From:	Kim Patten
To:	Rockett, Derek (ECY)
Subject:	Comments on NPDES
Date:	Monday, December 08, 2014 9:09:50 AM
Attachments:	Comments in the proposed npdes and deis imid Dec 8 2014 Kim Patten.pdf

Derek, Please find attach my comments on the NPDES.

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Re: Public comment on the proposed NPDES permit and draft Environmental Impact Statement (dEIS).

Date: December 8, 2014

To:
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From:
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1) SIZ map exclusion of southern Willapa

Tidal residence time: Ecology has excluded the southern ~ 1/4 of the bay (~15,000 ac+) from treatment. Of this tidal ground, ~ 6800 acres is shellfish ground. Much of this is actively farmed and some of this ground has serious infestations of burrowing shrimp. Ecology does not clearly state why it has been excluded. However, because the exclusion line matches the "dispersion gap" line developed by Banas and Hickey (Banas, N. S., and B. M. Hickey. "Mapping exchange and residence time in a model of Willapa Bay, Washington, a branching, macrotidal estuary." Journal of Geophysical Research: Oceans (1978–2012) 110.C11 (2005), I assume they are concerned about limited hydrodynamic mixing. As stated in the Banas and Hickey paper, depending on the locations within Willapa Bay, tidal circulation can be conveyor-belt-like in some places, or more diffusion-like in others. Dilution of a pesticide in this zone would be based more on diffusion-like, rather than Lagrangian mechanics. Diffusion is based on Fick's first law $J = -D\frac{\partial \phi}{\partial x}$ (a solute will move from a region of high concentration to a region of low concentration across a concentration gradient) and second law $\frac{\partial \phi}{\partial t} = D\frac{\partial^2 \phi}{\partial x^2}$ that predicts how diffusion changes the concentration with time. This diffusion is helped by the strong vertical mixing within the tidal prism of this "dispersion gap" (Banas et al. Mar Ecol Prog Ser 341: 123–139, 2007). In addition, there is a certain percentage of that tidal prism that is discharged with every tidal exchange in South Willapa Bay. These data are available in a report by Kraus, 2000. (Study of navigation channel feasibility, Willapa Bay, Washington / Nicholas C. Kraus, editor with contributions by authors Charles E. Abbott... [et al.]; prepared for U.S. Army Engineer District, Seattle. 440 p. ill.; 28 cm. —(ERDC/CHL; TR-00-6). He provides data on the tidal prism flow in various channels exiting South Willapa Bay (see following table). The mean values for these channels range from 3000 to 6000 cu meter of water/second

Table 4-7
Discharge Values for South Willapa Bay

Transect Number	Location Description	Discharge, cu m	Tidal Height, m (mllw)
1	South Channel	-9,407	2.07
3	Nahcotta Channel	-7,585	2.59
4	Stanley Channel	-3,781	2.71
5	Stanley Channel	-3,340	2.93
6	Shoal Area	-990	3.05
7	Nahcotta Channel	-3,472	3.11
8	Nahcotta Channel	-2,320	3.26
9	Shoal Area	870	3.26
10	Stanley Channel	-61	3.23
11	Stanley Channel	664	3.20
12	Nahcotta Channel	6,404	3.02
13	South Channel	8,718	2.65
14	South Channel	5,802	2.47
15	South Channel	5,873	2.32
16	South Channel	9,801	2.19

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Using the above information, along with some basic toxicology data, it is a relatively easy calculation to determine the risk to treating shellfish beds in the exclusion zone. There are ~ 10,000 acres of tidal grounds south and west of Long Island with the reported reduced hydrodynamic flushing. This area has slower flushing to the ocean than the north part of Willapa Bay, but still has strong vertical mixing within the tidal prism (Banas et al. Mar Ecol Prog Ser 341: 123–139, 2007). Any imidacloprid treated within this zone could be assumed to be vertically mixed and diluted within the tidal prism.

Thus if one hundred acres of treated tide flats were treated with imidacloprid, those resulting 2265 grams of imidacloprid would be mixing within the water covering 10,000 acres (this would be 4.9 $x10^{10}$ liters if a mean of 4 feet of water covered those 10,000 acres). This results in a peak concentration of 0.5 ppb of imidacloprid during the first high tide following treatment. This is below the aquatic life criteria for marine invertebrates of 0.65 ppb set by Canadian Council of Ministers of the Environment (Canadian water quality guidelines for the protection of aquatic life: Imidacloprid. In: Canadian environmental quality guidelines, Canadian Council of Ministers of the Environment, Winnipeg. 2007. (ceqg-rcqe.ccme.ca/download/en/187)) or the chronic no effect level (NOEC) for the most sensitive marine invertebrate (Mysid shrimp) (EPA risk assessment for imidacloprid). Furthermore, if one assumes 25% flushing with new water on each new high tide, then by the 10^{th} tidal flush imidacloprid is below the detection level (0.035 ppt) with each tide. The following table provides several projected imidacloprid concentrations in the tidal prism below the "dispersion gap" following various applications and mixing scenarios. They all suggest that dilution rapidly mitigates the risk to aquatic life and that imidacloprid goes below the detection level within a relatively short time period.

Assumptions-

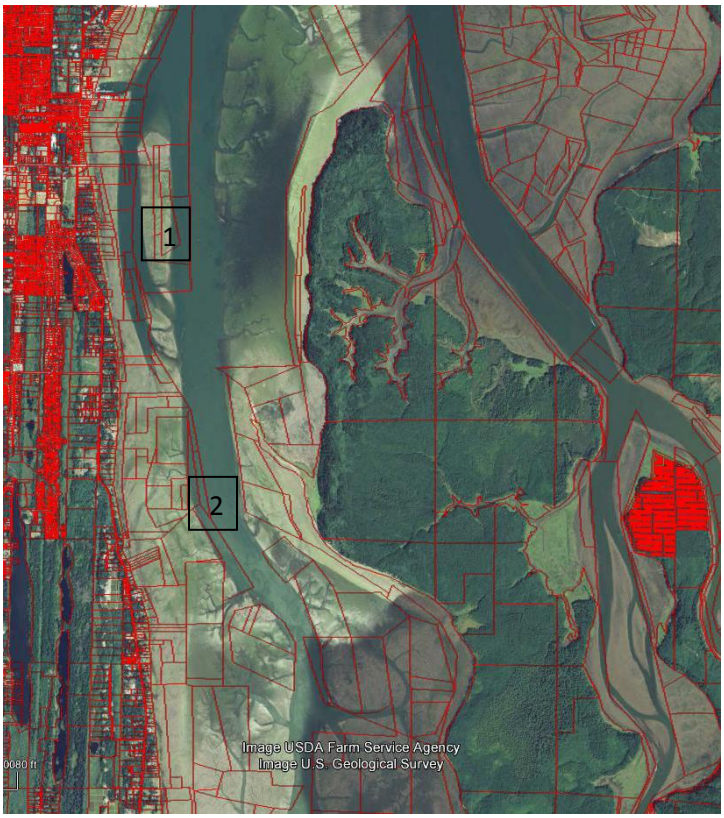
- 0.5 lbs ai/ac applied over 1000 or 20 acres
- Tidal area below the dispersion gap where mixing occurs ~ 10,000 acres or 6000 acres
- First order and second order diffusion of imidacloprid within the dispersion gap
- Mean depth of water for diffusion calculations 6' or 3'
- New water (imidacloprid-free) replaces old water @ 25% or 50% each tidal cycle

Acres treated	Acres of area of recirculated tidal water	Mean water dept ft'	Imidacloprid concentration within tidal prism first high tide (ppb)	Rate (%) of new water exchange with old water for each tide	Number of high tidal before imidacloprid < detection level (0.035 ppb)
100	10000	4'	0.5	25	10th
100	10000	3'	0.60	25	11th
100	10000	3'	0.60	50	5th
100	10000	6'	0.30	25	8th
20	6000	3'	0.15	25	6th
20	6000	3'	0.15	50	3rd

(0.5 lbs ai/ac x 453 g/lb. x 100 ac) / (4 ac-ft of water x 326,000 gal/ ac-ft x 3.78 l/gal x 10,000 ac) = 0.5 ug/l

The above table suggests that the concern of risk to aquatic life in the water column due to "lower hydrodynamic mixing" in the exclusion zone is likely to be unfounded.

The above calculated data set for imidacloprid in the water column is very similar to the historical data obtained for carbaryl in the water column sprayed in the "exclusion zone." The map below shows treatment and sampling for carbaryl in the exclusion zone for 2004 to 2009. The water concentration data for the samples, plus the calculated concentration that would be expected based on the assumptions made above for imidacloprid in the water column, are also shown in the table below. The actual data is within an order of magnitude or lower than the calculated data. They support the premise that imidacloprid would be significantly diluted by the tidal prism in the exclusion zone. It also indicates that the Banas et al. model on hydrodynamic mixing in Willapa Bay to create an "Exclusion Zone' is not appropriate for these circumstances. It has little relevancy to the sediment impact zone.



Concentration of carbaryl in middle of the tidal prism at high tide following a carbaryl treatment

Region on map for water sample and treatment	Date applied	Date sampled	Acres treated	Theoretical concentration 1st tide ppb*	Theoretical concentration at tide samples collected ppb**	Actual ppb measured
1	7/1/04	7/2/04	27.5	1.99	1.49	0.3
1	7/23/05	7/24/05	4	0.28	0.21	0.19
1	7/3/07	7/507	32	2.3	0.97	0.2
1	7/7/08	7/9/08	10	0.7	0.29	0.24
2	7/23/09	7/25/09	38	2.7	1.13	0.02

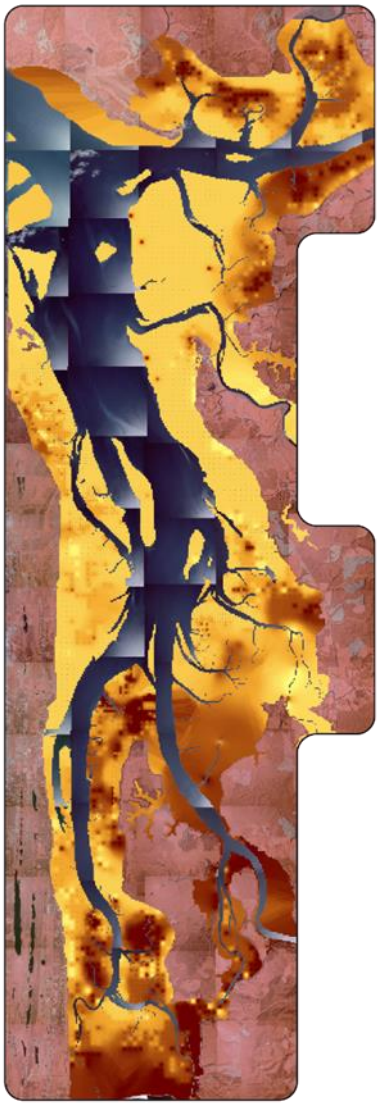
* amount of product applied diluted over 10,000 acres of tidal water 4' deep

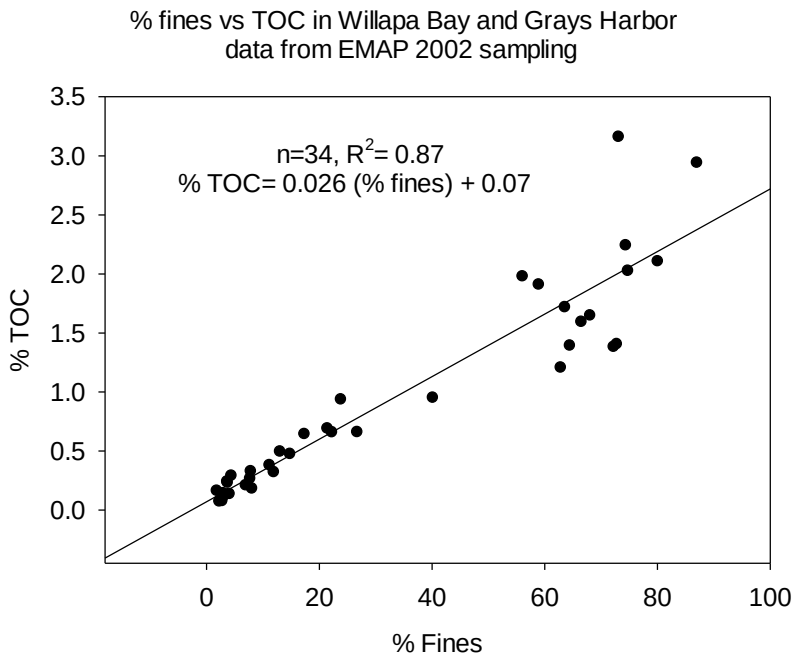
** assumes 25% dilution with each tidal flush

The above data corresponds to results by Grue (unpublished data) where he found the maximum concentration of carbaryl in the first tide following application in Willapa Bay was 30 ppb. This was followed by concentration well below 1 ppb in subsequent tides (see Troiano, Alexandra T., et al. "Brain Acetylcholinesterase Activity in Shiner Perch (Cymatogaster aggregata) and Juvenile Chinook Salmon (Oncorhynchus tshawytscha) After Application of Carbaryl to Control Burrowing Shrimp Within Willapa Bay, Washington." *Archives of environmental contamination and toxicology* 65.4 (2013): 779-789.)

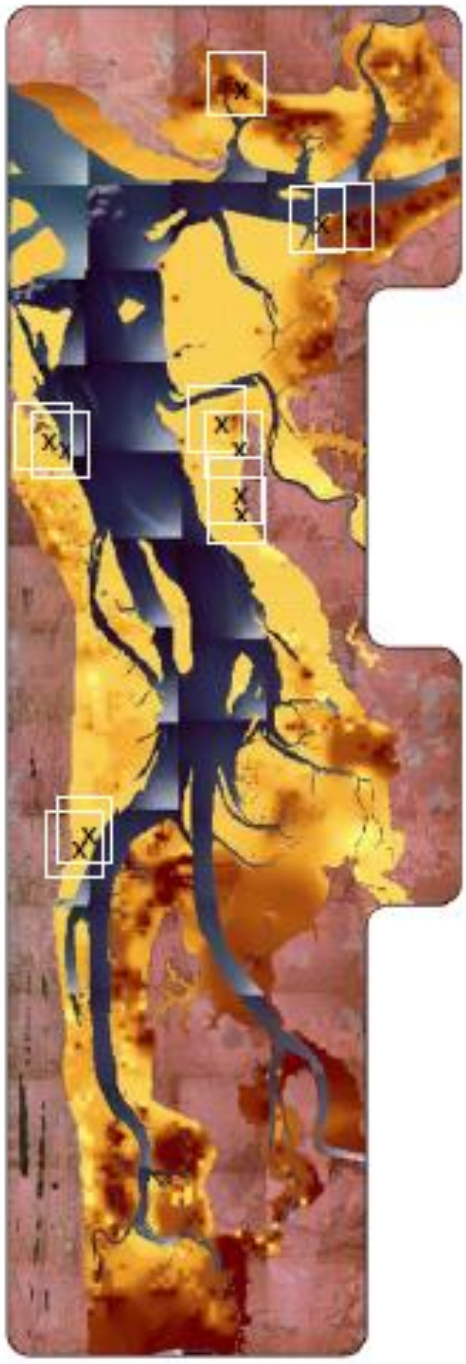
Sediment type: Although not entirely clear from the permit, the exclusion zone is also based on TOC and the concerns of persistence of imidacloprid in the heavy sediments in that that zone. In this case the boundary restrictions are not valid. The map below was developed by Dr. Dumbauld of USDA. It provides soil textures across the bay. As shown in the map, there are many locations in the south part of the bay that have light sandy sediments. These have high shrimp populations and are commercially viable shellfish farms. There is no justification to exclude them from the treatment zone. If the USDA map is accurate it indicates ¼ to ⅓ of that ground may be suitable for treatment without any persistence risk. This map is not dissimilar to the sediment data in Ecology's publications for EMAP 2002 sampling in Willapa Bay, which indicates numerous sandy locations in the southern section of Willapa Bay. Dr. Dumbauld's map, however, is not TOC. This is the variable that is of most concern to Ecology as it relates to sediment persistence of imidacloprid. Based on the Ecology data set for Grays Harbor and Willapa Bay sediments, there is a strong linear relationship between % fines and TOC (n=34, R^2= 0.87 % TOC= 0.026 (% fines) + 0.07) (see graph below). This indicates that the sandy sediment areas displayed in the USDA map are likely to be an accurate display of areas with low TOC in Willapa Bay.

Map of Willapa Bay sediment type
Brett Dumbauld, USDA





For reference, the ~ location of sites where imidacloprid and infauna sampling research has occurred in Willapa Bay. These locations bracket a large portion of the bay and do a good job of representing the types of sites growers are most likely going to treat.



In summary, the decision to exclude the lower half of Willapa Bay from treatment with imidacloprid based on heavy sediment types or lower tidal exchange should be reconsidered. Exclusion would put several growers out of business for no justifiable reason. If the concern is hydrodynamic mixing then consider collecting the data on imidacloprid in the water column over time. If the risk is based on sediment type then consider allowing treatment within these zones if the sediment is sandy and near a channel with good flushing.

2) Conditional SIZ map for Willapa.
The concerns stated above for the exclusion zone also apply for the conditional zone of the SIZ in Willapa (see above map). While some of the area has high TOC and % fines, much of the farmable acres in this zone are sandy with low TOC. It makes no sense to include these sandy areas as part of the conditional SIZ map. They are sandy soils and the area has a very dynamic tidal exchange.

3) Proposed alternative to exclusion and conditional zones.
Ecology may or may not have a valid concern about the persistence of imidacloprid on sediment with high TOC and % fines. Rather than creating a large exclusion zone or conditional use zone, which could limit treatment to lighter textured soils within those zones, I think they should enter into a dialog with the industry that looks at alternative considerations based on sediment types.

4) Draft monitoring plan- The plan is unclear in several parts – please clarify the following.

Pg 11 – This section is unclear. Is the industry required to monitor flow, temperature, setteable solids, conductivity, pH, or turbidity? If so, then when, on what, where, how? Either remove or clarify. The industry can not be held accountable for monitoring something this ambiguous.

Pg 12 – water imidacloprid.

- Are you requesting water be measured in the direction of drainage or flood? Please clarify.
- How do you measure offsite movement if you have no on-site concentration as a reference (none is indicated)? Please clarify.
- What depth – incoming tidal at 10 cm, or something else? Please clarify.
- What if the largest bed treated is a high spot and floods from all 4 sides (as has been the case in 2014); then there is no offsite flow. Please clarify.
- I question the need for sampling water imidacloprid in the 10 cm of water moving offsite vs water imidacloprid in the middle of the water prism in the high tide (as has been done with carbaryl). I realize you are interested in offsite movement, but there are ample data already to this effect. Imidacloprid, moves offsite as would be expected, but does finding find trace amounts in 10 cm of water 500 m offsite translate into any additional meaningful data?

Page 12- March 1 timeline. This submission date for a plan is difficult. Scouting of sites needing treatment would not have begun until after that date. Assessing which of those sites to monitor and what the controls for those sites should is not feasible on that timeline. Previous experience has suggested that finding sites to monitor that provide Ecology with the data they have requested requires considerable time. Please make accommodations that do not lock the industry into specific monitoring sites by March 1. It will not be possible to comply.

Page 13- sediment persistence monitoring. This calls for collecting samples 1, 14, 28 and monthly thereafter until <PQL. While this sounds good on paper, it is problematic in the field. Sampling could extend into the winter. Winter sampling would be in the dark during low tides. The combination of darkness and winter storms puts the sampling crew at unacceptable risk. WSU's team <u>will not</u> collect sediment samples under these conditions, unless safety concerns can be met. If there are five sites that need monitoring monthly during minus tides in the winter in Grays Harbor and Willapa Bay, it becomes a

major logistical problem and safety concern. Consider adjusting this sampling timeline to accommodate the need for safety. For example, this may require skipping sampling windows when storm patterns prevent safe access. It makes most sense to consider a geometric progression of time, (e.g. 1, 28, 56, 122, 224 days) rather than monthly. This would provide essentially the same data, but is much less costly. The 14 day data, while interesting, adds little information to the persistence data set. In addition, the results from day 14 are not available until after day 28, so the time and effort to collect, process and analyze data from day 28 are still required, even if the day 14 data comes back zero. [1]

page 8 - Experimental Use permit. - The section needs some revision or clarification.
The current version was taken from the previous NPDES permit. It is adequate for some purposes, such as testing new chemicals. However, it does not allow for research in the exclusion zone. It is also unclear if it will really allow for the type of research we might need to do to address the poor efficacy in areas with invasive eelgrass. For example, the use of an aquatic approved surfactant with imidacloprid or the use of split applications (two sequential applications 0.25 lbs ai /ac (0.05 lbs ai/ac total). Basically, as written there is very little we can do as far as research to improve the efficacy of imidacloprid.

page 6 -Action Threshold. The permit states imidacloprid can only be applied once burrowing shrimp levels meet or exceed the action threshold(s) based on at least one pre-treatment survey. While it does give some leeway "If the mean burrow count is less than ten burrows per square meter, a bed may be treated with imidacloprid provided justification is provided and approved by the Department of Ecology (Ecology)," I think it would be prudent to include something about the level of the previous/or current season's population of new recruits. In other words, shrimp don't make visible burrows until they are 2-3 yrs old. At this time it may be too late to control them on some sites with imidacloprid. I am proposing a recruit monitoring plan that assesses recruitment hot spot at several sites in the bay. If monitoring of those hot spots in September/October or early spring finds significant levels of new recruits, then growers with beds in those areas will be advised to plan on conducting treatments to control recruits. This permit suggests that this would be feasible if Ecology approves, but that is at the whim of whoever issues permits. Something in the permit that indicates the level of new recruits will be considered as part of the action threshold would help to clarify any ambiguity in the future.

Comments on overall monitoring plan.

Cost: The monitoring plan is very expensive. Below is a revised spreadsheet on the estimated cost that will be incurred to conduct this monitoring. It based on several years of conducting this work. The first set of data is for the project being conducted by WSU and PSI. The second set of numbers is based on WSU not conducting the monitoring after year 1. WSU is not a contract for service organization and has no interest in carrying out this monitoring beyond 2015. For the industry to contract those services, the cost will be three to five times what it cost for WSU to conduct the monitoring. Therefore the bottom set of numbers should be used as a minimum estimate for the cost of monitoring for this permit. I think Ecology should have a dialog with the industry and others to adjust their monitoring requirements to a more realistic cost structure.

1 Timeline for sediment samples- 1 day to collect, 1 day to process into pore water, 1 day to ship, lab stabilize within 7 days, sample analyzed and back for review usually with 30 days. This timeframe can be expedited at the lab but it costs significant more.

	WSU and PSI- yr 1 to 5					
	Yr 1	Yr 2*	Yr 3*	Yr 4 *	Yr 5*	Total
Offsite water movement once /yr , Willapa only (WSU)	3,500	3,675	3,859	4,052	4,254	19,340
Sediment imid & TOC (persistence and TOC)**/ yearly (WSU)	66,000	45,738	48,025	50,426	52,947	263,136
Benthic/ alternate years (PSI)	153,000		113,700		194,216	460,916
	222,500	49,413	165,584	54,478	251,417	743,392
* Adjusted for inflation 5% increase per year						
** -1,14, 28, and 56 days only, 3 sites/yr 1 and 2 sites/yr for yrs 2-5,						
	WSU and PSI - yr 1, contract consultant and PSI -yr 2 to 5					
	Yr 1	Yr 2*	Yr 3*	Yr 4 *	Yr 5*	Total
Offsite water movement once /yr , Willapa only (WSU yr 1 only)	3,500	11,025	11,576	12,155	12,763	51,019
Sediment imid & TOC (persistence and TOC)**/ yearly (WSU yr 1 only)	66,000	137,214	144,075	151,278	158,842	657,409
Benthic/ alternate years (PSI)	153,000		113,700		194,216	460,916
	222,500	148,239	269,351	163,433	365,821	1,169,344
* Adjusted for inflation 5% increase per year, and 3 x increase in cost for water and sediment monitoring for contract research						
** -1, 14, 28, and 56 days only, 3 sites/yr 1 and 2 sites/yr for yrs 2-5.						

Time: For WSU to implement this monitoring plan during year one will require working virtually every low tide during the summer and fall of 2015. It will leave no time for any research effort. At this point in time, WSU is very concerned that it needs to devote all its efforts into improving the IPM protocol and figuring out how to make imidacloprid work better at the commercial scale. We will not be able to achieve this goal if we are leading the monitoring effort. Before we spend $220,500 on monitoring in year one, it would be prudent to make sure that we are monitoring the protocol that will be ultimately implemented by the industry. Ecology should consider have a dialog with WSU that would accommodate their concerns about the inability to conduct research in 2015.

Complications: The monitoring plan proposed by Ecology, despite its high cost, does not resolve the need for the Agency to make far-reaching inferences about a very complicated ecosystem. There are too many variables and it is still very site time and space specific. The control sites don't match the treated sites. The treated sites don't represent all the sites in Willapa Bay and the time of sampling doesn't correspond to all the times the treatments will be conducted. Over the past several years and many sites, despite spending >$250,000, it has been extremely difficult to obtain any definitive data on benthic macrofauna. Our results are highly variable, and of questionable value. Finding suitable matching controls is, and has been, next to impossible. Picking a time period, like 14 days, where you draw the line in the sand for having impact seems arbitrary and capricious Research by Dumbauld et al (see Dumbauld, Brett R., Kenneth M. Brooks, and Martin H. Posey. "Response of an Estuarine Benthic Community to Application of the Pesticide Carbaryl and Cultivation of Pacific Oysters in Willapa Bay, Washington." *Marine Pollution Bulletin* 42.10 (2001): 826-844) indicates carbaryl has a variable but

relatively short-term effect on the benthic community. Small peracarid crustaceans experienced short-term mortalities, but generally recruited back to treated sites within 3 months. They were often more abundant on treated than untreated sites 1 year after carbaryl application and there was a greater abundance of epifaunal organisms like mussels, scaleworms, and the amphipod *Amphithoe valida*, which builds tubes in algae attached to shells. Why should imidacloprid be held to a different standard than carbaryl?

Other concerns about benthic species are related to recent papers by Ferraro et al. (Ferraro, Steven P., and Faith A. Cole. "Benthic macrofauna–habitat associations in Willapa Bay, Washington, USA." *Estuarine, Coastal and Shelf Science* 71.3 (2007): 491-507; Ferraro, Steven P. and Faith A. Cole. "Ecological periodic tables for benthic macrofaunal usage of estuarine habitats in the US Pacific Northwest."Estuarine, Coastal and Shelf Science 94.1 (2011): 36-47) which report that the type of habitats in Willapa Bay are the major determiners for benthic infauna populations. As a consequence making inferences about chemical impacts are greatly confounded by the temporal and spatial variables associated with different habitats.

Suggestions for alternative monitoring: WAC 173-204-415 section (I F) states the Department shall consider technical feasibility and cost in determining the minimum practical chemical contaminate and biologic effect levels. As proposed, the monitoring requirement is overly expensive, too time consuming and technically unfeasible. I think it is prudent that Ecology have a dialog with WSU, PSI and other scientists working in this area to develop monitoring alternatives. Here are a few suggestions that should be included in that dialog:

a) Half of the cost of these studies will be to collect data on the reference site. Over all the historical data sets the reference sites have not been useful. They have they been useable in the analysis because they don't match closely enough at the time zero. In that case, why should we continue to spend limited resources collecting this data if it is not useful?

b) In the past the infauna data has included epibenthic and benthic infauna. The epibenthic infauna populations are more temporary and labile. The benthic organism best correspond to changes on the sediment from the treatment. Including the epibenthic infauna adds cost in sorting and ID. Many of the species are small and obscure, and add great expense to pick out and ID. Consider eliminating epibenthics.

c) In the past, data has been collected for 14 days after treatment. This is a very short interval having no biological significance (see Dumbauld citation above). Why not skip that time frame?

d) In the past, 5" diameter clam guns have been used to obtain cores. We have suggested many times in the past that comparable data could be obtained from smaller cores, but Ecology refused to modify the SAP. Why not take a smaller core and reduce the time frame needed to sort the sample?

d) The bulk of the cost of monitoring is sorting and identifying benthic species. Sorting is expensive due to the requirement of picking out the very small invertebrate species from the large amount of small organic detritus. The use of a large mesh size would dramatically reduce the cost of sorting and identifying samples. Our data in the past has been using a 0.5 mm screen, while Ecology's EMAP uses a 1mm screen. Should we be held to a higher standard than Ecology?

g) Reduce sample numbers. The current SAP requires large numbers of samples. If these could be reduced if would greatly reduce the cost of the program.