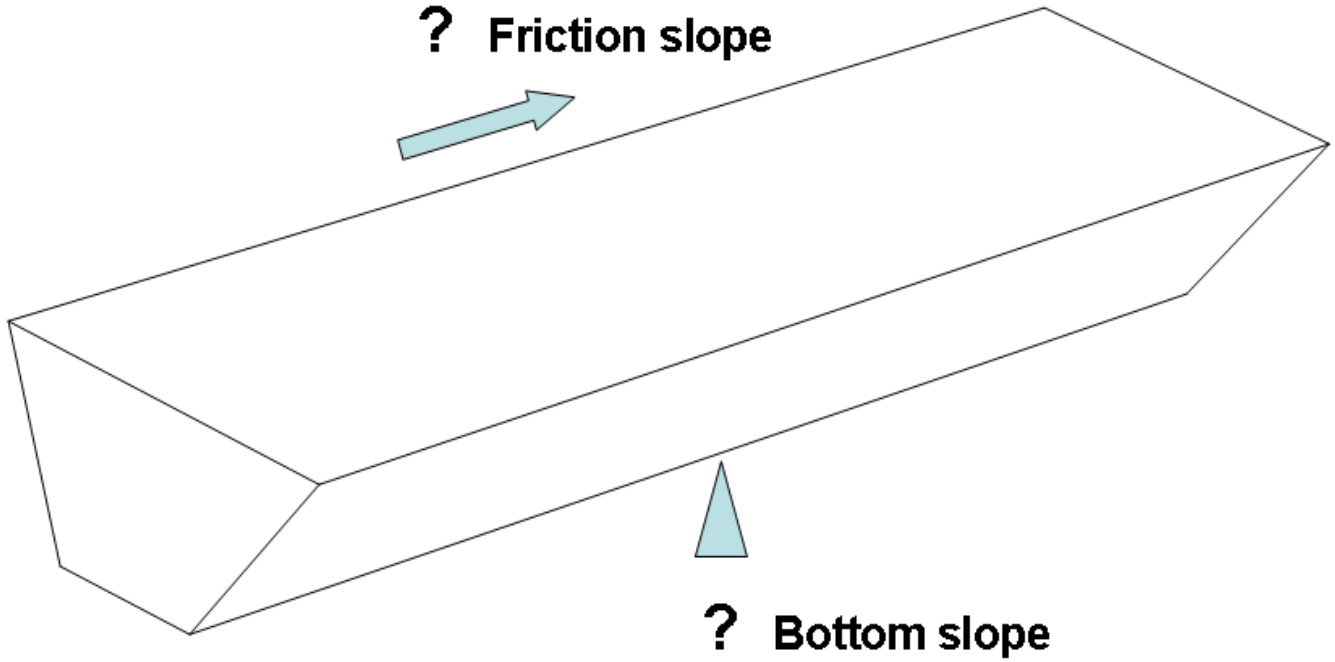
Cumulative velocity



Problem

- Estimate the flow (f/s) and discharge (f^3/s) through the Canal based on the tidal heights at Reedy Point and Town Point
- Solve St. Venant equations (1-d model)
- Calibrate to historical data

Canal schematic



St. Venant Equations

$$(Av)_x + A_t = q$$

and

$$v_t + vv_x + \frac{q}{A}v = S_0 g - S_f g - g y_x,$$

where

- $A = A(y(x,t),x)$ is the cross sectional area,
- S_0 is the bed slope,
- S_f is the friction slope (estimated from empirical formula),
- q is the flow into/out the canal.

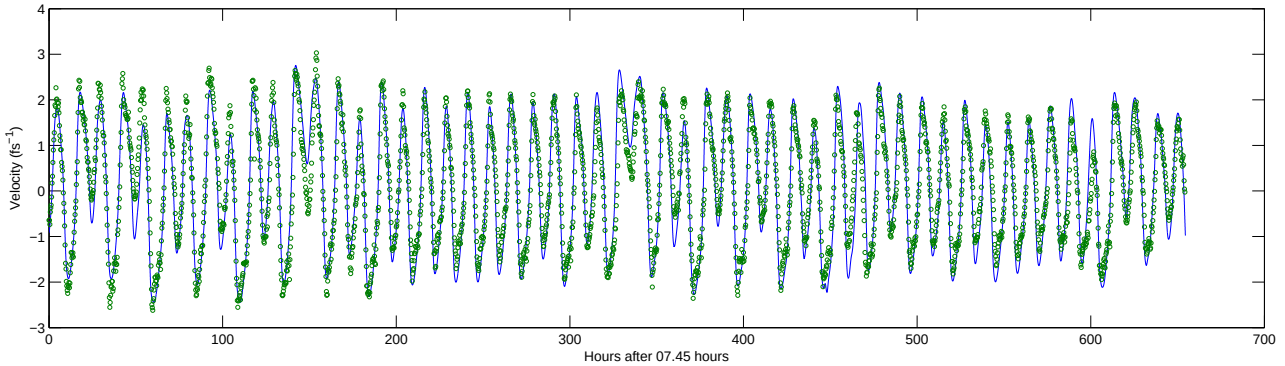
Manning's formula

One form of Manning's (empirical) formula is

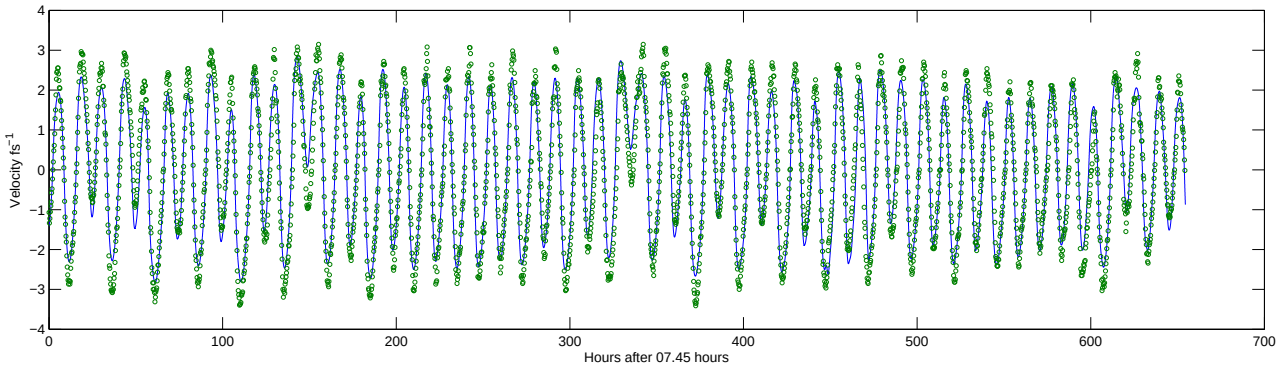
$$S_f = \frac{n^2}{1.49^2} \frac{V|V|}{R^{4/3}}$$

Manning's constant n is essentially a roughness coefficient.

Calibration (13 July-9 August 1993)

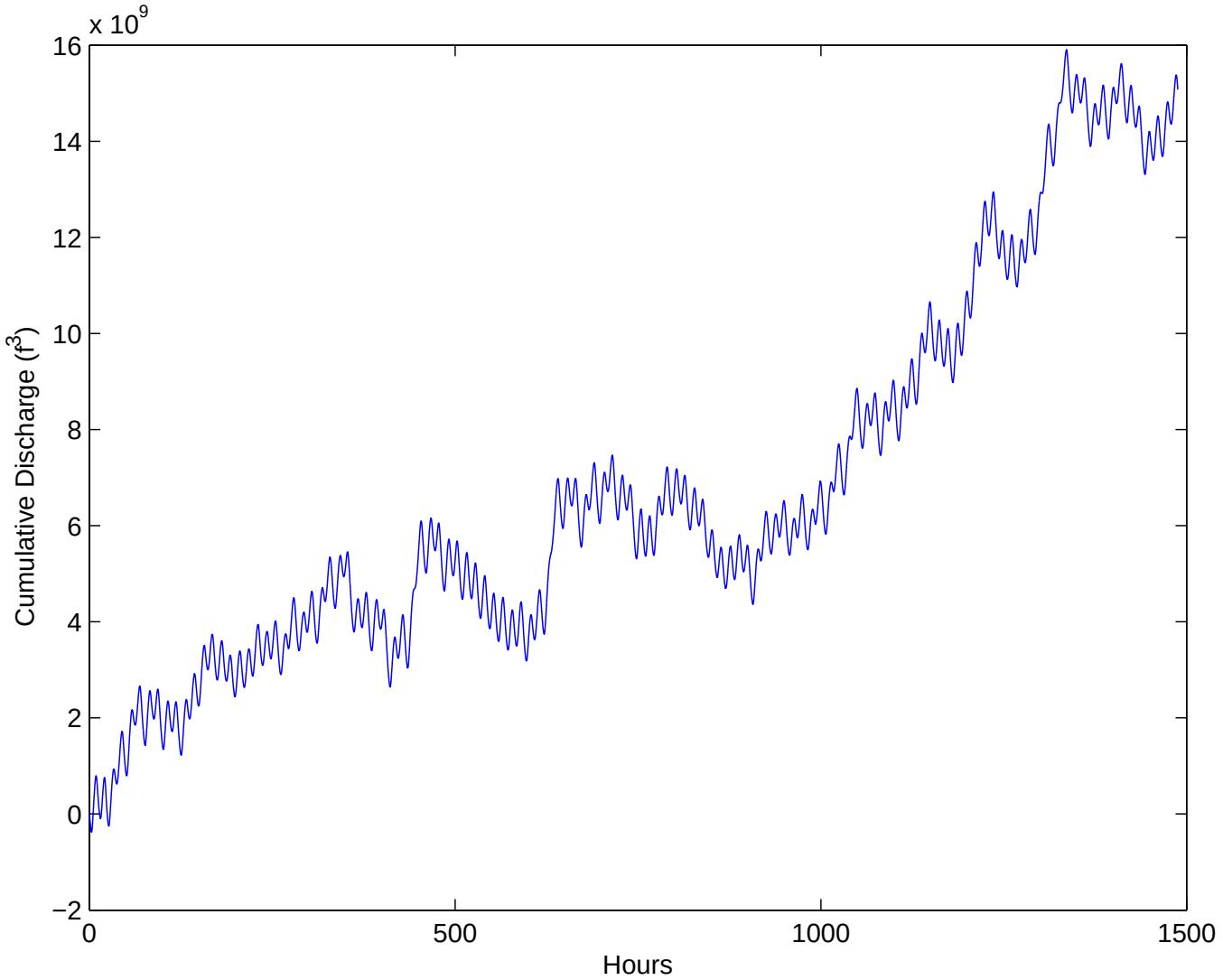


(a) Comparison at Reedy Point



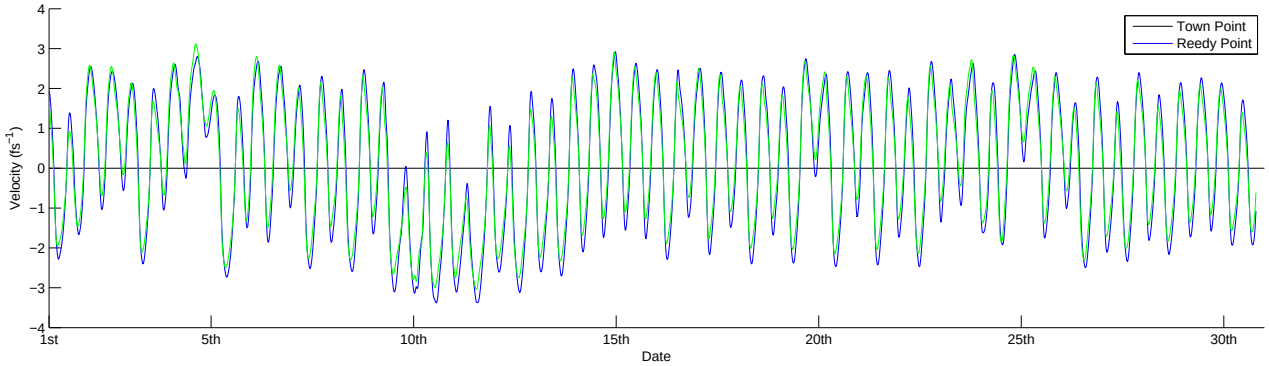
(b) Comparison at Town Point

Cum. Discharge (July-August 1993)



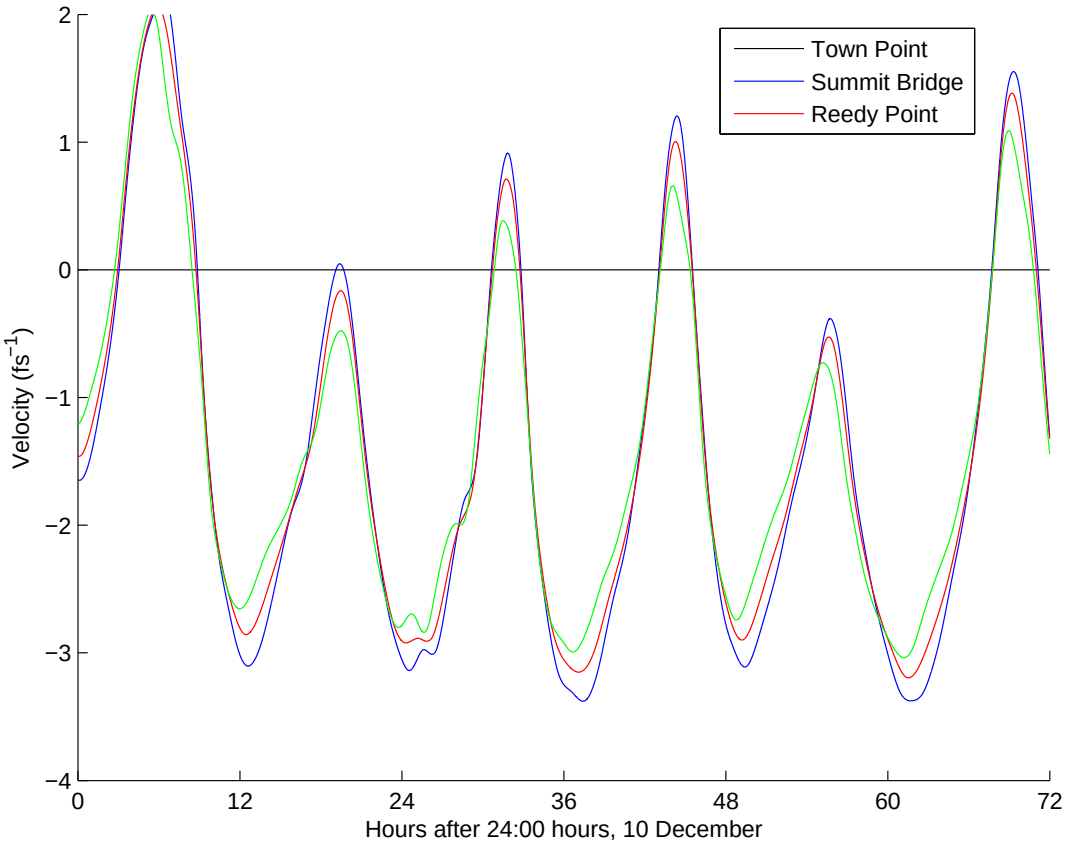
December 1992 Northeaster

- Simulated velocity distribution during December 1992



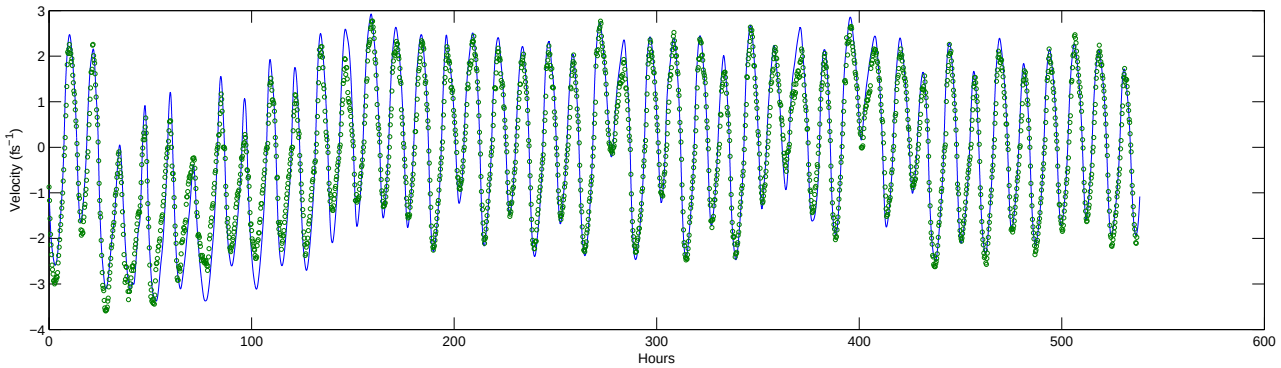
Flow reversal

- Simulated velocity distribution during flow reversal (10-13 December)

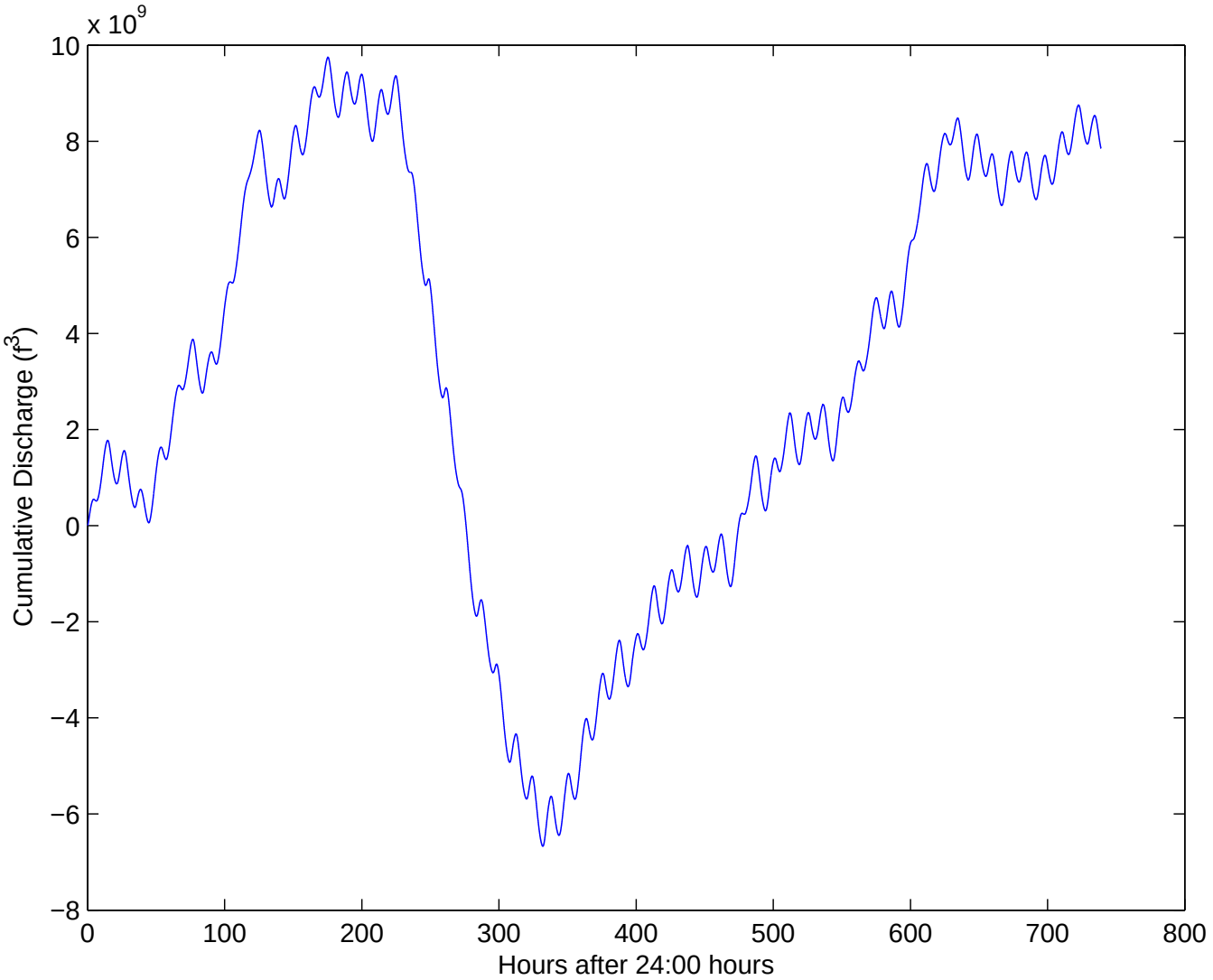


Comparison

- Comparison with observed velocities at Town Point during December 9-31, 1992, based on parameters from calibration period:



Cum. Discharge



Conclusions

- Long-term net eastward flow
- Driven by MSL at western end > MSL at eastern end
- Canal has a measurable role in affecting the water quality and salinity of the two estuaries it connects