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Subject: Water Quality/Mixing Zones, Docket No. 58-0102-140

Dear Paula,

I would like to offer some suggestions on subject rulemaking. These suggestions rise from spending a fair amount time over the years in different capacities thinking about the concepts and provisions of mixing zones and water quality criteria. They are not offered on behalf of any organization, stakeholder, or such.

First, well done to DEQ for taking on this complicated issue. I agree with points made during the May 1 presentation that the present rules are confusing and internally conflicting, which makes issuing clarifying guidance difficult without first addressing the rule language. Some suggestions on remaining potential internal conflicts follow:

1. Consider dropping or modifying proposed section 60.01.h.ii, "The mixing zone shall be no closer to the 10-year, 7-day low-flow shoreline than 15% of the stream width."

The rationale for this suggestion is twofold. First, in smaller streams the objective of avoiding interference with the passage of fish and other aquatic life may be better met if the discharge only affects one side of the channel rather than taking it out of the middle. This may be particularly important if greater than 25% of the width or volume of the receiving water is authorized as a mixing zone. Secondly, at face value, this provision would require a pipeline and a submerged diffuser, and open-channel discharges would be disallowed. I believe the present situation is the opposite of this, that is, far more existing dischargers presently use a side-channel outfall configuration than use a pipeline/diffuser configuration.

If a thorough count of presently authorized mixing zones in Idaho were made (which this is not), I believe it would show that the great majority are side-channel releases that do not follow this provision. From facilities that I have visited and a cursory check of current NPDES permits in Idaho, a short-list of permitted center-channel, pipeline and diffuser outfalls and mixing zones

resulted. These include the City of Boise (Lander St facility), Clearwater Paper, the City of Lewiston, City of Sand Point, City of Salmon, Thompson Creek Mine (Squaw Creek and Salmon River outfalls), Hecla Grouse Creek Mine (Yankee Fork outfall), and Meridian Gold's Beartrack Mine (Napias Creek outfall).

In contrast, a large number of major municipal dischargers appear to use a side-channel outfall configuration. These include the City of Boise (West Boise), City of Caldwell, City of Twin Falls, City of Heyburn, City of Hailey, City of Ketchum, City of Pocatello, City of Blackfoot, City of Idaho Falls, City of Rexburg, City of Coeur d'Alene, City of Post Falls, and the Paige/Mullan consolidated sewer district. Mining or industrial facilities with side-channel outfalls and mixing zones include Thompson Creek Mine (Thompson Creek), Hecla Grouse Creek Mine (Jordan Creek), Hecla Lucky Friday Mine (SF Coeur d'Alene River), the EPA/IDEQ Central Treatment Plant, and Hecla Lucky Friday Mine (SF Coeur d'Alene River). This side-channel effluent listing could go on and on. The point is, while the language retains DEQ's longstanding discretion to vary from this restriction, if the provision does not add environmental protection, the provision has routinely been waived in the past, and the provision might add unnecessary costs to discharges, what is the value of keeping it? Possible alternative language might say something about the need to avoid bank-hugging plumes for effluents that because of visibility or odor could be aesthetically objectionable or detract from recreational use.

Some illustrations of side channel versus submerged diffusers illustrate these points.

Figure 1 shows a side-channel outfall in which the undiluted, tailings pond effluent appears to be severely toxic to aquatic life within the "zone of initial dilution." The rocks within the ZID appeared completely devoid of algae and macroinvertebrates compared to nearby rocks. Were that outfall instead configured to release the effluent through a pipe into the center of the receiving stream, it might be a greater threat to interfering with the passage of aquatic life and thus jeopardize the protection of the water body as a whole than does the present side-channel configuration.

Figure 2 shows risers from a classic, submerged pipeline and diffuser configuration from the Clearwater Paper outfall into the Snake River in Lewiston, Idaho. Unlike the mine effluents which may be clear and not distinguishable by eye from the receiving water, because residual lignin and wood resins give pulp mill effluents turbidity and color, the effluents may be visibly apparent from the receiving water. Were they to be discharged from a shallow bankside outfall configuration, such a mixing zone configuration would likely lead to complaints.

Figure 3 shows that submerged, diffusers do not always result in rapid mixing. In this example, the warmer pulp mill effluent is buoyant and forms a discrete plume that remains intact far downstream of the diffuser.

Figure 4 shows two examples of a pipeline and center-channel, submerged diffuser mixing zone configuration with mining effluents discharged to much smaller streams than in the earlier

examples. The diffuser from the Hecla Grouse Creek Mine tailings pond to the Yankee Fork had probably been operating for around 6 years at the time of the photo (2009), and probably is functioning about as intended. However, the ports to Thompson Creek Mine's diffuser in Squaw Creek, a smaller stream, are no longer submerged at low flows, and the risers have become too high and are forming a little island with trapped sediment and debris. This diffuser had probably been in place for over 25 years at the time of the photo (2010). The mine began operation in 1983, and I presume the outfall pipeline and diffuser were built around that time. Since presumably the diffuser ports were submerged when first installed, this suggests that the stream channel degraded (downcut) at this location, eventually leaving the diffuser ports high and dry. The latter example shows that maintaining submerged diffusers in small streams can bring logistical challenges that might require periodic instream work and channel disturbance in order to perform maintenance.

In contrast, other outfalls at the Thompson Creek Mine discharge from a natural side channel (Figure 5). In this case, the regulatory mixing zone determinations were based in part on published thresholds for concentrations of metals that had caused fish avoidance, where at least half of the channel would be below these literature-based avoidance thresholds. The half-the-channel width was assumed to be sufficient following site-specific surveys showing that the velocities and water depth in the far side of the stream away from the effluent plume were probably adequate for fish passage, and that biological monitoring above and below the mixing zone showed similar fish and invertebrate communities, which in turn was considered to indicate that existing practices were not impeding passage of aquatic life.

The Bunker Hill Central Treatment Plant, operated by EPA & IDEQ under Superfund, is another large facility that presently discharges via an open channel and bankside discharge to its receiving waters, the South Fork Coeur d'Alene (Figure 6). There are considerations for rebuilding this as a pipeline and diffuser, apparently because the culvert under I-90 is undersized.

The point of these examples is that the optimal design configurations for outfalls and mixing zones are probably situational, and might be better addressed through meeting qualitative principles such as avoiding configurations that could interfere with the free passage of aquatic life around the mixing zone, avoid creating attractive nuisances where thermal or nutrient conditions might lure aquatic life into the mixing zone, and avoiding unaesthetic visible bank hugging or other discrete effluent plumes. Prescriptive pprovisions that in practice are routinely waived for those who know to ask may not necessarily add much environmental protection and might be preferable just to delete.

2. Critical volumes vs. width

I suggest considering adding language to the effect that as a first approximation, DEQ may at its discretion presume that provision h.iii "*The mixing zone shall not include more than twenty-five percent (25%) of the critical volume of the stream flow…*" will be sufficient to also meet

provision h.i "*the width of a mixing zone is not to exceed twenty-five percent (25%) of the stream width*."

The reason for this suggestion is that calculating 25% of stream volumes is a simple matter since streamflow information has to already be on hand in order to go through the reasonable potential to exceed criteria and waste load allocation calculations. Determining whether a plume is limited to 25% or other fraction of the channel width is another matter. At the minimum, measurements of channel and outfall geometry (i.e., series of transects), temperature gradients and substrate characteristics are needed if the CORMIX simulations are used. If the simulation results had important economic or ecological implications, more rigorous tracer studies could be warranted (e.g., Figure 5). Making and interpreting these measurements may be a nontrivial task. If in most cases, meeting the 25% volume constraint may presumptively be sufficient to meet the width constraint, perhaps there would be a benefit to say as much.

The availability of the CORMIX software and code bears mention. This modeling and decision support system for mixing zone analyses was developed with EPA funding and used to be freely available to the public from EPA's Center for Environmental Modeling and Assessment. However, CORMIX has subsequently been privatized and EPA CEAM has taken the code down from their website. CORMIX subsequently morphed into a sole-source and a very expensive product, with license fees ranging from $2800 to $5200 per year for commercial users (e.g., consulting firms, permittees). The basic version is presently provided free to US Federal and State Regulators. The dependence of mixing zone analyses on the CORMIX code and software, and its limited availability to all parties would tend to limit its transparency and reproducibility. This may give further impetus to the simple presumption that 25% volume restriction would also be sufficient to limit plume width in many cases.

3. Instantaneous lethality

Avoiding instantaneous lethality from heated discharges is a low bar to clear, or even define. For instance, dropping a live crab into a boiling pot of water doesn't result in instantaneous lethality. Rather it will desperately skitter around for 15 seconds or so before succumbing. Alternative language might be considered. In EPA's 2003 guidance for Pacific Northwest state and tribal temperature water quality standards, the section "Provisions to Protect Salmonids from Thermal Plume Impacts" has some good information on this point. For instance, they recommend that in a zone of initial dilution, the maximum temperature within the plume after 2 seconds of plume travel from the point of discharge does not exceed 32°C, the width of a stream exceeding 25°C not exceed 5%, and the width exceeding 21°C not exceed 25%. If the 21°C and 25°C provisions were also include, some provision for upstream conditions would have to be included since natural summer stream temperatures often exceed 21°C and sometimes exceed 25°C.

4. Clarification of acute and chronic criteria in relation to temperature

While provisions for being able to exceed acute and chronic criteria within ZIDs and mixing zones can be defined reasonably well, temperature criteria aren't formally expressed as acute and chronic criteria. The present daily max and daily average structure to temperature criteria could probably be interpreted along these ways, but if so, it might be helpful to give some guidance on this.

5. Consider retaining the present 060.01 introductory language:

I suspect the reasons for proposing to strike the present introductory language included its subjectivity and the implication that an "appraisal" is a written product that DEQ could be taken to task for not producing. That is, *"After a biological, chemical, and physical appraisal of the receiving water and the proposed discharge and after consultation with the person(s) responsible for the wastewater discharge, the Department will determine the applicability of a mixing zone and, if applicable, its size, configuration, and location. In defining a mixing zone, the Department will consider the following principles: ...*" However, this actually seems a pretty concise statement of purpose and it might be more helpful to the practitioners to retain the essence of this language instead of striking it altogether. For instance, perhaps language along the lines of "*In consideration of the biological, chemical, and physical characteristics of .....*" might recognize DEQ's discretion to look at conditions holistically instead of just the specific factors listed, yet not imply DEQ is obligated to produce a report in all circumstances. Some degree of subjectivity seems unavoidable here and in many other aspects of mixing zone determinations.

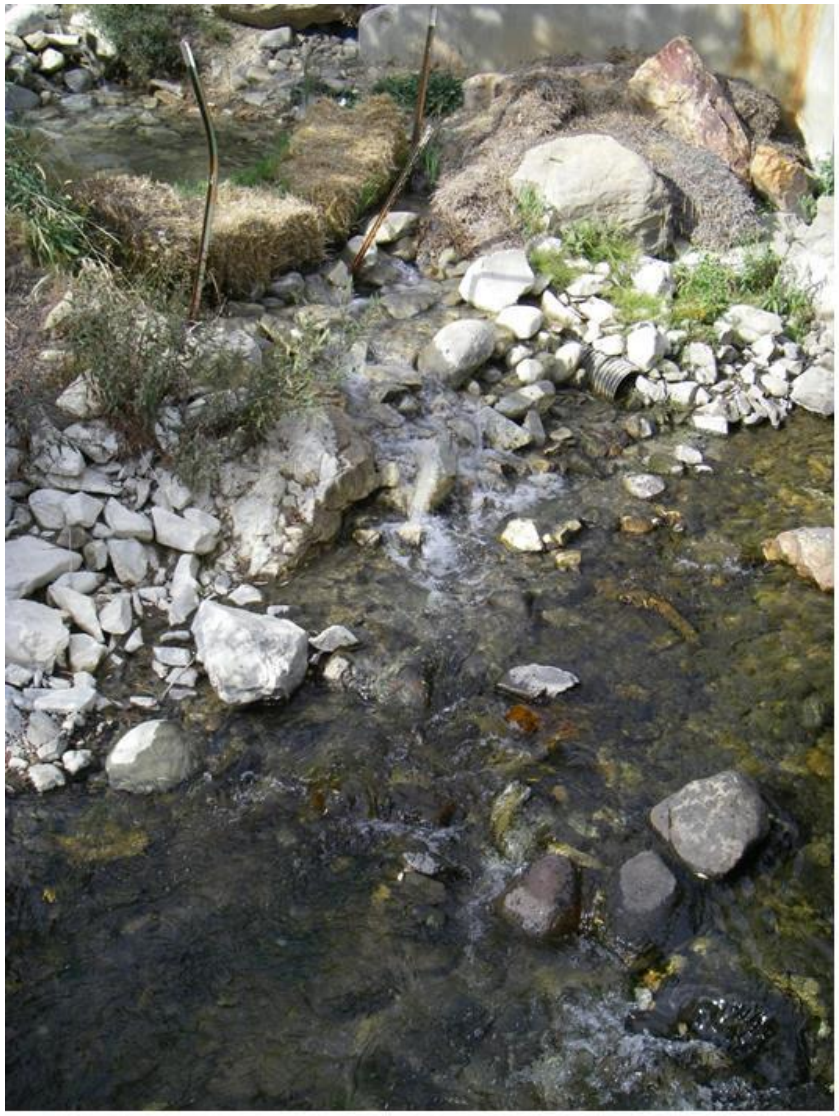

Figure 1. The Hecla Grouse Creek Mine outfall to Jordan Creek near Custer, ID, a tributary to the Yankee Fork of the Salmon River. This outfall uses a natural stream channel (i.e., an open channel, side confluence outfall and mixing zone configuration). The outfall, is shown as the outlet to Pinyon Lake on topo maps. The regulatory dilution volumes for this outfall for this outfall allows between 50% (copper) and 100% (cyanide) of the stream flow for different effluent constituents .

Within the zone of initial dilution (ZID) the stream appears lifeless, with no algae growing on rocks, and no insects were found on the rocks (top right)

Contrast the natural appearance of rocks immediately outside of the mixing zone (below), with those in the ZID (above).

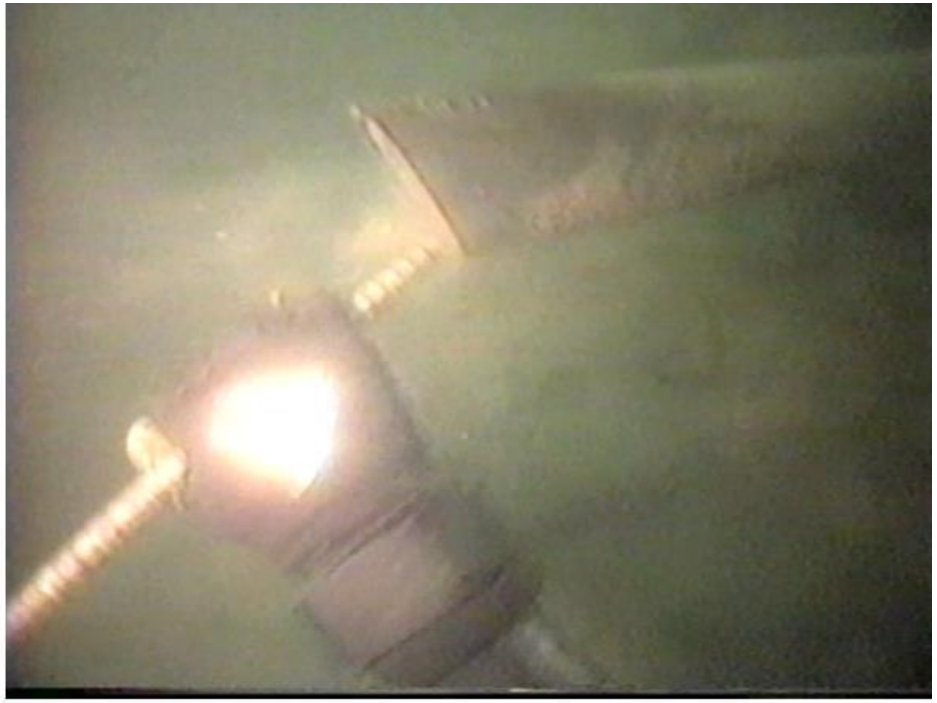

Figure 2. The pulp and paper mill in Lewiston probably has the largest mixing zone in Idaho. Bleached kraft mill effluent is piped from the mill located on the bank of the Clearwater River about 4 miles downstream to take advantage of the combined dilution flows of the Snake and Clearwater Rivers. The diffuser is about 400 feet across, spanning about 40% of the Snake River channel in about 25 feet of water or more, and as of 2003, released treated effluent at a rate of about 60 cfs into >12,000 cfs from about 72 functional risers, each rising about 1.5 feet above the river bottom.

The photos were taken by divers performing routine maintenance of the risers.

Figure 3. Diffusers do not always guarantee rapid mixing. In non-turbulent rivers effluent plumes can sometimes persist a long-time before breaking down if a strong density gradient is present. Pulp mill discharge to the Athabasca River in northern Alberta.

Figure 4. Examples of center channel mixing zones with diffusers in smaller streams. (**Top**) Hecla's Grouse Creek unit discharges into the Yankee Fork through a diffuser which appears to functional at low and high-flows. (**Bottom**) The risers for Thompson Creek Mine's outfall and diffuser to Squaw Creek protrude well above the stream bottom where they catch debris and appeared partially clogged with sediment. Their appearance suggests the stream channel may have degraded since installation, illustrating the challenges of designing, constructing, and maintaining center channel diffusers in small streams. Regulatory dilution volumes for this outfal for this outfall range from 0 to 50% for different constituents and flows

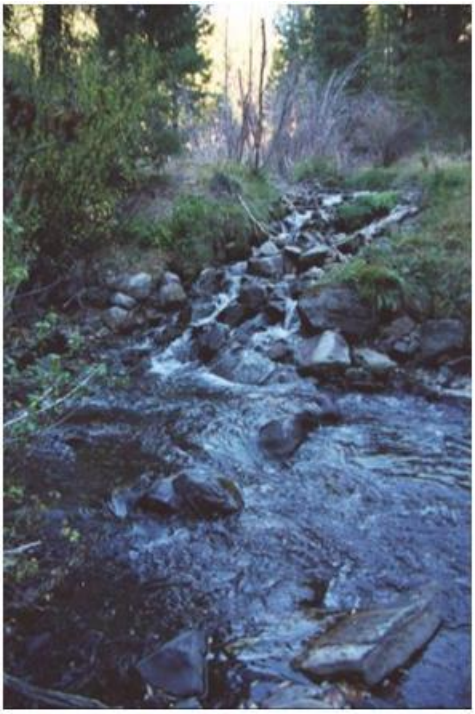

Figure 5. The Thompson Creek Mine's outfalls to Thompson Creek discharge from natural side channels. The outfall is a small tributary stream (Buckskin Creek) which carries drainage water from the toe of a waste rock dump. The photo at left is looking across Thompson Creek at the confluence mixing zone during base flows; the photo at right is looking downstream during a rhodamine dye tracer test conducted as part of the analyses in support of the mixing zone determinations.

The regulatory dilution volumes for this outfall allow between 5 and 75% of the stream flow for different effluent constituents and flow conditions.

Figure 6. At the Bunker Hill Superfund Site CTP (Central Treatment Plant) operated by EPA and IDEQ, contaminated water is treated (center) and clarified (outer tank) before being discharged into the SF Coeur d'Alene River via "Bunker Creek" and a side-channel culvert.