Prince William Sound
Regional Citizens Advisory Council

Public Comment Regarding the Draft NPDES Permit for BWTF at Alyeska Marine Terminal

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Abbreviations Used in Report

ADEC – Alaska Department of Environmental Conservation
AEMP – Alyeska Environmental Monitoring Program
AHC – aliphatic hydrocarbons
AMT – Alyeska Marine Terminal
BOD – biological oxygen demand
BTEX – benzene, toluene, ethyl-benzene, xylene(s)
BWTF – Ballast Water Treatment Facility
DAF – dissolved air filtration
DMR – discharge monitoring report
FID GC – Flame Ionization Detector/Gas chromatography
GC/MS – gas chromatography/mass spectrometry
GOC – Gold Creek sampling site
IC25 – inhibitory concentration, 25%
LTEMP – Long Term Environmental Monitoring Program
MDL – method detection limit
MGD – millions of gallons/day
NMFS – National Marine Fisheries Service
NOAA – National Oceanographic and Atmospheric Administration
NOEC – no observable effect concentration
NPDES – National Pollutant Discharge Elimination System
PAH – polynuclear aromatic hydrocarbons
POTW – Publicly Owned Treatment Works
PWSRCAC – Prince William Sound Regional Citizen's Advisory Council
S/T – sterane/triterpanes
SIM – selective ion monitoring
TAqH – total aqueous hydrocarbons
TARO – total aromatic hydrocarbons
TOC – total organic carbon
TON – total organic nitrogen
TPAH – total PAH
TSS – total suspended solids
TUc – chronic toxicity unit
UCM – unresolved complex mixture
UV - ultraviolet

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The Prince William Sound Regional Citizens' Advisory Council (PWSRCAC) wishes to thank EPA and ADEC for including the PWSRCAC's recent review of the NPDES renewal application into the administrative record and for allowing its consultants to confer with the BWTF Monitoring Advisory Committee prior to the issuance of the current draft NPDES permit. While a number of the issues raised in our previous review (Payne et al. 2002) have been addressed by the draft NPDES, many of PWSRCAC's concerns and recommendations for changes were not included. Therefore, it seems appropriate to revisit some of the more important recommendations for the public comment phase. The following sections reflect the views and concerns of the PWSRCAC but are in no way meant to imply that the any of the involved parties, EPA, ADEC, the BWT Monitoring Advisory Committee or Alyeska and their scientific contractors have been less than diligent or dedicated to task of operating with minimal impact to the environment. We respect their prior efforts and offer these comments only in the spirit of initiating improvements based on hindsight and advances in scientific understanding.

Introduction

In overview, the operators of the BWTF are tasked by regulation to stay within proscribed limits of pollutant effluent concentrations and to do no significant harm to the environment of Port Valdez. According to results from 28 years of Alyeska's Environmental Monitoring Program (AEMP), the operators appear to have essentially succeeded in their task. Discharged oil concentrations are reported at very low levels and with the exception of the localized changes to infauna and elevated stress in fish near the diffuser, no significant harm to the environment has been documented. However, the PWSRCAC review finds that the data are, in places, inconclusive in supporting this assessment. Since 1977, various environmental parameters, including physical, chemical, and biological concerns, have been the focus of the AEMP. Many sites or parameters were examined for a few years and then dropped when they seemed to imply an ineffective technique, no harm to the environment, or no exceedance of limits. In hindsight, some of those decisions may have been made with inadequate information and optimistic confidence.

In recent years, two events have happened that, from PWSRCAC's viewpoint, have changed the perspective of BWTF discharge monitoring. First, there have been advances in analytical chemistry technology. Where results from previous samples analyzed with outdated technologies showed primarily the presence of background hydrocarbons from natural or human pollution sources (which swamped the potential for seeing the BWTF hydrocarbons), modern selected ion monitoring gas chromatography/mass spectrometry (SIM GC/MS) techniques are much more sensitive and comprehensive in picking out the BWTF signal. This point is thoroughly discussed in PWSRCAC's review of the NPDES application (Payne et al. 2002). Secondly, another set of monitoring data exists, the PWSRCAC Long Term Environmental Monitoring Program (LTEMP). While the results from LTEMP are limited in scope (only two sampling sites in Port Valdez), they conclusively show that BWTF oil is unexpectedly present at a distant location 6 km across the Port (Payne et al. 2001). The results also show seasonal changes which suggest a probable transport mechanism. From this second data set and additional confirming PWSRCAC studies (Salazar et al. 2002), it is not a stretch to suggest that BWTF oil is likely present throughout the Valdez basin at low (but measurable) levels.

From the PWSRCAC's viewpoint, the failing of Alyeska's monitoring program is that the NPDES permit required them to use less accurate and less sensitive chemical methods, which in general, consistently found no conclusive evidence of widespread pollution nor environmental impacts. PWSRCAC says that the data are inconclusive and thus disagrees with this assessment. Unfortunately, based upon the AEMP findings using the less accurate chemical methods over the past 28 years, the monitoring program has been reduced piecemeal until now it only looks at a fraction of the original stations and no longer evaluates any biological organisms for tissue contaminants. The PWSRCAC now finds itself in the awkward position of suggesting that the current scope of AEMP studies is inadequate to fully assess the potential impacts from BWTF discharges.

However, changes are occurring; at the urging of both the AEMP's principal investigators and the PWSRCAC's reviewers, ADEC and EPA have updated the NPDES permit conditions and now require the more sensitive chemistry methods. It seems highly likely that the new chemistry results will reflect the findings of the PWSRCAC studies and find low levels of BWTF oil in both near and far field samples. Thus, with the expectation of new data, it seems appropriate to re-examine the historically-evolved goals of the AEMP.

Monitoring Tools

A conceptual model for EPA's approach to monitoring the Port Valdez environment is presented in Figure 1. Note that initially all phases of the receiving environment were monitored for discharged oil using various measurements or tests. Over the past 28 years, ambiguous chemistry and optimistic assessments of impacts have lead to dropping tests for sediment toxicity (tool 4) and measuring hydrocarbons in mussels (tool 6) and bottom fish (not indicated). Presently, no living organism is chemically analyzed. It is the PWSRCAC's concern that the AEMP no longer meets its mandate.

From the draft NPDES permit, the purpose of the environmental monitoring requirements is to ensure that the Port Valdez ecosystem …"is not being adversely impacted by the BWT discharge." But if aspects of the monitoring have been discarded, how can an accurate assessment be made? For example, PWSRCAC detected a large spike of hydrocarbons in mussel tissues at the far station after the 1994 T/V *Eastern Lion* spill incident (KLI 1994, Payne et al. 2001). The AEMP however no longer samples mussels and would not be able to measure this acute impact. Under the draft permit, total recoverable oil and grease (TROG), total aqueous hydrocarbons (TAqH) and aromatic hydrocarbons (PAH) in the discharge stream will be measured monthly, but live organisms in the environment will not be sampled for oil contaminants.

Similarly, sediment toxicity tests were last performed under the 1989-96 Permit and were found to show no significant differences from control sediments. This is a commendable result for BWTF operations but not necessarily a good rationale to discontinue the tests. Monitoring, by definition, may include a long string of negative results, but unexpected incidents may happen.

Oil contamination was found at near field sites in infauna samples in 1995 and persisted at low levels for several years. The initial discharge incident was not documented but was most probably linked to a flushing of built-up oil in the BETX air stripper unit. Following the discovery, the infauna population was monitored and some sediment chemistry performed, but sediment toxicity tests were not required. The point is, systems change and incidents happen but

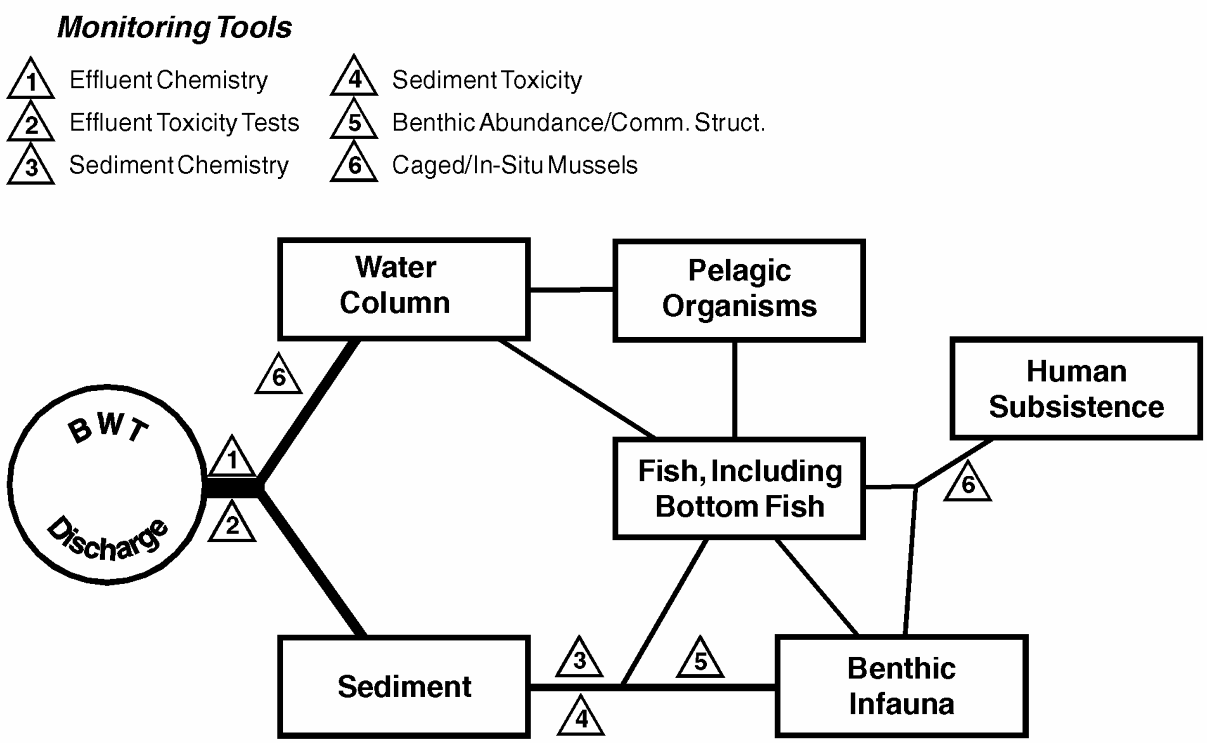

Figure 1. Schematic overview of integrated components comprising the Alyeska Environmental Monitoring Program AEMP) in place in 1996. (from EPA BWTF NPDES Fact Sheet, 1996).

unless the pathways are being monitored, the impacts go undetected. To meet the permit objective of "early detection/warning of any significant adverse effects due to BWT discharge," the monitoring design must be comprehensive else detection fails.

Likewise, the cessation of tests evaluating the levels of hydrocarbons in flat fish bile in 1993 left another path of oil uptake un-monitored. "Yellow fin sole collected near the terminal contained higher concentrations of polynuclear aromatic hydrocarbon (PAH) metabolites than bile from fish collected at the other sites (Columbia Aquatic Sciences, 1993). The likely source of PAH in the flatfish bile is contaminated sediment, tarballs, or contaminated food." Yet, the data were confounded and thus, the testing terminated: "… the test results were difficult to interpret since flatfish are mobile and it is not possible to separate inputs from the BWT discharge and other non-combustion sources of hydrocarbons (e.g., spills)." (NPDES Fact Sheet, 2003). Because the evidence was empirically strong with the flat fish, perhaps another less-mobile species and a more distinguishable indicator could be chosen to fill this niche in the environmental pathway. The updated chemical methods now required by the permit may also help to better define hydrocarbon sources.

Seasonal Transport

From the numerous studies of the mixing zone, the general behavior of the effluent plume is well described. Under typical conditions, the plume achieves its required dispersion within the mixing zone and transports from the area highly diluted. When the water column is stratified during late spring/summer/fall (Muench and Nebert 1973), the plume is typically trapped at depth beneath the lighter density surface layer. Due to the physical dynamics of the Port (local rivers, wind patterns, silled fjord basin, tidal exchanges, storm surges, etc.), the trap depth is highly dynamic although generally occurring below 20 m. In contrast, when the stratification is lost during the months of winter and early spring, the plume is no longer trapped and can reach the surface. Dye studies confirm these observations (Woodward-Clyde Consultants 1987).

Following these early studies, other events have demonstrated that transport across the fjord via surface-driven processes can and do occur. In 1994, a small spill from the *TV Eastern Lion* was easily detected at the LTEMP control site at Gold Creek (GOC), located across the Port and 6 km away from the terminal (KLI 1994, Payne et al. 2001). This transport process was also confirmed at the same location during routine LTEMP monitoring by differentiating the chronic low-level BWTF oil signal from the background signal (Payne et al. 2001). From the LTEMP samples, it is obvious that seasonally (winter/early spring) the plume from the BWTF surfaces in the wind-mixed, non-stratified water column and brings to the surface oil droplets that are ingested by intertidal mussels. When the effluent plume is discharged into a stratified water column (late spring/summer/fall), only the dissolved-phase PAH signal is detected in the mussels at the control site; the dispersed oil droplets are trapped beneath the stratified surface layer. Although the LTEMP program only samples from two locations with the Port, the transport mechanism suggests that it is probable that a BWTF effluent signal is present throughout the Port Valdez basin. A dissolved-phase alkyl-PAH signal consistent with the BWTF source was in fact measured in caged mussels placed in Anderson Bay, 10 km to the west of the terminal in 2001 (Salazar et al. 2002).

Seasonal surface transport, as implied by LTEMP data, typical results in the creation of surface microlayers whereby the oil droplets arise forming a very thin, concentrated layer floating atop the water. These microlayers are well studied in other regions and are know to have significant impacts on floating eggs, plankton and surface feeders which may come in contact with the contaminants. Because little is know about the level of concentration and magnitude of transport from surface transport in Port Valdez or the general surface currents patterns under seasonal conditions, the PWSRCAC suggests a one-time study to assess the importance of this phenomenon.

Infauna

One of the stated objectives of the AEMP is to: “Determine statistically significant and ecologically significant changes in the biota of subtidal Port Valdez.” Unfortunately, the only biota now monitored are the infauna, but this component of the program has remained consistently focused throughout the years.

Feder and Blanchard (Feder et al. 2000, 2001) report that the infauna populations are structured primarily by depth. Further, the deep basin infauna fall into populations characterized as east- or west-basin types with shifting transitional species in the middle. On the shallow shelf, the infauna are reported as quite dynamic and variable. In fact, this is an incredibly stable data set given that depths range from about 10 fathoms to over 130 fathoms. Several of the species that dominate in terms of biomass and abundance are found at both the deep and shallower stations. This degree of stability would occur in very few locations. Many of the dominant species are long-lived (life-spans of several years), and the fact that they are ranked in the top 10 by either abundance or biomass at different depths is striking for an infaunal data set. The types of changes detected and described in these reports are, in actuality, relatively subtle compared to the kinds of changes that are observed around wastewater outfalls or other substantial sources of organic enrichment or chemical contaminants.

In their monitoring reports, Feder et al. imply that infaunal population shifts are most likely the result of nutrient availability in a food-limited habitat. This explanation has some credence, but there is no direct supporting evidence—there are no environmental measurements of available food or of shifts in the physical habitat; only total organic carbon (TOC) and total organic nitrogen (TON). An alternative perspective whereby disturbance correlates to some degree with sediment chemistry (previously discarded from lack of supporting (old method) chemistry results) might be better tested with improved chemistry data. Since the effluent plume is said to predominantly disperse along the shallow shelf isobath at the location of the diffuser (Colonell, 1980), it seems highly probable that some of the population variance in the near field shallow (NFS) stations may correlate with the effluent signal. This was the case with the near field contamination incident in 1995-2001.

The improved chemistry required by in the Draft Permit should resolve some of the dynamic issues. Requiring the AEMP to obtain some measure of nutrient flux would contribute even more to corroborate the population dynamics with real data rather than just speculation of changing food resources. In fact, another of the stated objectives of the AEMP is to: "Determine whether changes to the monitoring program are warranted." In the most recent monitoring report, the collection of nutrient data was a recommended change from the principal investigators, and it was and continues to also be endorsed by the PWSRCAC; however, the change was not incorporated into the draft permit.

We also recommend that infaunal tissue samples be collected and analyzed by the improved analytical methods. Only with such analyses can the issues of exposure and source identification be addressed. In addition, the current permit requires that any oil seen in the infauna samples be noted but it does not require the chemical analysis of the oil. Requiring the analysis of any oil found in an infauna sample would seem logical and obviously crucial to interpreting infaunal impacts.

Multi-Species Monitoring

The NPDES Permit acknowledges in its environmental monitoring goal that the data are not comprehensive; not all components of the ecosystem are monitored.

> "Is there any change to the assessment that, *while not all components of the Port Valdez ecosystem have been assessed,* the environmental monitoring of Port Valdez to date suggests that the ecosystem is not being adversely impacted by the BWT discharge?"

An environmentally-conservative view would say that AEMP is too narrowly-focused on one species and one population. Conceptually, it would be prudent to watch for signs of exposure in multiple species. For example, what if planktonic mysids and copepods were the primary receptors for the dissolved effluent oils mentioned above, which then were consumed by transient herring or nearshore juvenile salmon. Neither mussel monitoring nor infauna populations would ever see the impacts.

In view of the previously discussed better analytic methods and new chemistry findings, it would seem prudent to periodically check the tissue loads of various species, perhaps not annually but on some multi-year basis. One highly appropriate species would be the intertidal clam, *Macoma balthica,* a common food item for many birds, fishes, and macro-invertebrates. With the new knowledge of probable surface transport, these small mud flat clams may be especially vulnerable receptors and primary transfer paths to the rest of the ecosystem.

Statistical Analyses

The previous annual AEMP reports (Shaw et al. 2001, 2002) contained a lot of required statistical fluff whereby various hypotheses were formally tested using rigorous inferential tests. Fortunately, the supplemental report (Feder et al. 2001, 2002) contained additional multivariate analyses which, although not hypothesis-driven, offered much better insight into the processes and events evidenced in the data sets. The 1997 permit required specific hypothesis tests; the draft permit does not contain the restrictive wording. Because there is no evidence that the multiple hypothesis testing is adding value to AEMP, we encourage EPA to permit the researchers leeway in statistical analysis, interpretation of the data, and presentation of relevant results. We anticipate the permission process would include consultation with regulators.

Also, the list of secondary oiling indicators was previously specified by the Permit. When the updated chemistry data become available, analysts should be allowed to derive their own set of pertinent parameters. The current Draft Permit does not contain the restrictive wording.

Chemistry Monitoring

The draft NPDES Permit requires PAH monitoring using SIM GC/MS methods but does not specify the list of analytes or reference a procedure for the SIM GC/MS method. The PWSRCAC suggests the following analytes (which are routinely examined as part of the LTEMP) as the typical suite of interest for hydrocarbon monitoring.

Table 1 Suggested PAH Analytes (compounds with an asterisk (*) denote EPA Priority Pollutant PAHs

Naphthalene*	Fluoranthene*
C1-Naphthalene	Pyrene*
C2-Naphthalene	C1-Fluoranthene/Pyrene
C3-Naphthalene	C2-Fluoranthene/Pyrene
C4-Naphthalene	C3-Fluoranthene/Pyrene
Biphenyl	C4-Fluoranthene/Pyrene
Acenaphthylene*	Benzo(a)Anthracene*
Acenaphthene*	Chrysene*
Fluorene*	C1-Chrysenes
C1-Fluorenes	C2-Chrysenes
C2-Fluorenes	C3-Chrysenes
C3-Fluorenes	C4-Chrysenes
Dibenzothiophene	Benzo(b)fluoranthene*
C1-Dibenzothiophene	Benzo(k)fluoranthene*
C2-Dibenzothiophene	Benzo(e)pyrene
C3-Dibenzothiophene	Benzo(a)pyrene*
C4-Dibenzothiophene	Perylene
Anthracene*	Indeno(1,2,3-cd)pyrene*
Phenanthrene*	Dibenzo(a,h)anthracene*
C1-Phenanthrene/Anthracene	Benzo(g,h,i)perylene*
C2-Phenanthrene/Anthracene	Total PAH
C3-Phenanthrene/Anthracene	
C4-Phenanthrene/Anthracene	

Analytical procedures that are appropriate for these alkylated PAH measurements have been widely published (Sauer and Boehm 1991, 1995; KLI 1995, Boehm et al. 1997; Short and Harris 1996; Stout et al. 2001, 2002) and cited in the Federal Register (Federal Register 2003). They can be performed by a number of commercial analytical laboratories.

The draft NPDES also specifies that TAqH be measured once per month in the BWTF effluent in accordance with 18AAC70.020, Note 8. Note 8 requires a combination of EPA Methods 602 and 610 to quantify monoaromatic hydrocarbons and polynuclear aromatic hydrocarbons (PAH), respectively. EPA Methods 602 and 610 are grossly antiquated and rely on 1980s technologies, which increase problems due to matrix interference (particularly with petroleum hydrocarbon-contaminated wastes). This results in very limited precision with higher than desired detection limits.

Method 602 is a purge and trap gas chromatographic technique that utilizes a photoionization detector. In the EPA Method 602 itself, it states that EPA Method 624, which is based on GC/MS analyses, can be used for qualitative and quantitative analyses of the analytes, and we recommend that the EPA Method 624 GC/MS option be specified in the permit. The GC/MS method supercedes the older technique, and it is not subject to the same interference and detection limit problems. In addition, ADEC has recently accepted the GC/MS method in its definition of TAqH. The target analytes for the EPA Method 624 analyses should at a minimum include benzene, ethylbenzene, toluene, and xylene(s).

EPA Method 610 for the PAH analyses is based on a solvent (methylene chloride) extraction followed by either high performance liquid chromatography (HPLC) or flame ionization detector gas chromatography (FID GC). Again, the method itself states that EPA Method 625 provides GC/MS conditions appropriate for the qualitative and quantitative analyses of the PAH components of concern, and we recommend that the GC/MS option be specified in the permit. As in the previous case, the newer GC/MS method supercedes the older technique, and ADEC has recently accepted the EPA Method 625 GC/MS method in its definition of TAqH. In addition, the EPA Method 610 list of analytes includes only the 16 EPA Priority Pollutant PAH identified by an asterisk (*) in Table 1 above. As such, it does not include the majority of alkylated PAH components present in crude oil and crude oil-contaminated water as described more fully in Payne et al. (2002). Therefore, we recommend that the list of analytes for the Method 610 analyses in support of generating TAqH be expanded to include all the alkylated PAH analytes noted above, and further that the analyses be conducted by selected ion monitoring GC/MS.

In Table 2 of the Fact Sheet, BWT Discharge (Outfall 001) Monitoring Requirements, it is stated that total aqueous hydrocarbons (TAqH) should be monitored monthly; however, in a footnote to the table, the fact sheet states that if TAqH in the effluent is < 0.54 mg/L during the first year of the permit, the monitoring frequency may be reduced to quarterly. It is not until half way through the document (p 28) that a limit for TAqH is even given. Alaska Water Quality Standards specify a TAqH criterion of 15 µg/L, and the Fact Sheet states that Alyeska must comply with the standard at the edge of the chronic mixing zone. Because the limit is specified at the edge of the mixing zone where it cannot be directly measured, we believe that only monitoring TAqH one time per month is inadequate. We therefore recommend TAqH monitoring four times per month, particularly in winter, when the fact sheet admitted there was a lack of historical TAqH data. The Fact Sheet states that the maximum daily value for TAqH was 17.5 µg/L (measured where?), and that a majority of samples analyzed since 1997 were below quantification limits. As noted above, we believe that the previous analytical techniques used for measuring TAqH were subject to matrix interference, and that the BTEX and PAH components should be measured by EPA Methods 624 and 625, respectively. With these newer GC/MS methods, it is unlikely that "a majority of samples" will continue to be "below quantification limits," and the more frequent measurements suggested above, should be completed until an adequate database is established with the new techniques.

The permit states that sediment shall be analyzed to determine whether contaminants from the BWTP bioaccumulate, concentrate, or persist above natural levels in sediments or in benthic infauna to significantly adverse levels. Because no alkyl PAH data are available from past programs for benthic infauna, it has been impossible to document potential bioaccumulation. LTEMP sediment data have shown an accumulation of alkyl PAH related to the discharges in sediments around the diffuser. The permit calls for a tiered approach with additional replicates analyzed whenever the sum of concentrations of all the polynuclear aromatic hydrocarbon analytes (TARO) from the first replicates lies above the 95 percent confidence interval of the arithmetic mean of TARO values measured from 1989 through 2001. Because selected ion monitoring GC/MS procedures will be used on the sediments for the first time in the AEMP, it is unlikely that the data collected will be directly comparable to the older data generated by FID-GC methods. As a result, the 95 percent confidence interval approach specified in the permit may not work, and we recommend analyses of all three replicates of sediments (and any infaunal tissues) collected as part of the monitoring program. With SIM GC/MS analyses to confirm the actual concentrations of individual PAH in sediments, comparisons to Sediment Quality Guidelines will also be better.

Plume Behavior

ADEC and the existing permit require that the top boundary of the mixing zone for the BWT discharge "…shall all times be 14 meters (46 feet) below the receiving water surface." Existing data from dye studies and modeling results completed by Alyeska suggest that this condition may not always be met, particularly in the winter when the water column for the receiving waters is not stratified. The temperature and salinity of the effluent is such that under nonstratified conditions in winter, the plume will be transported to the surface. In 1997, a pilot-scale caged-mussel program was successfully deployed in the vicinity of the mixing zone surrounding the offshore diffuser for the Alyeska BWTF (Applied Biomonitoring 1999). In 2001, a fully integrated study was conducted utilizing caged mussel samples, discrete dissolved- and particulate-phase water samples, and passive plastic-membrane devices (Salazar et al. 2002). Unfortunately, the deployed mussel cages had to be moored at a minimum water depth of 100 feet to avoid interference with tanker operations, and no data were obtained closer to the surface. We believe that a limited series of seasonal (summer and winter) near-surface water samples should be collected and analyzed as described by Payne et al. (1999) and Salazar et al. (2002) to ensure that Alaska State Water Quality Standards are indeed being met during stratified and nonstratified water-column conditions.

Toxicity Testing - Whole Effluent Toxicity Monitoring Requirements

The Fact Sheet states that whole effluent toxicity (WET) testing demonstrates that the effluent is not toxic because the no effect concentrations ranged from 50 to 100% effluent in 27 of 32 (84.4%) tests. The Fact Sheet fails to note that 4 of 15 (26.7%) of the echinoderm fertilization tests conducted since 1999 had no effect concentrations of less than 6.25%, which indicates periodic effluent toxicity (see Fact Sheet Table 3). The acute mysid tests do not assess chronic toxicity and the data from these tests should not be used to predict concentrations that may result in sublethal effects.

The Fact Sheet also concludes that there is not a reasonable potential to violate the toxicity criterion based on a calculation of toxic units. EPA's conclusions are not adequately supported because it assumes a maximum effluent toxicity of 5.88% (IC25 of 17%) based on July 2000 WET results. Although there was no apparent dose-response, tests performed in December 1999 indicate the potential for higher toxicity: i.e., 20 to greater than 30% impact at 6.25% effluent. Additionally, the relative sensitivity of the echinoderm fertilization tests and mysid acute tests to detect chronic toxicity of petroleum hydrocarbons is uncertain. PWSRCAC previously recommended that the draft NPDES Permit be revised to replace the fertilization and mysid acute testing requirements with larval development and mysid chronic tests (Payne et al. 2002). The data from these tests would provide a more defensible basis for determining the potential for violating the toxicity criterion.

The draft NPDES Permit requires the same whole effluent toxicity (WET) monitoring that was specified in the previous permit: (1) quarterly echinoderm fertilization tests and (2) annual mysid acute toxicity tests. While the fact sheet states that EPA has determined to use inhibition concentration (IC25) as the measurements of WET effects instead of the NOEC, we believe that more sensitive tests should be used to more accurately calculate a 25 percent inhibition effect. PWSRCAC previously commented that the WET monitoring requirements should be altered to include more sensitive and ecologically relevant measures of toxicity, and we continue to believe that the longer-term tests discussed below should be considered as replacement tests for the current procedures that show IC25 > 100 percent effluent. Specifically, PWSRCAC recommended changing (1) the echinoderm fertilization test to an echinoderm or bivalve larval development test, and (2) the mysid acute test to a mysid chronic test.

Quarterly Echinoderm Testing

The echinoderm fertilization test requirement does not adequately assess the chronic toxicity of the effluent because the duration of exposure to effluent is only 40 minutes. Of additional concern is that only toxicity to sperm and eggs is assessed, rather than determining the developmental toxicity to larvae. As previously commented by PWSRCAC, the NPDES Permit requirements should be changed to one of the longer-term bivalve or echinoderm development tests:

- Purple Urchin and Sand dollar Larval Development Test. This is a 72 hour static test described in EPA (1995) for the same species performed with the fertilization test.

- Pacific Oyster and Mussel Embryo-Larval Development Test. This is a 48 hour static renewal test described in EPA (1995) for the oyster *Crassostrea gigas* and a mussel (*Mytilus edulis, M. californianus, M. galloprovincialis,* or *M. trossulus*).

These tests would evaluate larval survival and development for a longer duration of exposure than the current fertilization tests. As stated in the EPA (1995) WET testing manual, the invertebrate developmental tests tend to be more sensitive to many chemicals and are more robust statistically, and are routinely performed by contract bioassay laboratories.

Annual Mysid Testing

The annual mysid acute toxicity testing requirement does not assess the chronic toxicity of the effluent. Mysids are exposed to effluent for only four days and only mortality is assessed. As previously commented by PWSRCAC, the NPDES Permit WET requirement should be changed to a chronic (7 day test duration) mysid test to allow evaluation of sublethal effects of the effluent discharge, and provide for a longer duration of exposure to the effluent. US EPA testing guidance specifies a 7 day Growth and Survival Test with either the west coast mysid, *Holemesimysis costata* (EPA, 1995), or Gulf Coast mysid, *Mysidopsis bahia* (EPA, 1994). These tests are routinely performed by contract bioassay laboratories, and in addition to allowing an assessment of chronic toxicity these tests also allow determination of a 96 hour acute toxicity endpoint that is consistent with previous testing.

In summary, PWSRCAC recommends changes to more sensitive and relevant endpoints in the WET monitoring requirements in the draft NPDES Permit, including quarterly echinoderm or bivalve development tests and annual mysid chronic tests. Additionally, statements in the Fact Sheet regarding WET should be revised to more accurately reflect the periodic toxicity of the effluent.

Engineering Considerations

The draft NPDES Permit effectively incorporates our previous comment regarding the residence time being the most important parameter related to the efficiency of the gravity oil/water separation. Specifically, we had questioned the low minimum 2-hour holding time in the gravity separation tanks (90s Tanks) that is listed in their 1998 Best Management Practices (BMP) Plan (Alyeska 1998). It is appropriate that there is now a requirement in the draft NPDES Permit that the BMP Plan be updated to state that ballast water be held in the gravity-separation 90s tanks for a minimum residence time of 4 hours and that Alyeska shall maintain the 90s tanks in accordance with their design specifications and treatment efficacy. Also, to ensure the optimum performance of the 90s Tanks, Alyeska should be encouraged to reevaluate all influent waste streams with the emphasis on reducing the amount of oil that enters the waterside of the BWT (90s Tanks) from sources other than off loaded ballast water.

It is also appropriate that Alyeska's BMP Plan be updated and submitted to EPA and ADEQ for approval, as is stated in the draft NPDES Permit. EPA and ADEQ should ensure that the updated BMP Plan addresses the efficiency of the DAF system and biological treatment system, as discussed below.

Similar to other treatment processes, one of the main parameters that affects the efficiency of oil removal by the DAF system is retention or residence time in the tanks. Under normal described operating procedure using all six DAF cells and assuming an average flow rate of 12 MGD, the maximum retention time would be approximately 2.9 hours. Factors that would reduce retention time and act to reduce oil removal efficiency would be the accumulation of settled solids in the bottom of the tank, the removal of one or more of the six DAF cells from service, and a higher than average ballast water flow rate. Alyeska personnel indicate that the accumulation rate of sediment in the bottom of the DAF cells is only about 2 inches per year and that cleanout for each cell occurs only once every few years. The BMP Plan for the facility does not indicate that there are minimum standards to ensure that a minimum retention time or treatment efficiency is maintained. During a previous site visit one of the DAF cells was drained and another cell appeared to be inactive. Alyeska should specify the performance desired from the

DAF system, and how it is to be achieved. For example, this might include the minimum retention time for the DAF system or the minimum number of DAF cells to be active at various flow rate ranges.

One future concern mentioned for the biological treatment system is with the increased use of ships having segregated (i.e., clean) ballast water that does not require treatment. This would reduce flows and potentially make the flow rate more sporadic. The concern would be that the flow may drop to zero or to such a low rate that the biological life in the system would die off from lack of food source. However, a lower or more sporadic flow rate can be handled in a number of ways, and better effluent results actually could be achieved. The biological treatment tanks could be modified to allow operation in series rather than only in parallel. The flows can be regulated through the controlled drainage of the 90s tanks. As long as scheduling of ships is monitored effectively, BWTF operators should be able to ensure that the flow rate to the biological treatment tanks never drops to a level that risks killing the microorganisms in the biological treatment tanks.

The Fact Sheet discusses improvements in the in biological treatment tanks design and process control changes completed during the 1990s to further reduce BTEX concentrations in the effluent. The Fact Sheet does not point out, however, that no biological monitoring tests are run in an association with BTT. Instead, the Fact Sheet states that active biomass within the biological treatment tanks is measured as total suspended solids (TSS). TSS does not equate to active biomass, and we recommend inclusion of biological monitoring (active microbial biomass determinations, substrate turnover rate studies, etc.) as part of the BMP for the BTT system. Currently, a "biological upset" is defined as any time the BTEX concentration goes up as measured by the online BTEX analyzer. When this happens, the situation is corrected by a series of on/off air strippers installed at the effluent end of the BTT. Also, is not clear from the fact sheet if there is an online analyzer on the second BTT.

The wording of both the Fact Sheet and the draft NPDES Permit implies that air stripper use is minimized to prevent excessive transfer of BTEX to the atmosphere. Are there any data or mass balance calculations to show how much of the BTEX is actually biodegraded vs. stripped by air sparging into the atmosphere? Calculations by Payne et al. (2002) indicate that approximately 580 pounds per day or 105 tons per year of BTEX is removed by the DAF system, and much of this mass is directly loaded into the atmosphere. We suggest that the fact sheet and the draft NPDES permit be changed to acknowledge that the atmospheric loadings occasioned by use of the air strippers, in essence, trade a decrease in water pollution for an increase in air pollution and that everything is being done to reduce both types of pollution.

A decrease in the efficiency of the biological treatment can cause an increase in air pollution due to reduced biodegradation and more BTEX being swept from the BTT by the continuous use of the air injection system that assists with mixing and provides oxygen to keep the system aerobic. The Fact Sheet states that the biological treatment system is seasonably variable due to colder ambient water temperatures and higher throughput during the winter when tankers carry more ballast to be stable during rougher winter seas. Given the shorter residence time and lower temperatures during the winter, it is again important to implement some type of biochemical testing or monitoring to assess the efficacy of the biological processes.

The fact sheet states that the re-issuance of the NPDES permit will not result in additional pollutant loading to the receiving water. Presumably the statement includes past BWT discharges as part of the new "baseline," because the BWT certainly is contributing to the total pollutant load. The Fact Sheet further states that the BWTF and sanitary waste discharges from the Alyeska Marine Terminal are only a subset of many potential human influences to the environmental quality of Port Valdez. Other listed influences include oil spills, the Small Boat Harbor, the hatchery, the seafood processors, storm water runoff from the city of Valdez and surrounding environs, tanker discharges, commercial/ recreational boats, and the Valdez POTW. When statements such as this are presented in the Fact Sheet, it would be valuable to provide volumes and estimated concentrations of contaminants of concern associated with these other discharges so that relative mass contaminant loadings can be assessed.

The collected data on BWTF effluent concentrations of oil, BTEX, and polynuclear aromatic hydrocarbons (PAHs) indicate low concentrations. However, because of the extremely large average flow rate, even low concentrations can have a large impact in terms of mass discharged. For example, Payne et al. (2002) estimated that with an average flow of 12 MGD this translates into approximately 220 pounds per day. Assuming a specific gravity of 0.9, this is the equivalent of 0.7 barrels of oil per day being discharged into the Port. We believe that 0.7 barrels of oil per day probably dwarfs the hydrocarbon input from all of the other sources combined, but it would be useful to have additional data to accurately make such comparisons.

There is a Permit requirement for analysis of total aqueous hydrocarbons (TAqH), which is a sum of BTEX and PAHs, but there is no established NPDES limit for the BWTF effluent. There is an ADEC limit of 15 µg/L for TAqH at the boundaries of the established mixing zone, but there is no easy way to monitor that this limit is being achieved. In addition, there are no NPDES limits for either total recoverable oil and grease or PAH. According to a review of regulations published in the year 2000 regarding hydrocarbons in water, the typical oil and grease discharge limit in the U.S. and internationally is 15 mg/L or less (Mohr 2000).

Oil refineries can be used as a comparison group to examine appropriate effluent concentration limits. For example, six oil refinery facilities in Washington State have NPDES permits for their wastewater, four of which treat ballast water. These facilities have each received renewed or modified NPDES discharge permits in the past 4 years; each of these permits requires that the concentration of oil and grease in the discharge shall at no time exceed 15 mg/L and shall not exceed 10 mg/L more than three days per month.

TROG monitoring data since 1994 indicate that the BWTF effluent exceeded 10 mg/L only on one occasion and has not exceeded 15 mg/L during this time period. Therefore, it is known that with proper facility operation, TROG effluent limit could be consistently attained. EPA is concerned with establishing a lower limit for BTEX compounds because it might result in more frequent use of the air stripper system. However, establishing a limit for TROG would not increase the frequency of usage of the air stripper system because air strippers would be ineffective in significant removal of TROG.

The Fact Sheet states that EPA must require the discharger "… [to] assist in the development of effluent limitations." While the draft permit addresses limits for the existing contaminants of concern (BTEX, pH, etc.), we suggest that the data obtained on alkylated PAH constituents be used for future development of effluent limitations. Because of the predominance of alkylated PAH in the BWT effluent and that fact that LTEMP data suggest they are accumulating in selected components of the ecosystem within Port Valdez, an additional explicitly stated objective for the NPDES permit should be the reduction of alkylated-PAH loadings to the water column.

EPA proposes continuation of the BPJ limits for TSS (except within 24 hours of stripper operation) of 40 mg/L and 25 mg/L maximum daily and monthly average, respectively. Within 24 hours of stripper operation, an alternate higher maximum daily TSS limitation of 170 mg/L would apply. The monthly average would not include TSS measurements within 24 hours after stripper use. We recommend that the monthly average should include TSS measurements after stripper use, if that use exceeds some percentage value agreed upon between EPA and Alyeska.

Reporting Requirements.

Virtually all of the measurements to be reported to EPA and ADEC may have significant variability within a compliance margin. Typically, the information contained in just a few points is insufficient to identify trends that might be adverse to the environment. Statistical analysis of reported data is essential to determine if trends are developing. Computer-readable data ensure that secondary transcription errors do not find their way into the database used for the statistical analyses. We recommend that all reports submitted to EPA and ADEC also be submitted in a commonly accessible digital format We also recommend that all reported data be accumulated and maintained by Alyeska in a quality-assured, commonly accessible, computer database format, and that this database be made available to regulators upon request.

Laboratory Audits

The draft NPDES Permit states that an updated copy of Alyeska's revised QA Plan shall be submitted to EPA for approval in consultation with ADEC no later than 45 days from the effective date of the NPDES permit. We recommend that a series of independent QA/QC audits be undertaken to ensure compliance by all in-house and contract laboratories used in Alyeska's Environmental Monitoring Program to ensure that proper laboratory methods and protocols are being followed in compliance with the data quality objectives specified in the Alyeska QA Plan. Quantitative data quality objectives subject to independent audit may include: method detection limits, precision, accuracy, and completeness (as required to achieve a specific statistical level of confidence). Qualitative QA objectives include, but are not limited to, representativeness, comparability, chain of custody, and other factors affecting sampling design and collection methods. Audits of analytical procedures may include reference to EPA-approved or other validated standard methods, data validation plans for non-standard or modified methods, and instrument calibrations procedures. Factors affecting instrument calibration procedures include reference to EPA-approved or standard methods, detailed descriptions of non-standard methods, calibration standard preparation logs (e.g., preparation dates, concentrations, sources, traceability, and purity), frequency of calibration checks, and defined acceptance criteria for all instrument calibration procedures.

Proposed Modifications to the NPDES Permit

1. Include an explicitly-stated objective "to reduce alkylated-PAH loadings to Port Valdez" because of their predominance in the BWT effluent and the fact that LTEMP data suggest they are accumulating in selected components of the ecosystem.
2. Specify PAH monitoring using SIM GC/MS methods for the following the list of analytes.

   Table 2 (copy of Table 1). Suggested PAH Analytes (compounds with an asterisk (*) denote EPA Priority Pollutant PAHs

Naphthalene*	Fluoranthene*
C1-Naphthalene	Pyrene*
C2-Naphthalene	C1-Fluoranthene/Pyrene
C3-Naphthalene	C2-Fluoranthene/Pyrene
C4-Naphthalene	C3-Fluoranthene/Pyrene
Biphenyl	C4-Fluoranthene/Pyrene
Acenaphthylene*	Benzo(a)Anthracene*
Acenaphthene*	Chrysene*
Fluorene*	C1-Chrysenes
C1-Fluorenes	C2-Chrysenes
C2-Fluorenes	C3-Chrysenes
C3-Fluorenes	C4-Chrysenes
Dibenzothiophene	Benzo(b)fluoranthene*
C1-Dibenzothiophene	Benzo(k)fluoranthene*
C2-Dibenzothiophene	Benzo(e)pyrene
C3-Dibenzothiophene	Benzo(a)pyrene*
C4-Dibenzothiophene	Perylene
Anthracene*	Indeno(1,2,3-cd)pyrene*
Phenanthrene*	Dibenzo(a,h)anthracene*
C1-Phenanthrene/Anthracene	Benzo(g,h,i)perylene*
C2-Phenanthrene/Anthracene	Total PAH
C3-Phenanthrene/Anthracene	
C4-Phenanthrene/Anthracene	

   Analytical procedures that are appropriate for these alkylated PAH measurements have been widely published (Sauer and Boehm 1991, 1995; KLI 1995, Boehm et al. 1997; Short and Harris 1996; Stout et al. 2001, 2002) and cited in the Federal Register (Federal Register 2003).

   Because selected ion monitoring GC/MS procedures will be used on the sediments for the first time in the AEMP, it is unlikely that the data collected will be directly comparable to the older data generated by FID-GC methods. As a result, the 95 percent confidence interval approach specified in the permit may not work, and we recommend analyses of all three replicates of sediments (and any infaunal tissues) collected as part of the monitoring program.

3. For TAqH, the BTEX and PAH components should be measured by EPA Methods 624 and 625 (based on GC/MS analyses), respectively, rather than the antiquated Methods 602 and 610. The list of analytes for the Method 610 (625)

analyses should be expanded to include all the alkylated PAH analytes noted above. TAqH monitoring should occur four times per month, particularly in winter, when the Fact Sheet notes there was a lack of historical TAqH data. In addition, the more frequent measurements are necessary to quantify contaminant levels that are limited only at the edge of the mixing zone (which cannot be easily sampled), and they should be continued until an adequate database is established with the new techniques.

4. Reinitiate *Mytilus* sampling (similar to the PWSRCAC's LTEMP approach) into the monitoring suite to assess surface transport, particularly at far field locations. The previous chemistry analyses using the older methods were inadequate to ascertain the BWTF signature, and the decision to drop that aspect of the program was ill-founded. Surface waters and intertidal exposure are aspects of the ecosystem currently being ignored.
5. Initiate a reconnaissance program to identify other intertidal sites that support ambient mussel populations that could be used to obtain a wider geographic evaluation of intertidal contamination within the Port. Because there are only data from three sites (AMT, Gold Creek, and Anderson Bay) with no information on transport processes or geographic fate, there may be other areas receiving more concentrated levels of pollutants.
6. Evaluate other potential receptor species. The current program is limited to one species and one population. Periodic assessment of hydrocarbon exposure in other species would monitor other pathways within the foodweb. The exposure of intertidal deposit feeders, particularly *Macoma balthica,* is of high ecological significance.
7. Collect additional environmental parameters that would help to better understand the variance in infaunal populations (also suggested by the AEMP investigators). "Reproductive success and subsequent larval stages of benthic organisms, and survival of recently recruited individuals on the bottom are dependent to a large extent on food availability. Monitoring environmental parameters (temperature, salinity, primary productivity, phytoplankton pigment accumulation within sediments and total annual carbon flux to the bottom) would improve the understanding of interannual fluctuations in community structure. Lack of such data throughout the years has made it difficult to interpret faunal changes. Addition of some of the parameters noted above, in particular, phytoplankton flux to the bottom and annual carbon flux to the bottom, is highly recommended for future surveys." (AEMP Final Environmental Report, 2000).
8. Analyze infaunal tissue samples for oil accumulation. Only with such analyses can the issues of exposure and source identification be addressed.
9. Require sampling and chemical analysis of any oil observed in infauna grab samples. Currently, if oil is present in infauna grab samples, it is noted but not analyzed. This information is critical to understanding impacts to infauna.
10. De-emphasize the hypothesis testing in consultation with EPA and ADEC, and use only as necessary (also suggested by the AEMP investigators); a plethora of nonessential hypothesis results tends to obscure the relevant findings. The multivariate approaches used by Feder and Blanchard (Shaw et al. 2000a,b) are modern, appropriate and flexible in addressing pertinent issues. Also, when the updated chemistry data become available, rather than being limited to the NPDES specified list of secondary oiling indicators, analysts should be allowed to derive their own set of pertinent parameters.

11. Change WET monitoring requirements to more sensitive and relevant endpoints, including quarterly echinoderm or bivalve development tests and annual mysid chronic tests. Additionally, statements in the Fact Sheet regarding WET should be revised to more accurately reflect the periodic toxicity of the effluent, and the potential for violation of the toxicity criterion should be re-assessed.
12. Assess the level of concentration and magnitude of transport from surface microlayers. Results from Payne et al. (2001) demonstrate chronic seasonal shallow (most likely, surface) transport across the Port. There is a data gap regarding the confirmation and magnitude of this process.
13. Initiate a one-time study that incorporates a conductivity-temperature-depth (CTD) profiler to identify the overall depth and structure of the water column and possibly a submersible fluorometer to better define the BWTF effluent plume. Then confirm its presence and PAH concentrations during stratified and nonstratified oceanographic conditions outside the mixing zone by more detailed chemical analyses of discrete filtered 3 L grab samples at specific depths suggested by the CTD and fluorometer data.
14. Include TSS measurements after stripper use in the monthly average if the volume of effluent associated with that use exceeds some appreciable percentage of total effluent volume discharged during the month as agreed upon between EPA and Alyeska.
15. Require TROG monitoring on a weekly rather than monthly basis. Weekly monitoring would provide a database with better resolution to correlate TROG discharges with changes in BWTF operations and changes in crude oil composition.
16. Establish an effluent concentration limit for TROG since limits exist at similar industrial facilities and Alyeska has demonstrated its ability to manage TROG levels.
17. Require that all reports submitted to EPA and ADEC also be submitted in a commonly accessible digital format.
18. Require that all reported data be accumulated and maintained in a quality-assured, commonly accessible, computer database and that this database be made available to regulators upon request.
19. We recommend that a series of independent QA/QC audits be undertaken to ensure compliance by all in-house and contract laboratories used by Alyeska's Environmental Monitoring Program to ensure that proper laboratory methods and protocols are being followed in compliance with the data quality objectives specified in the Alyeska QA Plan.

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