

March 31, 2002

Roger Giebelhaus
Thurston County Development Services Department
Thurston County Courthouse, Building One
2000 Lakeridge Drive SW
Olympia, WA 98502-6045

Subject: Taylor Resources North Totten Inlet Mussel Culture
SEPA No.: SEPA961372
CASE No.: SSDP961372

Dear Mr. Giebelhaus;

The members of the Association for the Protection of Hammersley Eld and Totten Inlets (APHETI) have reviewed the EIS Scope of Work (the Scope)¹ for the subject proposal. Our response to Thurston County's February 28, 2002 Request for Comments on the EIS Scope of Work is as follows:

1. The study proposals do not directly address the questions of how the proposed project will impact the environment.
2. The Scope is incomplete: impacts to fin fish and cumulative environmental effects of the project are not addressed.
3. Investigation of impacts to the benthic environment should include physical impacts due to the scraping of mussel colonies on benthic habitats, and the dredging of waste from underneath the rafts for offsite disposal. This part of the EIS should include studies underneath the rafts at Gallagher Cove as well as at the Deepwater Point site.
4. Characterizing the "impacts of escapement and propagation of mussels," as required by the EIS demands far more rigorous investigation than is proposed.
5. A strong potential for bias is evident in the Scope.
6. Some of the proposed studies are actually monitoring studies that are based on the assumption that the project will be permitted. These do not constitute scientific efforts to assess potential impacts of the proposal.
7. Elements of the study proposals suggest that the key uncertainties are not being taken seriously by the proponent.
8. Studies in support of the EIS are apparently already underway or complete, before the public has had an opportunity to comment on the Scope.
9. The Scope is confusing and difficult to follow.

The combination of these problems will result in an EIS that will not provide objective or complete documentation of potential environmental impacts, and which does not properly allow for meaningful public input.

¹ This letter references the 7 documents released with a February 28, 2002 Memorandum from Thurston County Development Services; to Interested Parties; Regarding "Additional Information associated with Refreshing the EIS Scoping for the Taylor Resources North Totten Inlet Mussel Culture Proposal"

In addition, we have attached excerpts from our previous review of the Ecological Concerns Assessment (slightly edited to reflect the current context). Since our recommendations in that document have not yet been addressed by the proponent, and are not addressed in the Scope, we wish to reiterate the need for the specific information as we have described previously. We refer the county to the full document: Comments on the proposed Totten Inlet Mussel Raft-Project expansion and the Visual Impact and Ecological Concerns Assessment for the Totten Inlet Mussel Rafts Project. Michael M. Pollock, Ph.D. June 1998. This was submitted in response to information provided by Taylor during the County's SEPA threshold determination process. They were submitted again during Taylor's appeal to the Hearing Examiner of the County's SEPA Determination of Significance ("DS").

These comments were prepared in partnership with Jennifer Sampson, M.S., of 10,000 Years Institute.

The study proposals do not directly address the questions of how the proposed project will impact the environment.

Our fundamental concern with the Scope is that it does not address the potential environmental impacts of the proposed project. We concur with the conclusions of the Independent Technical Review Committee (ITRC; 2/13/02) that "...additional scope of work information [is needed] ...to bridge the gaps between the PSI [Pacific Shellfish Institute] study and the site-specific mussel farm impact analysis..." We submit that all of the studies described in the Scope, not just the PSI studies, will fail to meet the basic requirement of the EIS to "identify and evaluate probable impacts...emphasizing important environmental impacts and alternatives..." [WAC 197-11-030(2)(b) and (g)]².

Studies proposed by PSI and Aquatic Environmental Sciences (AES) will describe conditions at the proposed development site and near the mussel rafts already existing on the west side of Totten Inlet, at Deepwater Point, but will not provide a determination of potential impacts of the North Totten Mussel Culture Project. This is because analytical links between descriptive information and potential impacts to the environment are lacking. For example, AES proposes to use a "regression approach" to evaluate potential impacts of the proposed mussel rafts to benthic invertebrate communities. Data collection procedures are impressively described in great detail. However, descriptions of the analyses to determine whether and what type of impacts to the benthic environment will occur and to quantify benthic impacts are not provided.

For the assessment of impacts to the benthic environment, the Appendix to AES's letter (8/29/01) says that the purpose of sediment chemistry and benthic sampling is to "evaluate trends in these endpoints as a function of distance from the farm and to determine thresholds for biological effects by evaluating the covariance of biological and physicochemical endpoints." These are the only statements to link the data to be collected with the scientific uncertainties regarding project impacts listed in the Thurston County Findings of Fact, Conclusions of Law & Decision, (Declaration of Significance, DS; 6/18/99). Several relevant questions about the study remain unanswered:

- What are the decision criteria or testable hypotheses for the proposed analyses?
- What if there is no trend, what does that say about potential impacts?
- What if there are trends, what sort of trend would reveal the presence, absence, or likelihood of impacts?

² State Environmental Policy Handbook. Washington State Dept. of Ecology Doc. #98-114. Sept. 1998.

- How will impacts be quantified?
- Using regression analysis, at what point would covariance or a lack of it between sediment physiochemical and biological variables indicate that there would be no adverse impacts?
- How will the data be analyzed to minimize bias and maximize confidence in predictions?

The specific biological variables to be measured in the samples of benthic infauna are also not provided. Additional questions that should be addressed in the Scope include:

- Will species richness, total abundances, biomass, number of rare species, or all of the above be measured?
- Will there be any focus on the benthic species upon which herring or salmonids depend, so that impacts to higher trophic levels can be addressed?
- What community indicators will be regressed against what physical parameters, and how will predictive relationships inform the question of impacts to the environment?

Without answers to these types of questions, the public cannot make a judgement as to whether the values about which it is concerned will be addressed by the EIS.

Thus, the assessment of impacts to bottom-dwelling organisms given in the Scope is lacking:

- An analytical framework for making a determination that the proposal will or will impact the benthic environment.
- *A priori* decision criteria for drawing unbiased conclusions from the data.
- A method for quantifying impacts.

The same fundamental problems exist with the PSI studies. The objectives of the PSI work (p.6), paraphrased here, focus on how ambient conditions affect mussel production, not how the mussel production impacts the environment. PSI's objectives are:

- “1. To characterize...bivalve shell growth and meat yield...against measured parameters...
2. To characterize a suite of physical chemical and biological variables...with concurrent physiological measurements of feeding and biodeposit production.
3. To examine...the application of measured water quality and biological conditions... on growth and yields...
4. ...to evaluate the potential carrying capacity of intensively cultivated suspended bivalves in an entire farming area.”

These objectives are directed at locating mussel farms to maximize mussel production. They are not designed to probe the specific questions of the environmental impacts of mussel production at the North Totten Site.

Thurston County has required preparation of an EIS to address, in part, “impacts to the phytoplankton resource.” The PSI studies are presented in response to this mandate. However, the PSI studies describe an approach for measuring plankton species richness, and possibly density, near existing mussel rafts, not for assessing phytoplankton dynamics and the impacts of mussel farming on this resource. Plankton-eating fish such as herring in Totten Inlet rely on large, episodic plankton blooms to provide high densities of their prey. These plankton blooms, by concentrating fish into one area, also provide upper trophic levels (e.g., salmon, birds) with critical feeding opportunities. Although mussel farming itself consumes the phytoplankton resource, nothing in the Scope addresses the impact of the proposal on this critical ecological

dynamic. Moreover, the cumulative impact on plankton dynamics in the context of other aquaculture in Totten Inlet is not addressed.

We recognize the occasional references paid to the needs of the EIS in the PSI proposal. On p. 12, PSI states: "...we will then evaluate the probable impact of a larger-scale suspended farm operation on the potential carrying capacity of the given system." Another statement, near the end of the study description, provides similarly vague assurances that the study will "assess the influence of the experimental raft system on carrying capacity in the local area." However, such statements are inadequate to meet the requirements of an EIS Scope. The analytical approach, logic, and methods to "evaluate the probable impact," linking the data with the questions identified by the DS should be provided by the Scope. Like the AES studies, the PSI studies also provide no *a priori* decision criteria or clear testable hypotheses to prevent investigators from drawing biased conclusions.

The Scope is incomplete. Impacts to fin fish and cumulative environmental effects of the project are not addressed.

The DS states that the important scientific uncertainties include the "impact of the Gallo mussel on the tube worms *and the feeding chain involved therein*" [emphasis added]. Potential impacts on upper trophic levels, including herring and salmon, are not addressed at all in the Scope. In its August 29, 2001 letter describing benthic studies, AES states that "work to be performed by the fisheries biologist will address potential impacts to fin fish." This is the last mention of potential impacts on fin fish in the Scope.

Impacts of changes in the benthic community, plankton densities and abundances, water quality, and the ramification of these effects on higher trophic levels, including juvenile and adult salmonids, their prey, herring, and other fish must be addressed. The informational and analytical links between studies of the plankton and benthic communities to evaluation of effects on fin fish should be clearly described. For example, if fin fish rely on certain benthic taxa (as specifically referenced in the DS), then the Scope should indicate that abundances or densities of this prey item will be among the parameters measured in the benthic community samples, both below existing rafts, and in reference areas. Currently, there is nothing in the Scope to address the impacts of increased oxygen demand, changes in plankton densities, and other direct effects of the project on fish, and no analytical approach linking changes in benthic communities to the fish which depend on benthic communities.

The Scope also lacks an approach to address cumulative impacts - that is, how the proposed project will impact the environment in light of other developments in the area. Totten Inlet is full of aquaculture facilities, all of which affect water quality, benthic communities, and plankton community dynamics. It is the mandate of SEPA that the EIS address not just the impact of the proposed project if it were alone in the Inlet, but the impact of the proposal in the context of all the other development impacts³. According to the observations of local people, the native oyster is less and less commonly found in Totten Inlet, as aquaculture and other developments increase in extent and number. This is an example of a probable cumulative impact which can only increase with increased aquaculture. Both direct effects of the proposed project and cumulative impacts on water quality, benthic communities, trends in native invertebrate populations including the Olympia oyster, fish and other resources must be quantified for a complete EIS.

³ Ibid. p. 47

Investigation of impacts to the benthic environment should include physical impacts due to the scraping of mussel colonies on benthic habitats, and the dredging of waste from underneath the rafts for offsite disposal. This part of the EIS should include studies underneath the rafts at Gallagher Cove as well as at the Deepwater Point site.

Scraping of the Gallagher Cove rafts along the bottom, and frequent dredging of materials from beneath these rafts have been documented. These types of impacts are not addressed at all by Task A, or any other element, of the Scope. Physical impacts to the benthic environment must be addressed in the Scope. Dredging destroys habitat, removes breeding organisms, disrupts sediment chemistry and leaves the benthic environment under the rafts open to the continued impacts of deposition from the rafts. Dredging has been frequently observed at the Gallagher Cove site, but is not addressed at all by the Scope.

Characterizing the “impacts of escapement and propagation of mussels,” as required by the EIS demands far more rigorous investigation than is proposed.

Understanding the environmental impacts of the escape of the Gallo mussel (*Mytilus edulis provincialis*) into habitats throughout Totten Inlet and Puget Sound *before new projects are initiated* is of the highest importance. The environmental impacts of the spread of the exotic Gallo mussel will include competition with native animals and interbreeding with *Mytilus edulis trossulus*. The Scope provides nothing to address competition and little to address the magnitude and extent of interbreeding of the Gallo with native mussels.

Many exotic species, cultivated in Washington and elsewhere, have escaped into the environment and become uncontrollable pests, causing a wide range of environmental and economic impacts. The Scope provides no attempt to predict or understand the effects of the spread of the Gallo mussel throughout Puget Sound. The ecological impacts of the spread of the Gallo should be addressed by compiling a review of case studies of the spread and impacts of other exotic species which have similar dispersal mechanisms or occupy similar ecological niches. For example, the zebra mussel invading the watersheds of the Great Lakes provides important insights into potential economic and ecological impacts of the spread of the Gallo. Another relevant example is the spotted knapweed of Montana and Idaho. This weed reproduces and spreads on the wind, similar to the way mussels reproduce and spread with the help of flowing waters. The spotted knapweed has drastically altered the ecology of the Rocky Mountain grasslands, ruining much of their economic (grazing) value and their value as wildlife habitat.

Predicting environmental impacts of exotic species introductions is difficult, but not impossible. The case studies mentioned above and others provide guidance and insight for avoiding environmental impacts and ecological disasters, which is the mandate of SEPA. The Scope should include a task which reviews at least 5 examples of exotic species with passive dispersal mechanisms like the Gallo mussel. Selected case studies should include the spotted knapweed of the Northern Rockies region; the Japanese green crab of the Pacific coast; and the zebra mussel of the Great Lakes. This review should analyze and compare the biology of the case study species with the biology of the Gallo mussel. Reproductive strategies, dispersal mechanisms, inter-species interactions and other biological and ecological factors which have made these species invasions problematic should be comprehensively discussed. The similarities and differences between these and the Gallo mussel should be provided for public review as part of the EIS.

The impacts of interbreeding are partially addressed by the Scope. Three study elements should be added to ensure that results are unbiased and comprehensive:

1. The geographic scope of the investigation of interbreeding (Task D3 in AES's Appendix to the 8/29/01 letter) should be expanded to include areas outside of Totten Inlet including: in Hammersley and Eld Inlets; around the shoreline of Squaxin Island; on the southwest shoreline of Harstene Island; the south shoreline of Dana Passage; and on the west shoreline of Pickering Passage. This is necessary because the proponents assert that Totten Inlet is adequately flushed by tides, and the Gallo mussel disperses itself on tidal currents. Thus, it would be expected that the Gallo would disperse outside Totten Inlet.
2. The investigation should be conducted not by random sampling, which will find the Galo only after it has reached adversely high densities, but by actually looking for mussels that resemble Gallo. This will identify the leading edge of a spreading population of Gallo mussel or their hybrids with the trossulus mussel.
3. Citizen volunteers should be employed to collect and submit samples from these areas for genetic analyses, as described in Task D3. Citizens will document time, location and habitat type of any mussels submitted for analyses.

Regardless of changes to the study design that are implemented as a result of these comments, clear decision criteria must be provided for tasks in the scope related to escapement and dispersal of the Gallo mussel. The following are not currently addressed in the Scope, but must be addressed to ensure the objectivity and scientific credibility of the results of the proposed Task D:

1. At what point will the findings of Tasks D1, D2 and D3 indicate an environmental impact?
2. How will the results of Tasks D1, D2 and D3 be used to judge the severity, geographic extent and nature of environmental impacts? Specific statistical endpoints or other objective criteria should be provided.
3. For how long will quadrats at the three permanent genetic study sites (Task D2) be in place before a decision can be made as to the potential for adverse environmental impacts of the proposed project? We suggest the monitoring of the spread of existing Gallo mussel populations for a minimum of 10 years before making a determination of its potential impact on the environment. The size or number of quadrats should be increased – the current area proposed for the monitoring task is 9 square meters. This is a ridiculously small area for monitoring the spread of the Gallo mussel. The total area to be monitored should be at least equal to that of the proposed project, about 5,700 square meters, and should include offshore structures similar to those where the Gallo has already been observed, like on buoys, anchored boats and floats.
4. Will installation of the project depend on the findings of Task D2, and what is the analytical threshold for Task D2 to indicate no environmental impacts due to dispersal of Gallo mussels?

The authors of the Scope have provided themselves too much latitude in the interpretation of results of the studies of escapement. Moreover, there is insufficient third-party oversight provided in the collection of samples. By leaving sample collection and interpretation of data of Task D open-ended, the Scope fails to provide an unbiased assessment of potential environmental impacts of the spread of the Gallo mussel.

A strong potential for bias is evident in the Scope.

Among the problems described above, the lack of *a priori* decision criteria or testable hypotheses are of particular concern. This suggests the potential for bias in the conduct of studies and in interpretation of data. With no third party oversight, a key assurance to the public is the scientific process itself. The scientific process, specifically *a priori* decision rules or testable hypotheses, provides the substantive foundation for an EIS.

The focus on the Deepwater Point mussel rafts also suggests that the EIS will not provide the full picture of potential impacts. The benthic, water quality and phytoplankton study elements should include collection of data at Gallagher Cove. This is one of the most heavily impacted areas in Totten Inlet. Since Gallagher Cove is much closer to the proposed development site than the Deepwater Point site, it is likely more relevant to predicting impacts of another mussel raft system than the Deepwater Point site. Gallagher Cove should be included in studies of potential impacts so that the full range and degree of impacts can be included in the EIS.

Finally, the design of the study of the benthic environment as described in the Appendix to AES's letter (8/29/01) appears to avoid the area of highest impact at the study site. Specifically, the proposed project will cover about 1.4 acres of Totten Inlet, but the design of the benthic study focuses sampling outside the perimeter of the area that will be directly impacted. Out of 9 sample stations for sediment chemistry and benthic community analysis, plus 3 reference stations, only 1 sample station is located under the raft, and 1 at the perimeter. All of the other 10 stations are placed at incremental distances away from the primary impact zone. In calculations of average conditions for comparison with reference stations, and in regression models, this will result in unduly weighting conditions in the benthic environment not directly under the raft. In other words, the study will not capture the conditions of primary concern to the impact assessment. In the absence of a clear description of the study rationale and analytical approach, we interpret this as a bias in the study design to de-emphasize the impacts of greatest concern. More samples should be collected directly under existing rafts at both Gallagher Cove and Deepwater Point, and at sample stations dispersed on at least 4 sides of the rafts (not just "downstream" as proposed) for assessment of impact to the benthic environment.

Some of the proposed studies are actually monitoring studies that are based on the assumption that the project will be permitted. These do not constitute scientific efforts to assess potential impacts of the proposal.

Much of the work described by AES is better suited to environmental monitoring than to determination of future impacts. For example, AES proposes to establish 3 permanent "genetic study sites" as a way of addressing the question of dispersal of the exotic Gallo mussel throughout the Totten Inlet and elsewhere in Puget Sound. This approach appears to address the question of Gallo mussel dispersal after the rafts have been installed. AES also proposes to describe benthic communities at the site of the proposed action to "define the resources that would be put at risk" and to "provide baseline data against which to assess physicochemical changes associated with the mussel culture operation." This is presented as a strategy to address the impact to benthic communities of the proposed project, but in fact has no predictive value, and appears to only address a need for monitoring change. This type of work, while possibly appropriate in *mitigation* steps (i.e., after a permit is received), does not constitute a study of potential impacts. The mandate of Thurston County's DS will not be met by planning longer-term monitoring work.

Elements of the study proposals give the impression that key uncertainties are not being taken seriously by the proponent.

By ignoring concerns of the local community that were raised at the Public Hearing referenced in the DS, the Scope does not respond to key uncertainties.

- AES's proposal twice states (3.0 Task A), "The deep water and currents at the North Totten site will disperse feces and pseudo-feces from the mussels and their fouling biomass." This is

the very issue to be investigated, not a basic assumption upon which the proposed study is to be designed.

- AES's letter states, "In terms of hydrodynamics and production levels, Taylor Resources' mussel culture operation at Deepwater Point resembles the proposed mussel culture operation." Hydrodynamics at the site is one of the specific phenomena that should be under investigation (see Attachment). There are no data to support this assumption.
- PSI's study Objective #3 is: "To examine...the application of measured water quality and biological conditions... on growth and yields in production-scale suspended bivalve systems..." This is the exact inverse of the necessary information. What is necessary is data to reduce uncertainty on the impact of the mussel culture project on water quality.

Flawed assumptions and irrelevant objectives indicate that the proponent's scientific team does not understand the uncertainties key to potential environmental impacts of the proposal.

Studies in support of the EIS are apparently underway, before the public has had an opportunity to comment on the scope of the EIS.

According to schedule information provided at various points throughout the Scope, AES has performed a literature review, conducted sampling of benthic communities, sampled sediments, and set up its canister study. The schedule in Table 1 of the PSI study description, indicates that PSI's sampling schedule began in the autumn of 2001. This means that while the public has just begun to review the scope of work and approaches to determine whether the study program in support of the EIS adequately addresses their concerns, the proponent has authorized work to begin, presumably to expedite the SEPA review.

This goes directly against the intent of the SEPA process⁴. Public involvement in determining the range of topics to be investigated and the approaches to be used should be solicited *before studies are initiated* for a fair and complete EIS. By skipping the process of public input to the Scope, Taylor Resources has expressed its indifference to the concerns of the local community.

The Scope is confusing and difficult to follow.

The project proponent has provided no single document to describe how the proposed studies are to be used to directly address the uncertainties identified in the DS. Moreover, parts of the Scope contain ambiguities preventing a clear understanding of proposed methods. For example, the apparent study design for impacts to benthic communities consists of:

1. The proposed study design in the letter and Appendix dated August 29, 2001
2. Changes made in response to comments of the ITRC.
3. Final remarks by the ITRC.

No complete and final description of the study is provided to the public for review, and the public is left uncertain as to which aspects of the ITRC comments will be incorporated by the proponent's consultants. The lack of a clear direction for the analyses is exacerbated by combining Taylor Resources' research and development needs with SEPA requirements. This is particularly problematic in the studies proposed by PSI.

⁴ Ibid.

Requiring the public to sift through the contents of a highly technical debate between experts as an explanation of the EIS Scope is simply not appropriate to the SEPA process. According to the Washington Department of Ecology, the “SEPA Rules indicate that environmental documents should be clear, concise, and to the point⁵.” As an EIS scoping document, the Scope fails on all three counts. Providing the public with a scoping document that confuses industry research goals with SEPA requirements strongly suggests that the potential environmental impacts identified by the DS will not be adequately addressed.

Concluding Remarks

The Scope for the North Totten Mussel Raft EIS conveys a process for assessment of environmental impacts that will not be adequate to meet the informational needs of SEPA, and which precludes meaningful public review. Since the project draws on public resources to generate private income, this is inappropriate and unfair. The process described in the Scope does not adhere to standards of objective scientific investigation, which would ensure unbiased data interpretation. The outcomes of the proposed investigations, themselves not designed to clearly address environmental impacts, remain open-ended, subject to “professional judgement” regarding the degree, nature and likelihood of possible impacts. Since all the professionals involved work for the proponent, the outcomes of studies can probably be guessed at this point.

Thank you for the opportunity for comment.

Sincerely.....

⁵ Ibid.

Attachment to comments from APHETI

April 1, 2002

1. Effects of the rafts on local currents

The placement of a large object such as mussel rafts in the water column will affect local patterns of water circulation and current velocities. Since the mobility of sediment is largely controlled by current velocity, addition of these obstructions will also affect sedimentation rates under and near the rafts. The actual effects of the mussel rafts and fully developed mussels on current speeds should be determined more accurately using computer models of current flow around rafts. Models should incorporate basic measures of currents, including the mean and the minimum current speeds *determined at the site of the proposed rafts*.

2. Effects of waste accumulation on the benthic environment

In the Ecological Concerns Assessment, no information was presented to provide even a first-order approximation of the extent to which mussel waste will accumulate under the proposed rafts. Substantially more information is required for the public to understand rates of waste accumulation under the proposed rafts. Since this will impact the benthic environment, rates of waste accumulation should be addressed in the EIS.

3. Physical effects of raft operations on the benthic environment

The scope does not address the direct physical effects of pseudofeces, feces and shell accumulation on the herring spawning grounds, on the benthic environment, or the effects that accumulation of these waste materials will have on benthic geomorphology and near-bottom current patterns. The physical effects of the existing and proposed rafts including impacts on herring spawning grounds should be assessed.

4. Flawed assumptions and lack of data regarding tidal flushing and reflux rates.

Regarding assumptions and estimates of tidal flows in Totten Inlet, the critical error of assuming that no refluxing occurs is of primary concern. "Reflux" describes water that leaves an area but then returns again. The waters of southern Puget Sound are poorly flushed and have long residence times, generally on the order of months to years rather than days. Much of the water entering Totten Inlet during incoming tides is water that left the Inlet during an outgoing tide or is coming from other nearby shallow inlets such as Eld and Budd Inlets. Even by Taylor's own estimate, water in southern Puget Sound as a whole has a residence time of 90 days. This implies that most of the "new" water entering Totten Inlet is actually old water that has been circulating around Totten Inlet or the rest of southern Puget Sound for months. An accurate assessment of tidal flushing should include an assessment of the extent of refluxing in Totten Inlet and the whole of southern Puget Sound. Additionally, given the questionable quality of water in nearby water bodies such as Budd Inlet and the extensive aquaculture that occurs in the general area, an examination of the flow characteristics in southern Puget Sound (e.g. estimates of efflux and reflux rates, vertical mixing rates, stratification data and circulation patterns) is necessary in order to determine the proximal source (and quality) of water entering Totten Inlet as well as where the waters (and aquacultural waste products) of Totten Inlet are going.

5. Impacts on water quality.

Degradation of water quality occurs on a regular basis when existing mussel rafts or longlines are cleaned during the mussel harvesting process. The degradation is described by local residents as a "slimy, brown fibrous gunk" which floats in the water. The chemical nature of mussel waste

material should be determined, and mussel harvest operations should be modified so that water quality is not degraded during harvest operations. More generally, the amount and timing of waste production from mussel rafts and the various pathways through which mussel waste enters the environment needs to be described and quantified

6. Impacts of the proposal on the phytoplankton resource.

The productive capabilities of Totten Inlet have not been examined. The proposed project assumes that there will always be enough phytoplankton for the needs of mussel culture with no concurrent impact on the productivity of other valued marine species. The carrying capacity of other aquaculture sites has been calculated (Rodhouse and Roden 1987, Dame 1993, Heral 1993, Dame 1996)⁶, and there is no reason why the carrying capacity of Totten Inlet could not also be estimated. More specifically, a carbon budget needs to be calculated for Totten Inlet (and anywhere else that extensive aquaculture is occurring). A carbon budget (or model) is a formal accounting system which determines the amount of carbon stored in each of the components of an ecosystem, the amount and timing of the transfer of carbon between system components, and the rates of input to and output from the system (e.g. Rodhouse and Roden 1987)¹. It is important to budget carbon because carbon represents biomass or the potential to produce biomass and thus is an indicator of what is being produced in an ecosystem. By understanding where carbon is stored and when and how much moves, we can predict what the effects are to system components when one component is altered.

The following specific questions need to be answered in order to determine the level of aquaculture that is appropriate for Totten Inlet, and in particular to determine whether any additional aquaculture activities should be allowed:

- How much phytoplankton is available in Totten Inlet and what is the seasonal availability of phytoplankton?
- How much phytoplankton in Totten Inlet is produced internally, and how much comes from external subsidies?
- What percentage of the available phytoplankton is currently consumed by aquaculture, and how much would be consumed by the proposed mussel rafts?
- What percentage of the phytoplankton crop is needed to maintain other important ecosystem functions such as food production for salmonids, baitfish crabs, etc.

7. Risks of escapement of Gallo mussels

The environmental effects of a Gallo mussel invasion or a Gallo-trossulus hybrid mussel invasion of Puget Sound have not been assessed, but the impacts could be substantial. Unlike the native mussel, Gallo mussels generally do not die after one year. They continue to survive and if left alone will grow to quite a large size. Thus the Gallo has the potential to become a dominant species in the intertidal ecosystem. Unless there is a natural mechanism whereby Gallo mussel populations are regularly reduced (e.g. disease, predation or a disturbance such as wave action) it

⁶ **Dame, R. F., editor. 1993.** Bivalve filter feeders in estuarine and coastal ecosystem Process. Springer-Verlag, Berlin. Dame, R. F. 1996. Ecology of marine bivalves an ecosystem approach. CRC Press, New York.

Dame, R. F. 1996. Ecology of marine bivalves an ecosystem approach. CRC Press, New York.

Rodhouse, P. G., and C. M. Roden. 1987. Carbon Budget for a coastal inlet in relation to intensive cultivation of suspension-feeding bivalve molluscs. Marine Ecology - Progress Series **36**: 225-236.

Heral, M. 1993. Why carrying capacity models are useful tools for management of bivalve molluscs culture. Pages 455-478 in R. F. Dame, editor. Bivalve filter feeders in estuarine and coastal ecosystem process. Springer-Verlag, Berlin.

can be safely predicted that they will continue to increase in number and eventually dominate the intertidal zone of Puget Sound, provided that environmental conditions continue to remain favorable. There are no known mortality-inducing diseases of Gallo mussels in Puget Sound (one of the reasons that they are preferred by aquaculturalists) and wave action, the most common mortality-inducing disturbance in the intertidal, is unlikely to substantially effect Gallo mussel populations in much of the protected waters of Puget Sound.

The Gallo mussel is an exotic species the release of which should undergo a SEPA-EIS review process in order to assess it's potential environmental impact. Once the potential environmental impacts have been assessed, a determination needs to be made as to whether it is appropriate to be releasing this species into the Puget Sound ecosystem.

8. Endangered Species

Taylor Resources does not acknowledge the existence of any threatened or endangered species that utilize the area. However we are aware of two endangered species which will likely be impacted by the project; the American bald eagle and the Puget Sound chinook salmon. Both these species utilize the site of the proposed mussel rafts for a critical need - foraging. A list of state and federal threatened and endangered species that utilize Totten Inlet needs to be generated, and the potential effects of the mussel rafts on these species needs to be discussed.