Budd Inlet, Capitol Lake and Deschutes River TMDL
DRAFT Potential Management Scenarios to Evaluate <u>with Modeling Tools</u> **DRAFT**

(Initial brainstorming September 22, 2011; re-organized and vetted by Greg Pelletier and Mindy Roberts)

Analysis order	Scenario	Improvement mechanism	Budd Inlet	Budd Inlet watershed	Capitol Lake	Capitol Lake watershed	Deschutes River	Deschutes River WS	Response
Budd Inlet-oriented potential model runs:									
1	Reduce nonpoint nitrogen sources	Various management activities that target nonpoint sources[1]		X		X		X	No local data on effectiveness of specific BMPs other than large centralized, publicly owned facilities. Nutrient benefits generally recognized but not quantified. *Approach: Decrease nonpoint source nitrogen contribution by 10, 20, and 50% to bound nutrient target reductions; iterate on finer reductions.*
2	Extend LOTT outfall	Shift nutrient load to better circulating region	X						Move discharge location to different grid cell. *Approach: Evaluate with GEMSS model; decide where*
3	Reduce other South Puget Sound nutrient sources	Decreased nutrients entering Budd Inlet	X						Change model marine boundary condition concentrations as sensitivity analysis. Because existing scenarios compare differential DO from differential loads, will not affect WQ standards. *Approach: Evaluate with GEMSS model; decide %change using SPS DO Study*
4	Advanced wastewater treatment for all plants all the time	Decrease nitrogen discharged to marine waters	X						LOTT generally achieves 2 mg/L in summer. Biological nutrient removal technology can decrease effluent concentrations to 6 to 10 mg/L. *Approach: Set all WWTP discharges to 2 mg/L and 6 mg/L all year.*

[1] Specifics will be determined in subsequent Implementation Plan. Including but not limited to these: * Reduce residential, commercial, institutional fertilizer use * Reduce pet waste * Install rain gardens * Decrease roof runoff * Fix cross-connections between sanitary and stormwater systems

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Previous scenarios or other analyses but no new model runs:									
5	Shellfish for restoration	Sequester nutrients in harvested tissue	X						No existing modeling tools can evaluate interaction between shellfish and water quality. *Approach: mass balance calculation for nitrogen mass removed as %inputs. If significant, would need model code changes for benthic and water column losses; consider in Implementation Plan.*
6	Decrease boat waste disposal (Budd Inlet and marinas)	Decrease nutrients introduced directly to marine waters	X						Have not quantified how much this currently contributes to Budd Inlet, so nothing to remove as part of a scenario. *Approach: quick calculation of potential current nitrogen load from this source as #boaters (per year or summer) * per capita waste * estimated 25% to marine waters as upper bound; compare with other inputs. Consider in Implementation Plan.*
No additional scenarios proposed:									
	Install aerators In Budd Inlet	Increase DO in marine waters through mechanical action	X						Add a tributary with low flow and high dissolved oxygen to generate several order-of-magnitude oxygen loads. Could back-calculate the energy needed to inject. *Approach: require high effort and other scenarios may be higher priority.*
	Shift from marine discharge to groundwater recharge	Shift nutrient load from marine to groundwater	X					X	Easy to reduce marine WDG but hard to quantify how shift changes Deschutes nutrient *Approach: defer to LOTT GW study; addressed partly in #2 and #4*

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	Establish no-discharge zone	Decrease nutrients introduced directly to marine waters	X						Currently being done at the Puget Sound scale. *Approach: rely on Puget Sound no-discharge zone project for programmatic development and quantify potential benefit as described above.*
	Nutrient trading	Maximize water quality benefit and minimize cost	X	X	X	X	X	X	Not a separate scenario but a way of implementing scenarios. *Approach: No additional scenario but consider as Implementation Plan tool*
	Public education	Reduce nutrients inputs		X		X		X	Not a separate scenario but a way of implementing scenarios. *Approach: No additional scenario but consider as Implementation Plan tool*
	Reduce phosphorus in detergents	Statewide ban in effect; quantify benefit		X		X		X	Data from statewide ban indicate 10-15% reduction *Approach: Include as one of several practices bounded by a sensitivity analysis.*
	Reduce residential, commercial, and institutional fertilizer use	Decrease nutrients reaching fresh and marine waters		X		X		X	No local data on effectiveness. Nutrient benefits recognized but not quantified. *Approach: Include as one of several practices bounded by a sensitivity analysis*
	Reduce pet waste	Decrease nutrients and bacteria inputs to fresh waters						X	This nutrient concentration is not separated out from other sources so cannot directly quantify benefits of reducing it. Nutrient benefits recognized but not quantified. *Approach: Include as one of several practices bounded by a sensitivity analysis*

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	Increase urban tree canopy	Decrease temperature and decrease pollutant delivery		X		X			No local data on link between action and pollutant benefit. Nutrient benefits recognized but not quantified. *Approach: support program, but no scenario evaluation*
	Reduce effective impervious cover	Decrease pollutant delivery and temperature		X		X			No local data on link between action and pollutant benefit. Nutrient benefits recognized but not quantified. *Approach: support program, but no scenario evaluation*
	Decrease roof runoff	Decrease pollutant delivery and temperature		X		X			No local data on link between action and phosphorus benefit. Nutrient benefits recognized but not quantified. *Approach: Include as one of several practices bounded by a sensitivity analysis*
	Fix cross-connections between sanitary and stormwater systems	Decrease nutrient delivery to fresh and marine waters		X		X			No local data on link between action and phosphorus benefit. Nutrient benefits recognized but not quantified. *Approach: Include as one of several practices bounded by a sensitivity analysis*
	Install rain gardens	Reduce nutrient inputs from stormwater		X		X		X	Ongoing grant to WSU LID Center is evaluating pollutant removal of rain gardens. No local data on effectiveness. *Approach: Include as one of several practices bounded by a sensitivity analysis*

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Capitol Lake-oriented potential model runs:									
1	Reduce nonpoint phosphorus sources	Various management activities that target nonpoint sources[2]				X		X	*Approach: Decrease nonpoint source phosphorus contribution by 10, 20, and 50% to bound nutrient target reductions.*
2	In-lake treatments to inactivate phosphorus	Temporarily sequester phosphorus in sediments			X				Model includes today's benthic fluxes. *Approach: compare lake with decreasing benthic fluxes* *To do: decide on %decrease*
3	Riparian plantings	Reduce temperature going into Capitol Lake			X		X		Have quantified temperature, DO, and pH benefit in technical report for the Deschutes River but not linked to Capitol Lake conditions directly. *Approach: Compare lake temperature and DO by decreasing boundary condition temperature by 4°C.*
Previous scenarios or other analyses but no new model runs:									
4	Remove dam	Improve circulation	X		X				Scenario evaluated in technical report *Approach: no additional scenarios but carry existing results forward*
No additional scenarios proposed:									
	Eliminate stormwater outfalls to Capitol Lake	Decrease nutrients and bacteria inputs to Capitol Lake			X	X			Estimates of local watershed stormwater contributions = 7% of phosphorus load to Capitol Lake. Not currently separated out from other sources.

[2] Specifics will be determined in subsequent Implementation Plan. Including but not limited to these: * Reduce phosphorus in detergents * Reduce residential, commercial, institutional fertilizer use * Reduce pet waste * Install rain gardens * Decrease roof runoff * Fix cross-connections between sanitary and stormwater systems

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									Approach: Include as one of several practices bounded by a sensitivity analysis.
	Solar-powered aeration system	Increase oxygen in Capitol Lake through mechanical action			X				Adding oxygen would not decrease the macrophyte growth in the lake. An aerator could benefit the deep hole to reduce phosphorus release from sediments. However, an aerator would not affect phosphorus release in other parts of the lake and would have no effect on macrophyte growth overall. *Approach: No scenario evaluation*
	Back-flush lake	Decrease plant (macrophyte) organic matter			X				The Budd Inlet Scientific Study found that back-flushing had a detrimental effect on Budd Inlet, and the practice was discontinued. Back-flushing for New Zealand mud snail control has been part of an initial emergency control strategy and not viewed as a tool for the routine management of invasives. DES views back-flushing with marine water as a potential tool for reducing the spread of the snails that would only be undertaken following thorough coordination with our natural resource partners. There is no current plan for back-flushing. Further, because back-flushing is not viewed as a routine action, this management tool need not be included in TMDL-related modeling.Historically back-flushing was not allowed to protect the freshwater mitigation site in the central basin. *Approach: No scenario evaluation*
	Harvest lake weeds	Direct removal of plant (macrophyte)			X				Following the 2004 herbicide application, the macrophyte biomass grew back within two months.

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		organic matter and disposal offsite							Water column phosphorus levels would replenish quickly due to the low retention time in Capitol Lake, and the sediments provide a continuous source of nutrients. *Approach: No scenario evaluation*
Deschutes River-oriented potential model runs:									
1	Reduce nonpoint phosphorus sources	Various management activities that target nonpoint sources[3]						X	*Approach: Decrease nonpoint source phosphorus contribution by 10, 20, and 50% to bound nutrient target reductions.*
2	Increase nonpoint sources	Land development and wastewater infrastructure could increase nonpoint sources						X	No local data on potential increases. *Approach: Increase nonpoint source nutrient contribution by 10, 20, and 50%.*
3	Increase channel complexity	Enhance reaeration and nutrient transformation					X		Channel restoration including engineered log jams to increase channel complexity. No local data on effectiveness. Nutrient benefits recognized but not quantified. *Approach: sensitivity analysis increasing Manning's n* *To do: decide on %increase or value*

[3] Specifics will be determined in subsequent Implementation Plan. Including but not limited to these: * Reduce phosphorus in detergents * Reduce residential, commercial, institutional fertilizer use * Reduce pet waste * Install rain gardens * Decrease roof runoff * Fix cross-connections between sanitary and stormwater systems

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Previous scenarios or other analyses but no new model runs:									
4	Shift from septic systems to centralized wastewater	Reduce nitrogen (and phosphorus?) to groundwater	X				X	X	Complicated land, groundwater, surface water interaction not covered by current models. *Approach: Include as part of sensitivity analyses in #1. No additional scenarios. Could calculate difference between population * per capita flow * (OSS – centralized effluent concentration) as %inputs in system*
5	Reduce exempt well withdrawals and conserve water	Increase summer baseflow						X	Technical report quantifies temperature benefits of a scenario with 30% higher baseflow (but no change in load). Not clear whether increased baseflow would dilute groundwater or would deliver higher loads. *Approach: carry existing scenarios forward*
6	Evaluate potential land conversion	Increase or decrease in nutrients associated with different land development activities						X	Complicated land, groundwater, surface water interaction not covered by current models. *Approach: use Surface Runoff unit area loads with today's land cover to compare with regression-based estimates. If reasonably close, then can use unit area loads to evaluate how change in land cover affects nutrient delivery.* *To do: initial calculations then scope*
No additional scenarios proposed:									
	Manage livestock manure	Decrease nutrients and bacteria inputs to fresh waters						X	This nutrient concentration is not separated out from other sources so cannot directly quantify benefits of reducing it. Nutrient benefits recognized but not quantified. *Approach: Include as one of several practices bounded by a sensitivity analysis*

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	Restore wetlands	Increase in-stream nutrient transformations					X		No local data on relationship. Nutrient benefits recognized but not quantified. Potential mechanism for achieving tributary nutrient reductions. *Approach: Include as part of sensitivity analyses on channel complexity, but no specific scenarios*
	Revisit Critical Areas Ordinance	Decrease riparian vegetation removal and enhance restoration to decrease water temperature and enhance natural nutrient filtering		X		X		X	Water temperature benefits of riparian vegetation already quantified in technical report. Full mature riparian shade needed. Nutrient benefits recognized but not quantified. *Approach: no additional scenarios, but include as tool in Implementation Plan*
	Prioritize land acquisition	Enhance riparian vegetation to decrease temperature and enhance natural nutrient filtering						X	Water temperature benefits of riparian vegetation already quantified in technical report. Full mature riparian shade needed. Nutrient benefits recognized but not quantified. *Approach: no additional scenarios, but could consider highest differential temperature predicted in Implementation Plan development*
	Encourage cluster housing	Maintain %forested, decrease %developed, decrease pollutant delivery						X	Complicated land, groundwater, surface water interaction not covered by current models. *Approach: consider if land conversion calculations are pursued. If not, then include as tool in Implementation Plan*
	Address	Manage land						X	Not a separate scenario but a way of implementing

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	vesting issues	conversion to reduce nutrient inputs							scenarios. *Approach: No additional scenario but consider as Implementation Plan tool*