

**Capitol Lake and Puget Sound.
An Analysis of the Use and Misuse of the Budd Inlet Model.**

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Page #	OUTLINE AND INDEX.
--	Executive Summary.
1-1	SECTION 1. INTRODUCTION
1-3	1a. The Budd Inlet Computer Model. Introduces the computer simulation that calculates effects of changes on Budd Inlet.
1-4	1b. Data Sources. Data are from WDOE's Reports and the 1997 Budd Inlet Scientific Study (BISS).
1-5	1c. Encounters with WDOE. Face to face info exchanges between WDOE computer modeling staff and the author.
1-8	1d. The Special Case of Capitol Lake. The Lake differs from the Sound; WDOE modelers don't understand that.
1-9	1e. The Natural Null Zones of Estuaries. All estuaries run low on oxygen in natural "null zones." WDOE doesn't get it.
1-10	1f. The Analysis That Follows. Names the topics analyzed in sections 2, 3, 5, 6 and 7 of this report.
2-1	SECTION 2. THE COMPUTER GETS MANY WRONG ANSWERS. Only about half of the computer's oxygen level calculations are accurate, over all. <i>However WDOE modelers insist that <u>all</u> of its calculations are pinpoint accurate.</i>
2-1	2a. Methods. Counting Right Answers. Compares the computer's graphs with known, observed oxygen measurements.
2-2	2b. Results. "Hits and Misses." Computer answers are "pinpoint accurate" between 20% and 80% of the time.
2-2	2c. Discussion. Hits and Misses. Computer should detect abrupt oxygen changes that occur naturally ... but doesn't ...
2-4	2d. Statistics could play a role. Near certainty could be obtained via statistics; however WDOE staff won't use them.
2-7	2e. Hiding the Search for Violations. The calculated poor water quality of the "natural" pre-dam estuary is not shown.
2-9	2f. Methods. Finding the Water Quality Standards Violations in the Pre-Modern ('Natural') Estuary. A Photoshop technique reveals widespread "violations" in the 'natural' estuary – WDOE doesn't show us that.
2-9	2g. Results. Most of the 'Natural' Estuary Violates Modern Water Quality Standards. Calculated DO's in most pre-dam 'natural estuary' areas are standards "violations".

- 2-10 **2h. Discussion. It is Impossible to Check the Calculations when the ‘Natural’ Estuary is used as the Water Quality Standard.**
The title says it all; no outsider can check to see whether WDOE got it right or wrong.
- 3-1 **SECTION 3. THE SIMULATED (AND REAL) ROLES OF ORGANIC CARBON.**
Modelers’ claim “it’s not N-nutrient that harms Budd Inlet, it’s organic carbon.”
- 3-1 **3a. Background.**
N-nutrient damages Puget Sound; lots of it enters the Lake but the Lake plants trap it.
- 3-4 **3b. The Production of Organic Carbon by Lake and Estuary.**
Model graphs show Lake’s organic carbon input to Sound is bigger than estuary’s.
- 3-5 **3c. Methods. Estimating TOC from DIN Uptake, using Figures 3-3a and 3-3b.**
Tables of my calculations test WDOE’s claim, using WDOE data & graphs.
- 3-8 **3d. Results. Estimating TOC from DIN Uptake.**
My calculations & graphs show the opposite of the WDOE claim in **3b** above.
- 3-9 **3e. Discussion. TOC from DIN Uptake.**
Expectations; big Lake plants trap lots of N-nutrient; tiny estuary plants can’t do that.
- 3-10 **1). Lake Case.**
Unrealistic WDOE graph shows plants in Lake not trapping & storing N-nutrients.
- 3-11 **2). Estuary Case.**
Unrealistic WDOE graph shows tiny plants in estuary trapping & storing N-nutrients.
- 3-12 **3) Summary of Both Cases.**
In realistic scenarios, the Lake puts far less TOC into Sound than would an estuary.
- 3-14 **3f. How Would These Errors Affect Our View of Dissolved Oxygen in Budd Inlet?**
WDOE graphs comparing Lake & estuary effects on bottom DO got it backward.
- SECTION 4. THIS PAGE DELIBERATELY LEFT BLANK ...**
Due to the way in which the report was written; blank page saved reformatting work.
- 5-1 **SECTION 5. CAPITOL LAKE PROTECTS BUDD INLET’S WATER QUALITY.**
Exposes minor errors and WDOE’s failure to show negative estuary DO features.
- 5-1 **5-a. Miscellaneous Unimportant Mistaken Claims.**
Pulsed flow? Residence time? Wild claims by WDOE include calculating errors ...
- 5-5 **5-b. Miscellaneous Puzzling Figures.**
Graphs claimed to show the Lake harms the Sound actually show the opposite.
- 5-7 **5-c. Where are the Estuary Data?**
Another poorly worded WDOE chapter; unclear definitions.
- 5-8 **1) Finding the ‘Natural Estuary.’**
WDOE portrayal of ‘natural estuary’ is confusing and mis-formatted. Deliberately?
- 5-8 **2) Methods and Results. Reformatting the ‘Natural Estuary.’**
Shows the Photoshop technique that gets the results in the next few sections.

- 5-11 **3a) Discussion 1. Interpreting the Simulation of the ‘Natural Estuary.’**
The ‘natural estuary’ effect on Budd Inlet is worse than the alleged Lake effect.
- 5-12 **3b) Discussion 2. The enigmatic puzzle of Figure 5-8.**
After this went to press, I discovered what the modelers were talking about here. Too bad, it would have been fun to expose yet another example of errors.
- 5-13 **5d. Conclusions.**
Budd Inlet is better off with Capitol Lake in place than it would be if the Lake were removed and an estuary replaced it. WDOE avoids showing us what Budd Inlet would look like with a modern (high N-nutrient) estuary replacing the Lake.
- 6-1 **SECTION 6. THE LATE-SEASON DEPARTURE OF ORGANIC CARBON. AN ALTERNATIVE HYPOTHESIS.**
- 6-1 **6-a. WDOE’s “Organic Carbon” Hypothesis and an Alternative.**
WDOE claims that plants in the Lake trap N-nitrogen, then quickly enter the Sound.
- 6-1 **6-b. Seasonal Change in Capitol Lake.**
Seasonal ecology of Lake plants; computer model unable to give fall season answers.
- 6-4 **6-c. Background for a Test of the Alternative Hypothesis.**
The Budd Inlet current pattern; is there a late-season uptake of oxygen?
- 6-5 **6-d. Methods. The Search for a Late-Season Lake Effect.**
How to search six Budd Inlet locations for evidence of late-season O₂ uptake.
- 6-5 **Part 1. DO levels of incoming- and outgoing water in mid-Budd stations.**
Dissolved oxygen at two locations, September 1996 through January 1997.
- 6-6 **Part 2. Oxygen Uptake from the Atmosphere in November.**
Uptake of O₂ from the air at one location, September through November 1996.
- 6-7 **Part 3. Massive Re-Oxygenation of All Depths in Budd Inlet in Late Fall.**
Giant uptake of O₂ by water from air masks O₂ used by plant decay in November?
- 6-7 **6-e. Conclusions. The Search for a Late-Season Lake Effect.**
Not enough evidence to be sure about late-season decay of Lake plants in Sound.
[I continued to study late-season O₂ uptake in Budd Inlet after this Analysis went to press, and ended up convinced that the evidence in this section, with other evidence discovered later, actually confirms that Lake plants decay in the Inlet in late fall. The Lake plants really don’t harm the Inlet. This will have to await my next Analysis.]
- 7-1 **SECTION 7. CAPITOL LAKE: ERRORS AND MIS-CHARACTERIZATIONS.**
This section disproves WDOE’s claim that Capitol Lake has “oxygen depletion.”
- 7-1 **7-a. There is No “Oxygen Depletion” in Capitol Lake.**
In real life, oxygen levels in the Lake are *always* “extraordinary” – very high.
- 7-3 **7-b. Phosphorus Levels are Irrelevant in Capitol Lake.**
Phosphorus is not the “ruling” nutrient in the Lake; WDOE mistakenly thinks it is.
- 7-4 **7-c. Dissolved Oxygen “Deficiencies” in Capitol Lake Were Calculated Incorrectly.**
Starts section on correct calculation of possible oxygen depletion in the modern Lake.

- 7-4 **1) Background for the Correct Calculation.**
It is almost never possible to check the computer’s calculations; in the Lake case it is.
- 7-6 **2) Methods. Checking The Dissolved Oxygen Calculation.**
Southernmost Lake water is 100% O2 saturated; that is the key to checking the claim.
- 7-8 **3) Results. The Corrected Dissolved Oxygen Calculations.**
The computer model (and modelers) produced huge calculating errors.
- 7-9 **4) Discussion. The Lake’s Theoretical Water Quality Violations are Tiny or Nonexistent.** The modern Lake has no significant low-O2 differences from its imagined pre-modern state.
- 8-1 **SECTION 8. REFERENCES.**
This section shows all sources of information used to compile my Analysis.
- 9-1 **SECTION 9. APPENDICES.**
This section shows my recommendations to WDOE staff and a source of data.
- 9-1 **A. Recommendations presented to WDOE staff during a meeting in November, 2014.**
Recommendations for improving confidence in the model’s calculated output.
- 9-2 **B. The “DeMeyer data” used in this Analysis.**
A key set of data showing Lake removing N-nitrogen from water exiting to Sound.