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SOME COMMENTS ON NEAR-TIDAL BUFFER COVERAGE IN CHAPTER 11 OF ECOLOGY'S SMP "HANDBOOK"[1]

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Comes now guidance buffer guidance intended to "...assist local government planners..." in meeting requirements of the Shoreline Management Act and the Department's SMP Guidelines, drawing on "a vast body of scientific knowledge".[2] Having spent several years reviewing some 4,000 references on buffering and related subjects, and several decades in the company of buffer research, I would like to be impressed by DOE's present command of tidewater buffer science, informed by the agency's antecedent attention to wetland buffer scholarship.[3] I'm disappointed; here's why.

Chapter 11 is "Vegetation Conservation, Buffers and Setbacks", whose scientific foundation is, in my opinion, ill-derived and misleading to the point of absurdity. I put the problems into groups:

Accepting streamside science as it stood two decades ago

Imputing and mis-applying habitat science, drawn from aquatic environments, to marine shores and nearby uplands

Ignoring whatever linkages do or do not exist between upland environments and marine organisms

Advancing quantitative land-use prescriptions in the absence of quantitative or even relational background information

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[1] Chapter 11 in "Shoreline Master Program (SMP) Handbook", Washington Department of Ecology Publication 11-06-010, November 2011. Author(s) unk.

[2] Handbook's first page.

[3] The latter is Sheldon, D., et al. 2003.

Ignoring societal costs and displacement despite requirements of the Shoreline Management Act and the considerable social science available

Ignoring many of the natural factors that, continually or episodically, act to affect the inshore and its inhabitants

Does all this matter? Yes. It confuses and misleads people and policies, down nine garden paths, as follows:

Technical questions confronting waterfront owners, council members and planning commissioners

1. Why buffers? This question has been given many answers, for divers situations. Chapter 11 treats this question far too casually, perhaps because the reasoning behind tidewater buffering is weak.

2. Are there diminishing returns or economies of scale?

3. If buffers, how big? How variable in size?

4. What range of contents and in-buffer activities fit buffer objectives?

5. If not buffers, what?

Economic and societal issues

6. What costs and impacts do buffers incur?

7. What levels are warranted?

8. Who should bear them? In what fashion?

9. Are there near-tidal measures carrying lower societal and owner costs?

1. Buffer rationales old, recent, and in the Handbook

Contrary to the Handbook's claim, the statement that "Research on freshwater riparian areas is relevant to marine riparian areas and vice-versa"[4] is largely incorrect. The best that can be said of the relationship is quoted by the Handbook, "riparian areas provide ecological functions regardless of whether they are adjacent to freshwater or marine water bodies."[5] All areas everywhere provide ecological functions. Those adjacent to streams are in large measure different from near-tidal ecosystems.

Marine life is very different from aquatic fauna. A Scripps Institution professor has remarked, "...seawater is a toxic material to most land organisms and highly inimical to their survival..."[6]

Treed buffers, to break the wind, have been used for centuries around the world, and for many decades in the prairie parts of North America. In farmed regions buffers are common, not only for flood-silt control but also to constrain errant nutrients and pesticides. Along forest streams buffers have been left after logging for at least the past 80 years, to reduce flooding and flood-borne silt, and to keep fish-impeding debris at bay. In West Coast woodlands streamside buffers also figure in the aquatic food chain and provide habitat for wandering wildlife as well as certain birds and amphibians for whom riparian places are crucial.

The Handbook, quoting a DOE WAC, mentions most of these benefits,[7] that derive from freshwater research. Unfortunately these areas of efficacy are imputed to near-tidal buffers, where they generally do not belong. I have discussed the fallacies elsewhere, at length.[8] Here I summarize:

<u>Shade</u> -- Backshore bluffs, especially those facing northward, obviously cast shadows. The reach of tree shade is similarly aspect-dependent. In neither case does shade make a difference

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4 Page 13.

5 Page 13, quoting Eurovision & Herrera 2010.

6 Isaacs, J. D. 1978.

7 At pages 1 and 11-12. All page number refer to Chapter 11.

8 Flora, D. F. 2011a; Flora, D. F. 2011b.

to passing fish nor, here, to upper-beach summer-spawning smelt. The latter visit only three sites in the mid-Sound, of which two have had no shade during the past century. The third is beneath homes built over the beach on piling, which suggests the inshore ends of docks may be important, not harmful, for their shade.

In any case, in researched aquatic settings in Western Washington and Oregon, warming is being found more important than cooling to stream biomass production. I can provide a dozen studies. Hence the Handbook's suggested extrapolation of shade conclusions from stream studies to the central Sound may have unintended results.

Organic inputs and bugs -- The thousands of miles of headwater streams in western Washington depend heavily on riparian sources of nutrients, microbes, plant tissues and invertebrates (big ones are the bugs) for support of aquatic life including nascent fish and amphibians.[9] Near-tidal vegetation, whether natural or planted, probably matters in a small way, given the vastness of our saline waters and the immensity of oceanic inputs. For instance over 200 times as much nitrogen enters Hood Canal from the ocean as from all other sources. On average, 9/10 of the water in Puget Sound is ocean-sourced.

Wrack is another biota issue. The wayward, aimless debris along the high-tide swash line provides transient shelter to some amphipods (beachhoppers) and other inverts. Its counterpart in freshwater is leaf and twig litter. However leaf and needle litter are omnipresent in headwater streams; wrack is mostly seaweed.

Aquatic insects are key players in streams; neither they nor other insects have much to do with tidewater, where they play a minor role in diets of juvenile salmon. About 1/8 of the biomass consumed by juvenile salmon in the Sound is insects; on average about 1-1/2 percent is tree-dependent insects.[10] In

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[9] Here some definitions. "Aquatic" universally pertains to fresh, never salt, water. "Riparian", as in riparian water rights or the riparian zone beside streams (into and from which fresh water and its contents seep). This interplay accounts for the special productivity of riparian places. "Riparian" is not pertinent to marine watersides, where infiltrating salt water would be fatal to non-beach plant life.

[10] The Hood Canal input estimated by Paulson et al of USGS; the Seattle fraction estimated by Flora using mass-balance approach, confirmed by Ebbesmeyer et al 1988. Insect consumption numbers rely on four diet studies, by Duffy, Fresh et al, and Brennan et al.

short, the welfare of tidewater organisms depends far more on marine than upland inputs.

Stabilizing banks and reducing sediment input -- These Handbook proposals, drawn like those above, run contrary to both recent stream science and tidewater bluff failure/sediment doctrine. The stream science points to avalanches and debris flows as major and largely un-preventable factors driving stream geometry and dynamics.[11] Meanwhile much favor is awarded to bluff failures along the Sound.

The difficulty with dogma is its utter absence of dimensional content: no quantitative measures are available anywhere on Puget Sound for the periodic amounts of cascading sediments desired, nor what those would achieve for habitats and biota. Presumably nothing for salmon.

Protection from pollutants -- Sediment aside, the Handbook implies that vegetated buffers can filter and ingest pollutants, and do this better than conventional landscaping. The limp logic here founders on the fact that stormwater, the pollutants' vector, flows in winter when vegetative uptake of anything is near zero. Which leaves near-surface flow to the Sound or subsidence to aquifers. The clear alternatives for tainted stormwater are not buffering but rather short-life chemistry and abstinence.

Corralling nutrients -- If nitrogen, phosphorus, and other nutrients are an issue, to be solved with buffers, the previous paragraph applies full well. However the tempest over nitrogen in Hood Canal (and other fjords) obscures the absolute necessity for nutrients to support the marine food chain, starting with plankton and peaking with sea birds, marine mammals, fish, and the entire shellfish industry.

Nutrients are scarce, limiting, and welcome in forest streams; they are (perhaps wrongly) considered hostile in the Sound, where oceanic sources are immense. It is ironic that headwater streams are low in nutrients, to the extent that salmon carcasses are hand-carried to creeks. Meanwhile there are those immense volumes of nitrogen coming in from the ocean. In the Sound as a whole, "...only a few percent of the nitrogen load

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[11] See for instance Ryan, D. F. and J. M. Calhoun, eds. 2010.

comes from anthropogenic sources."[12] So much for buffers.

$15 million is about to be spent at the Central Kitsap sewage plant to keep nitrogen out of Puget Sound; meanwhile volunteers are hand-carrying high-nitrogen salmon carcasses to forest streams. A noted marine biologist has suggested that primary production in tidewater is constrained by light, not nutrients.
Large woody debris -- The Handbook avers that LWD benefits accrue to freshwater environments for pool forming. This important feature of headwater (not riverine) woodland streams has been transported into tidewater doctrine. Driftwood hosts and protects certain marine invertebrates while burying others. Where fallen bank-top trees comprise the LWD there are unanswered questions about the merits of collapsed banks versus the harm from prostrate trees' blockage of longshore sediment travel. Indeed there is no research showing that LWD is a habitat asset, nor how much would make it so.

The effects of trees falling toward other trees are very different from trees falling toward nearshore houses. And trees falling into streams have dynamic roles, while those in tidewater are largely static. Even in the best of windthrow worlds, the roles of downed trees are very different along streams relative to tidal shores.

Microclimate regulation -- Yet another stream concern is transmuted by the Handbook to intertidal areas. Yet it is not explained how upland buffering will affect temperature nor humidity on the beach at high nor even low tides. No research has shown that humidity, air temperature, windspeed gradients, nor soil-moisture profiles are the same above tidewater shores as those adjacent to streams.

Wildlife habitat -- The Handbook vaguely refers to wildlife as if buffers are uniquely qualified to benefit critters. They often are along streams, for amphibians plus certain birds, plants and mosses. Buffers above tidewater, on the other hand, are typically, and usually are intended to be, an extension of conditions farther inland.

Critters and people co-habit near-tidal lands all across Kitsap County. Day and/or night the wild things sally near. There is no showing that buffers outpace residential places in producing

[12] Harrison, P. J., et al. 1994.

or protecting wildlife nor predators. Except perhaps feral cats. On the Island four kinds of marine birds are nearshore obligates in nesting: herons and eagles, ospreys and pigeon guillemots, none dependent on buffers, and all meandering nigh human home places.

Other reasons why near-tidal places differ greatly from headwater streamsides ==

The biota of stream-held logs are different from those in beach logs.

Most backcountry headwaters are seasonal; those on the Sound are diurnal.

Wind's role along streams is very different from its intertidal activities.

Old-growth forest headwater streams are typically high-gradient and narrow

Fire has played a determining role in backcountry forests and riparian areas; burning bushes along the bay are rare.

Snow and ice are common arrivals in headwater riparian areas; not so along the Sound.

Amphibians have major presences and are major concerns in managing forest nearshores. They cannot abide tidewater.

2. Diminishing returns and buffering

The Handbook leans heavily on a paper[13] that in turn relies on freshwater science compiled in 1993[14] for *headwater streams in old-growth forests*. The DOE guidelines and Handbook lists of streamside functions, discussed hereabove, parrot the 1993 FEMAT headwater habitat-factor compilation.

FEMAT, a scientific team assembled to devise protection strategies for high-country salmon-producing streams, prepared for each habitat factor a curve illustrating, for the first

[13] Washington Sea Grant 2009.

[14] FEMAT 1993.

time, diminishing returns from adding increments of buffer width. The FEMAT curves were endorsed in principle by subsequent inquirers including individual scientists[15], a group of researchers including former FEMAT colleagues[16], and a local group assembled to support some buffer widths[17]. In all cases "endorsement in principle" implies endorsement of the diminishing-returns principle. It would have been folly to endorse the specific buffer widths chosen by FEMAT for uniform application over thousands of streamside miles, when that uniformity was being questioned sharply and the many differences between aquatic and marine shores were well-known.

3. Buffer geometry

What about specific buffer parameters for particular places or any of the wide array of nearshore situations? The Puget Sound Nearshore Ecosystem Restoration Project (PSNERP) says, "We do not have many studies that identify how wide nearshore buffers and setbacks should be. Local jurisdictions developing shoreline regulations typically rely on science from stream and wetland buffer studies, *which may make the regulations subject to legal challenges."*[18] [emphasis added]

The Handbook defers for buffer geometry to the Marine Riparian Functions paper[19], which is flawed in several respects. For each of the various functions the paper puts forth a diminishing-returns graph, expressed in terms of the percentage effectiveness for various buffer widths. Unexplained is what "effectiveness" means, what full effectiveness comprises on the ground, over what time frame, and what effects derive for habitats and biota beyond the buffer. For example, would 50 percent of shading effectiveness mean that shade occurred over half the space, or cut off half the insolation, or accomplished half of whatever shade was expected to generate, or protected half of whatever shade was considered able to defend? Thus "80% effectiveness", the paper's metric of choice, is vacuous.

[15] For example Reeves, G. H. 2006.

[16] Ryan, D. F., et al, 2010.

[17] Washington Sea Grant 2009.

[18] PSNERP 2009, p. 8-8.

[19] Washington Sea Grant 2009.

There is another fact that makes "effectiveness percent" a spurious metric. Pollutant flows from farms clearly exceed those that might spring from residences. Nitrogen from three cows equals that of 40 people. A buffer that stops, say, 10 percent would suffice for an average Puget Sound home. Similarly agricultural fertilizers and pesticides are applied heavily throughout the growing season, and row-cropping involves much bare soil. That matters because buffer research has been done chiefly in the Midwest and East; at feedlots, row-crop farms and pastures; and mostly gauges just nitrogen, phosphorus, and sediment restraint.

The Marine Riparian Functions paper assembles buffer findings from 20 studies.[20] It is not clear how they were chosen from among the hundreds of extant buffer-effectiveness studies.

Another fault is the use of ranges and averages from a list of buffer studies.[21] When WDFW resorted to averaging[22] Buell[23] commented:

> There is no scientific or technical basis for the use of averaging, taking the median value, or any other measure of "central tendency" when arriving at a conclusion regarding the effectiveness of protective measures, such as streamside buffer widths, without first evaluating the relevance or appropriateness of *each* of the values being used in the analysis to the watershed or stream types subject to protection. At the very least, some reasoned analysis must be performed and a weight assigned to each value reflecting the similarity of the watershed, vegetation condition, and fish and wildlife resources present prior to arriving at a conclusion....The best way to use the research is to choose one or more scientific studies which apply particularly well...and use those studies for guidance.

Yet another issue is that where effects data, relevant to buffer

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[20] Washington Sea Grant 2009 Appendix C.

[21] Washington Sea Grant 2009 Appendixes G and C respectively.

[22] Knutson, E. L. and V. L. Naef 1997.

[23] Buell, J. W. 2000.

width, is tabulated, there are no tests of its statistical relevance. I did so for two compilations cited in the Handbook, for sediments, nitrogen and phosphorus, using nonlinear regression. In every case except phosphorus the equations could reasonably predict intercepts but not slopes. This supports the hypotheses that buffer width had an effect, but that effect did not change with buffer width. A change of buffer width did not produce a predictable change, up nor down, in pollutant reduction.

The Handbook turns also to a source on priority freshwater near-stream habitats[24] and a "white paper" on floodplains and freshwater riparian areas[25]. The following statement is from Buell[26]:

> Appendix C [of the 1997 Knutson & Naef update] is usually appealed to as representing the *minimum* buffer 'needed to retain' functions. This is not true...these values were the *maximum* distance studied by investigators. This distance is nearly always significantly in excess of that required for *complete or nearly complete protection* of 100% of fish and wildlife needs....the [Appendix C] table itself is a rather egregious exaggeration and misrepresentation of the underlying science and the facts.

A fourth report put forward by the Handbook says, "Variable width buffers can allow for greater flexibility, account for variation in site conditions and land management practices, and potentially achieve desired ecological goals while minimizing undue losses to landowners." and "When applied properly, variable width buffers can be more ecologically sound because they have the potential to reflect the true complexity of the environment and management goals. However, there are no generally accepted criteria for the establishment of variable width buffers."[27] Nor, clearly, for standardized one-size-fits-all buffers.

The four documents highlighted in the Handbook do nothing to

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[24] Knutson, K. C. and V. L. Naef et al, 1997.

[25] Bolton et al, 2001.

[26] Buell, J. W. 2000.

[27] Envirovision et al, 2010, at p. III-41.

advance the proposition that tidal-shore buffers of designated widths and prescribed vegetation are superior to more efficacious than residential landscaping in protecting or improving near-tidal functions, much less values.

4. What ranges of contents and in-buffer activities fit buffer objectives?

Chapter 11 does not dwell on this subject beyond many mentions of native vegetation. However single, narrow pathways among no-touch trees, shrubs and groundcover appear to have DOE favor.

Bainbridge Island's citizen advisors have railed against lawns. Yet successful use of grass for slowing stormwater and halting sediment. is apparent in road-cut restorations and construction projects generally. Alternative vegetation, shrubs and trees, invites rill erosion as water channels itself around stems and trunks. A widely-respected research synthesis[28] says:

> [Grasses] are generally able to respond rapidly to increased concentrations of nutrients, grow rapidly and densely, and typically grow well in nearly all climates. Thickly planted, clipped grasses provide a dense, obstructive barrier to horizontally flowing water. This increases the roughness of the terrain, which reduces flow velocity, promotes sheet flow, and increases sediment and adsorbed pollutant removal efficiency.

Perhaps indicative of the efficacy of grass is the absence of overland sediment flowing into the Sound from Bainbridge shoreline yards, where about 80 percent of the shoreline is developed.

The pros and cons of nativeness and the loss of children's spaces are addressed in two manuscript reports.[29]

5. If not buffers, what?

Of the stream-based buffer functions discussed above, two can arguably be needed in near-tidal areas, to alter or sustain

[28] Desbonnet, A., et al. 1994.

[29] Flora, D. F. 2010 and 2011.

beach habitats and/or biota. Those functions are wrack and controllable sediment contributions. It has not been shown that near-tidal upland wildlife habitat, insects, falling trees, nutrients, nor upland microclimate make significant difference to salmon nor other nearshore marine biota, except in salt marshes.

Not mentioned in the Handbook's list of functions is protection from toxic chemicals in tainted stormwater. I do, because it is part of nearshore doctrine. However toxicity knows few bounds: what is toxic to people and marine life is generally harmful to buffer plants, unless they refuse to ingest the stuff, which negates their protective role.

Wrack and sediment are alike in being unpredictable in both source, quantity and utility. Neither is linked to buffer geometry. Wrack is partly derived from nearshore vegetation, mostly from seaweeds. The density and discharge of buffer vegetative material has not been shown to be greater or less from mandated buffering than from ordinary landscaping. Curiously, the same is true for stormwater dynamics, with no Puget Sound comparisons, past nor present.

The bottom line here seems to be that buffering in not notably different in its efficacy from front yards. This may be unfortunate in that bank-collapse sediment is largely unpredictable in timing and extent, and neither yards nor buffers can be expected to halt sustained, heavy inputs of stormwater-bearing chemistry. Not even animal poop. Abstinence is apparently the best option. I can provide a 9-page discussion of alternatives to buffers.[30]

6. Economic and societal costs and impacts of buffering: what kinds and how much?

That these occur is without question. Near-tidal uses of home places and their surrounds are impinged upon and ultimately displaced. "Mitigation" costs, current and future, can be immense in the aggregate. Some of the impacts may lead to litigation. Others may be borne publicly. The Handbook neither estimates nor suggests how to estimate these effects. In fact they are not mentioned.

[30] Flora, D. F. 2010.

View property clearly are worth more than those without views. How much has been estimated lately, but not in the Handbook. Cutting off visual and physical access to the Sound while surrounding homes with 100-foot buffers surely imposes very large losses in use and market values. Again, no mention in the Handbook.

7. Economic and societal costs and impacts of buffering: What levels are warranted?

The Handbook does not address these matters nor does any of its referenced literature. This interesting subject can also be phrases in terms of opportunity cost: What do we give up as resources are spent and conscripted?

8. Who should bear them? In what fashion?

Curiously neither the Handbook nor its underlying statutory language address this matter, instead implicitly sending the burdens to property owners. It has been suggested that Constitutional provisions will be brought to bear on this issue, a subject beyond my cognizance.

9. Any near-tidal measures carrying lower burdens than buffers?

Yes, partly because of the narrow range of benefits actually provided by buffers. Yard clippings generate wrack as well as fallen leaves. Abstinence deals well with wayward horticulture chemicals. Yards are stopping sediment and serving wildlife well. And so on.

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