Beaver dam and ponding at the intersection of Wetland A - Finger 4 and Beaver creek. April 19, 2004.

Allen creek excavated section looking northwest.

Ponded water east of Allen creek caused by beaver damming downstream.
Beaver creek looking east, note ponded water behind dam, abundant and diversity of vegetation which is typical of this emergent scrub-shrub wetland.

Beaver Creek, note channeling created by beaver.

Ponding created by beaver at the confluence of Beaver creek and Finger 4 of Wetland A. April 16, 2004.
October 14, 2004

Allen & Company, LLC
PO Box 2510
43520 SE North Bend Way
North Bend, WA 98045

RE: Maytown Aggregates • Response to Black Hills Audubon Society Comments dated September 22, 2004

This letter is Ecological Land Services’ (ELS) response to selected comments from the Black Hills Audubon Society for the Maytown Aggregates project.

**INTERMITTENT STREAM IN MINE AREA 1**

**Comment:** How will the project operator be required to protect or mitigate for the intermittent stream identified in DOE’s comments of April 9, 2004 (page 5) in mining area 1?

The above-referenced comment from the Washington Department of Ecology letter dated April 9, 2004 and is as follows:

> An intermittent stream (type Ns, per Chapter 222-16 WAC) was not identified in Area 1 in the environmental checklist and should be included in the mitigation plans for this project.

**Response:** We have reviewed the following sources of information regarding the referenced “intermittent stream in Mine Area 1."

- Department of Natural Resources (DNR) Forest Practice Activity Map.
- Thurston County GeoData Center wetlands map.

After a thorough review of the above sources of information, we conclude that there is no existing intermittent stream in proposed Mine Area 1 as indicated by the DOE letter. This conclusion is based upon the following observations and determinations:
1. ELS staff have been present on-site over a period of years, and at various times of the year (winter-spring-summer) since 1995. These on-site visits were for the purpose of determining the presence or absence of jurisdictional streams and wetlands. In 1995 and 2002, ELS staff conducted complete and thorough on-site surveys for this purpose, and prepared subsequent reports detailing the findings. In addition, ELS staff conducted a delineation of the native outwash prairie in 2002 and follow-up stream and wetland data collection in 2004. At no time during any of these on-site surveys or inspections, did ELS staff observe or document the presence of an intermittent stream in the location of proposed Mine Area 1, or in those areas south of Mine Area 1 or north of Finger 4 of Wetland A. None of the indicators typical of an intermittent stream were observed within the area in question, including standing water, saturated soil, scour marks, channels or remnant of channels, hydric soils, hydrophytic vegetation or water-stained leaves.

2. The DNR Forest Practice Activity Map indicates the presence of a Type 5 stream on the site, extending from the northeast corner of the site in a southerly, then southwesterly, orientation to the northernmost extension of Finger 4 of Wetland A. We found no evidence of this mapped intermittent stream on-site in the location indicated by the DNR map.

3. The National Wetland Inventory (NWI) map indicates the presence of an intermittent drainage in approximately the same location as the DNR map; however, the dashed line stops short of connecting to Finger 4 of Wetland A. We found no evidence of this mapped intermittent drainage on-site in the location indicated by the NWI map.

4. The Thurston County GeoData Center wetlands map indicates the presence of a stream roughly in the same location as the two previous sources; however, its connection to Finger 4 of Wetland A is depicted in a different location. We found no evidence of this mapped stream on-site in the location indicated by the GeoData Center map.

5. ELS staff reviewed 13 aerial photographs of the site, at various intervals from 1941 to 2002. The photos do appear to indicate historic drainages associated with the formation of the outwash prairie, but none of the photos indicate the presence of an existing defined stream channel in the locations indicated by the DNR map, NWI map, and Thurston County GeoData Center map. One infra-red photo, taken in January 1997, indicates the presence of standing water or shallow surface water sheet flow across a 100- to 200-foot wide swath of the native outwash prairie, in the approximate location of the DNR-mapped intermittent stream. This apparent sheet flow of water was likely a result of an abnormally high groundwater level due to above-normal precipitation occurring in the years 1995-1999. Similarly, high groundwater levels caused localized flooding problems in other areas of south Thurston County. This generalized sheet flow of surface water is known by ELS staff to have occurred only once during the period of time covered by the aerial photos.
6. Review of Chapter 222-16 of the Washington Forest Practices Manual, specifically the water typing system (WAC 222-16-030 and 031), defines Type 5 Waters (Type Ns Water under the new rules) as "...all segments of natural waters within the bankfull width of the defined channels that are not Type 1, 2, 3, or 4 Waters. These are seasonal, nonfish habitat streams in which surface flow is not present for at least some portion of the year..." The key phrases in the definition relating to the mapped on-site stream are 1) "within ...the defined channel" and 2) "flow is not present for at least some portion of the year..." As stated previously, both on-site observation and aerial photo interpretation indicates that there is no defined channel, or even remnant of a channel, within the area in question. Secondly, the term year, as opposed to years, suggests that an intermittent stream has flow on a yearly basis, not at intervals of multiple years or decades. Therefore, on the basis of the manual's definition for Type 5 Waters (Type Ns), there is no intermittent stream present within the area in question because there is no defined channel or remnant of a channel, and there is no seasonal flow on a yearly basis.

In conclusion, it is ELS' determination that there is no existing intermittent stream in proposed Mine Area 1 as indicated by the DOE letter. This conclusion is based on formal on-site observations and documentation, review of resource agency maps and historic aerial photos from 1941 to 2002, and review of the water typing system definitions in WAC 222-16-030 and 031 of the Washington Forest Practices Board. ELS staff assume that a mapping error was repeated among the DNR, NWI, and Thurston County GeoData Center maps. Further evidence supporting this mapping error is provided in the maps themselves, in that while they all agree that some form of drainage is present within the area, they all differ somewhat on its extent and location.

SOIL BERMS
Comment: Will DNR, Thurston County and WDFW agree to allow the project operator to bury prairie soils under proposed berms—permanently altering type of habitat and potential of restoration?

Response: All mining related activities will occur within the proposed project boundary that was purposely located exterior of the Native Outwash Prairie boundary. The Native Outwash Prairie was delineated by ELS staff and surveyed per Thurston County Code, refer to Habitat Management Plan For Maytown Aggregates Thurston County, Washington, August 1, 2002. Additionally, a voluntary 100-foot buffer has been established between the Native Outwash Prairie and the project boundary to further protect this priority habitat.
IMPACTS TO STREAMS, WETLANDS AND GROUNDWATER

Comment: How will this impact stream and wetland water levels?

Response: Pacific Groundwater Group (PGG) has updated the predicted water level changes based on a revised model that corrects a “glitch” in the modeling software, whereby a parameter for the conductance of the lake skins was written incorrectly for confined layers. The software manufacturer has acknowledged the error and has issued a revised model that corrects the problem. The full revised analysis will be reported by PGG in the near future.

PGG’s new data are based on the corrected software and predict the water level change at full development with an expected lake bed skin of 0.7 feet of silt. Based on PGG’s corrected model, the average, annual water levels in Beaver Creek and Fingers 3 and 4 of Wetland A will slowly rise, whereas water levels in Finger 1 of Wetland A will drop slightly over a 20-year period. These water level changes will occur very gradually over the 20-year life of the mine. Using the corrected software, the predicted stream and wetland water level changes at full development are as follows:

<table>
<thead>
<tr>
<th>Monitoring Location</th>
<th>Average, Annual Water Level Change with Expected Skin after 20 Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Finger 4 (F4)</td>
<td>+1.1 feet</td>
</tr>
<tr>
<td>Finger 3 (F3)</td>
<td>+0.7 feet</td>
</tr>
<tr>
<td>Beaver Creek and Finger 4 (BF4)</td>
<td>+0.5 feet</td>
</tr>
<tr>
<td>Finger 1 (F1)</td>
<td>-0.3 feet</td>
</tr>
</tbody>
</table>

1 Positive = increase in water levels
Negative = decrease in water levels

The data presented above represent the average, annual change in water level at full development with the same lake bed skin used in prior base-case simulations. Contrary to findings prior to the model corrections, less side-wall siltation or reduction of inter-pit berms would temper the water level change and help the predicted water level effect approach zero change.

Comment: Have wildlife and wetland scientists had adequate opportunity to ascertain the potential impacts to plants and wildlife?

Response: Since our initial involvement in the Maytown Aggregates project in May 2002, we have surveyed the entire project area for sensitive species and habitats, researched sensitive species’ literature, and communicated with agency staff on species and habitat issues. We conducted a total of eight field visits between May 2002 and June 2004. ELS staff delineated the on-site wetlands and native outwash prairie boundary in 2002. We surveyed Allen and Beaver Creek and their associated wetlands in April 2004. Under a
previous development proposal in 1995-1996, ELS staff also surveyed the property for wetlands and streams. Furthermore, we consulted with agency staff for expert knowledge on the Oregon spotted frog, Olympic mudminnow, and howellia. The experts include:

- Kelly McAllister, District Wildlife Biologist, Washington Department of Fish and Wildlife
- John Gamon, Natural Heritage Program Manager, Washington Department of Natural Resources
- Steve Shelly, Regional Botanist, U.S. Forest Service Region 1 in Montana
- Lynh Davis, Botanist, Flathead National Forest in Montana
- Scott Mincemoyer, Botanist, Montana Natural Heritage Program

We have had adequate time to determine the potential impacts to plants and wildlife based on the data available to us to date, which includes PGG’s corrected hydrogeological data and our field surveys, literature review, and consultation with experts. We anticipate no substantial impact to plants and wildlife because the corrected water level data predict that the average, annual water level change will be gradual over the life of the mine and will be able to approach zero effect based on simulations of the expected lake bed skin versus no lake bed skin. We are in the process of revising our sensitive species analysis based on PGG’s corrected hydrogeological data and it will be issued in the near future.

Sincerely,

Ecological Land Services, Inc.

Francis Naglich, Wetland Biologist

Roy Garrison, Soils & Reclamation Specialist

Mara McGrath, Botanist
MAYTOWN AGGREGATES
SECOND SUPPLEMENTAL REPORT TO
THE HABITAT MANAGEMENT PLAN
Clarification and Response To Thurston County MDNS

For
Maytown Aggregates
Thurston County, Washington

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September 23, 2005
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Figure 2   Estimated Water Elevations By Historical Aerial Photo Analysis
INTRODUCTION

Ecological Land Services, Inc. (ELS) has prepared this supplemental report in response to Thurston County’s letter to J. M. Allen of Allen and Company, LLC dated 8 June 2004. The first comment in that letter asks for a “back up plan” for the lake effect in the event that the previously proposed measures to mitigate the lake effect were not effective. Pacific Groundwater Group (PGG) has corrected a software error in their modeling and determined that previous analyses likely over-stated hydrologic effects. The corrected hydrologic analysis predicts that the lake effect will develop slowly over the 20-year mining period and the seasonal effects will be so small as to be insignificant. A hydrologic effects analysis is presented in PGG’s September 2005 letter report.

This supplemental report addresses the predicted maximum water elevation change at full development of the lake pits (20 years) with 1) the expected, unmitigated lake skin (average of 0.7 feet of silt) and 2) no lake skin. This report also analyzes the effects of the predicted long-term water elevation change on three sensitive species and their habitats — howellia (Howellia aquatilis), Oregon spotted frog (Rana pretiosa), and Olympic mudminnow (Novumbra hubbsi). Howellia is a state and federally listed threatened species. Oregon spotted frog is a federal candidate species and a state endangered species. Olympic mudminnow is a state sensitive species, but has no federal designation. Both the Oregon spotted frog and the Olympic mudminnow are County-designated important species; howellia is not.

Wetland A, located in the southern portion of the property, has four fingers identified as Fingers 1 through 4 moving west to east. We conducted additional field work in Wetland A to assess wetland topography and the impact of potential water elevation changes in more detail. We also surveyed three cross-sections through Finger 4, Wetland A and one cross-section through Finger 1, Wetland A to obtain profiles of the wetland topography and to document the water elevations on 22 June 2004 and 13 July 2005. We investigated Fingers 1, 2, 3, and 4 of Wetland A for the preferred habitat required for the three identified species. Fingers 1, 2, and 3 lacked water and preferred habitats for these species.

We also worked extensively with representatives from the Black Hills Audubon Society, The Nature Conservancy, the Capitol Land Trust and their consultants Drs. Sarah Cooke and Joel Massman (collectively referred to as the “Conservation Organizations”), as well as biologists from the Washington Department Fish and Wildlife and the Washington Department of Natural Resources to identify potential mining impacts and appropriate actions to mitigate mining effects. The habitat assessment contained in this report and ELS’s April 2004 report were used by the science and stakeholder teams in reaching an agreement to establish a conservation fund to be used by the Conservation Organizations.
The habitat monitoring proposed in ELS's April 2004 report (p. 24) is no longer necessary because Allen & Company, LLC has reached an agreement with the Conservation Organizations that accommodates the mining related concerns. A conservation fund was established as a part of the agreement, which can be used for enhancement, monitoring, and/or restoration of habitats as deemed appropriated by the Conservation Organizations. The conservation fund can be used regardless of whether the action is in response to mining.

**BASELINE WATER ELEVATION FLUCTUATIONS IN FINGER 4**

The 2.5-year baseline groundwater data from PGG (2005b, 2004) indicate that Finger 4 of Wetland A is a dynamic system and naturally fluctuates in response to changing seasonal and climatic conditions. Between June 2002 and February 2005, Finger 4 fluctuated approximately 5 feet vertically and at least 30 feet horizontally as measured at a surveyed stage gage and piezometer located about 10 feet waterward from the northern bank of Finger 4 near Oak Area 1. The highest water elevation occurred in December during the 2.5-year monitoring period; the lowest water elevation occurred in October over the same period. Fluctuations in groundwater levels exceeded 8 feet upgradient of Finger 4 during the monitoring period (PGG 2004). Our aerial photo review corroborates PGG's baseline data and demonstrates that water elevations have fluctuated widely over the past six decades (Figure 2; ELS 2004). The aerial photo analysis indicates that Finger 4 naturally exhibits much variability in the timing and seasonality of water elevation changes.

**PREDICTED WATER ELEVATION FLUCTUATIONS IN FINGER 4**

**LAKE EFFECT**

Based on PGG's updated hydrologic analysis (2005a), the main effect from the proposed mining is the long-term “lake effect,” which is caused by the flattening of the hydraulic gradient as the aquifer is turned into lakes. The lake effect will contribute to a change in water elevation that develops slowly over time as the lakes are created, but is not seasonal. According to PGG's updated model with the corrected software (2005a), the lake effect will cause water levels to slowly rise on the upgradient side of the mine and to slowly decline on the downgradient side of the mine over the long-term, assuming the expected, unmitigated lake skin of 0.7 feet of silt. For instance, the long-term, maximum water levels in Beaver Creek and Fingers 3 and 4 of Wetland A will slowly rise, whereas water levels in Finger 1 of Wetland A will drop slightly over the 20-year mining period. Specifically in Finger 4 of Wetland A, groundwater is predicted to rise 0.1 feet by year 5 with one pit open, 1.2 feet in year 14, and settle back to a 1.1-foot rise in subsequent years.

In contrast to the unmitigated lake skin condition, the water elevations are predicted to decline on the upgradient side of the mine and increase on the downgradient side of the mine for the no lake skin model. The “no lake skin” scenario simulates the lake
effect where no skin of silt is formed from the mining activity and no reduced berm permeability occurs from sloughing of the lake walls. At full development of the mine after 20 years, the water elevations are predicted to decline about 1.9 feet in Finger 4 of Wetland A with the no lake skin condition. This represents a theoretical, worse-case scenario; PGG does not consider it to be a realistic scenario (PGG 2005a).

PGG’s revised letter report (2005a) present the 20-year trend in water level changes with the expected, unmitigated lake skin and no lake skin conditions. Like the previous simulations, the revised model predicts a gradual change in water elevations that develops slowly over the 20-year mining period and becomes more pronounced as pits closer to Finger 4 of Wetland A are developed.

SEASONAL EFFECT
The existing seasonal fluctuations in water elevations range widely in Wetland A and Beaver Creek, for instance, Finger 4 fluctuated approximately 5 feet between the high and low water elevations during a 2.5-year monitoring period (PGG 2005b, 2004). The annual “seasonal effects,” which are caused by changes in the timing and magnitude of groundwater recharge, will change very little from present conditions with all eight lakes developed. The revised model with the expected lake skin and no lake skin scenarios result in less than a 0.1-foot seasonal change compared to existing conditions. Consequently, the predicted seasonal effect will be negligible and will be difficult to filter out from the existing variations in groundwater levels. PGG (2005a) concludes that the seasonal effects are insignificant.

HISTORICAL AERIAL PHOTO ANALYSIS
To obtain a historical perspective of seasonal water level fluctuations within Finger 4 of Wetland A, ELS staff reviewed all available aerial photographs taken of the site since 1941. Each aerial photo, except for the July 1941 photo, was labeled with a specific date on which the flight occurred. The labeled flights ranged between January (1997) and September (1960). By visually interpreting the coverage of water within the deeper ponds in Finger 4 of Wetland A, which is profiled in the Figure 1 cross-section, it is possible to estimate the water elevation for each date on which a photo was taken. The estimated water elevations for each “snapshot in time” were then plotted on Figure 2. The combined spring precipitation (March, April and May) for that particular year as recorded in the Olympia WSO AP (WRCC 2004) is listed in parentheses following each aerial photo year.

Figure 2 compares particular years, such as 1960 with 1967, and 1993 with years 1999 and 2002. Note that 1960 and 1967 aerial photos exhibit similar estimated water elevations (210.5 feet) within the wetland; however, the 1960 photo was taken in September and the 1967 photo is in July. With an assumed seasonal water elevation drop occurring yearly and each photo providing a “snapshot” along that seasonal decline, we estimate that the water elevation decline occurred two months
later in 1960 than in 1967. This may correlate with the spring (March-May) precipitation of these two comparison years; precipitation was 14.15 inches in 1960 and 7.44 inches in 1967. Roughly the same comparison can be made between years 1993 and 1999 (or 2002). In 1993, the approximate 211-foot water elevation occurred in mid-August, whereas in 1999 and 2002, that water elevation occurred in mid-May to early June, a difference of 2.5 to 3.0 months. Here again, there is an apparent correlation between spring precipitation, which was 16.19 inches in 1993 compared to 9.91 inches and 11.3 inches in years 1999 and 2002, respectively. This historical aerial photo analysis suggests that there is much variation between years in the rate of water elevation decline in Finger 4 of Wetland A. Between the years compared, similar water elevations within an annual seasonal water elevation drop can differ as much as three months. There also appears to be a correlation between the amount of spring precipitation and the water elevation within the wetland from the late spring to early fall. Higher spring precipitation correlates with later seasonal water elevation decline.
HOWELLIA ANALYSIS

DISTRICTION
Howellia (*Howellia aquatilis*) is currently identified in scattered populations in Washington, Oregon, Idaho, California, and Montana (Vrilakas 2004; Shelly and Gamon 1996; Gamon 1995). The largest known populations are located in Montana. In Washington, populations of the species have been identified in Clark, Pierce, Spokane, and Thurston counties.

HABITAT REQUIREMENTS
Howellia is an aquatic winter annual with submerged and floating stems that grows in wetlands with firm, shallow consolidated clay and coarse organic sediments that are generally less than about 10 inches deep (Lesica 1990). The species is found in shallow water and the margins of deeper wetlands associated with glacial potholes and former river oxbows that become dry late in the season, such as small vernal pools, ponds, and sloughs. Howellia favors small ponded areas with little or no aquatic vegetation, although it has been found growing in reed canarygrass-dominated (*Phalaris arundinacea*) areas in Washington (Gamon 2004; USFWS 1994; Lesica 1990; Shelly and Moseley 1988). The ponds typically are surrounded by deciduous trees and shrubs, such as Oregon ash (*Fraxinus latifolia*), red-osier dogwood (*Cornus sericea*), black cottonwood (*Populus balsamifera* spp. *trichocarpa*), and common snowberry (*Symphoricarpos albus*) (Gamon 1995; Shelly and Moseley 1988). The wetland habitats that support howellia are filled by fall, winter, and spring rains and become dry during the late growing season (Shelly and Gamon 1996). Unlike most other aquatic plants, howellia requires a late growing season water level decline that exposes substrates for its seeds to germinate.

LIFE HISTORY
The self-pollinated seeds of howellia germinate in the late summer-fall when exposed to the air and fluctuating cool temperatures (Gamon 1995; Roe and Shelly 1992; Lesica 1992; Lesica 1990). After germinating, the plants overwinter as seedlings. The species begins active growth in early April in western Washington lowlands and flowering typically occurs May through August (Shelly and Gamon 1996; Gamon 1995). Howellia forms self-pollinating submergent flowers that develop underwater early in the spring and can produce fruits as early as May in western Washington (Shelly and Gamon 1996). As the growing stems mature, the plant forms emergent flowers that develop above the water surface usually in late June through August. The submergent seeds typically are dispersed beginning in June and extending, along with the emergent seeds, through the late summer (Shelly and Gamon 1996). The reproductive biology varies depending on macro-climatic conditions; Gamon (2004) has observed howellia producing new flowers and fruits in late August and early September in western Washington. After dispersing its seeds, howellia generally
deteriorates when the water completely evaporates from the wetland, which varies in seasonal timing depending on the macro-climate conditions.

The early submergent and later emergent flowers may ensure that some seeds will be mature enough to reproduce in case of early season drying, which would help hedge against excessively dry years (Shelly 1997). That is, the early and rapid development of submergent flowers allows the species to reproduce in years with an earlier water level decline than normal (Shelly and Gamon 1996). In years with more water, in contrast, the later development of emergent flowers essentially extends the length of time the seeds are produced. The relatively large seeds (0.2 to 0.5 inches long) do not have any physical appendages for dispersal and likely sink near the plant. Some authors suspect that howellia seeds may be dispersed by wildlife either through ingesting or by becoming physically lodged along with sediments in the feet of birds and mammals (Shelly and Moseley 1988). Wildlife vectors also would help explain the species' scattered distribution. Additionally, free-floating fragments of the species have been observed detached from the main plant and floating on the water surface. These free-floating fragments may provide a possible method of fruit dispersal whereby small currents move the fragments, which continue to flower and fruit, to other parts of the wetland (Gamon 2004; Shelly 2004).

Roe and Shelly (1992) have observed that howellia seeds are viable for several growing seasons. Thus, the seeds can remain dormant and delay germinating until the proceeding growing season, provided that the macro-climatic conditions are favorable. The ability of the seeds to remain viable for several years and create at least a short-term seed bank likely helps the species to survive years with excessively wet or dry conditions (Shelly and Gamon 1996).

The annual cycle of inundating and drying, as influenced by the preceding climatic conditions, controls howellia’s lifecycle and distribution (Shelly 2004; Lesica 1996; Gamon 1995; Roe and Shelly 1992). Howellia requires a hydrologic pattern of inundation in the fall, winter, and spring for growth and exposed substrates in the late summer-fall for reproduction. As a result of the macroclimatic influence on reproduction, the species has a highly variable population size that can change rapidly based on the amount of drying the previous growing season (Shelly 1997; Lesica et al. 1988). Mantas (2002) documented that the annual exposed zone determines the area available for germination and directly affects the current distribution of the species. Thus, successive years of excessively wet or dry conditions would likely lower populations (Shelly and Gamon 1996). Other studies have documented that the size of an annual population is affected by the extent of the previous growing season's water level decline. The amount of water, as measured by precipitation or pond water depths, appears to be inversely correlated with population size (Mantas 2002; Roe and Shelly 1992).
In typical years with average precipitation and normal water level decline, howellia germinates in the fall on exposed substrates and when fluctuating cooler temperatures occur. In contrast, in years with insufficient water level decline, the high water and lack of aerobic conditions prevents or reduces seed germination. Thus, howellia populations tend to be lower following a wet year, as measured by deeper pond depths (Roe and Shelly 1992) and percent cover (Lesica 1997, 1996). In high precipitation years, the seeds are dispersed but remain dormant until the following growing season, thereby avoiding the unfavorable hydrologic conditions. In years with early water level decline, however, the species may maximize the available exposed substrates and aerobic conditions by germinating earlier in the season than normal if the temperatures are favorable, e.g. cool and fluctuating. Consequently, howellia populations tend to be higher following a dry year and early water level decline, as measured by lower pond depths (Roe and Shelly 1992).

HABITAT ON-SITE
In June 2004, we re-assessed portions of Wetland A to determine if suitable howellia habitat exists. Fingers 1, 2, and 3 of Wetland A are dominated by forested and scrub-shrub vegetation (ELS 2002) and lack inundated areas that could support howellia; therefore, these fingers of Wetland A do not provide suitable howellia habitat. Finger 4, however, is a mosaic of scrub-shrub and emergent vegetation and does provide howellia habitat (Figure 1). Finger 4 was inundated with several inches of water along its perimeter and over 5 feet in deeper open water areas during our June 2004 field visit. We surveyed the northern perimeter of Finger 4 of Wetland A, a distance of about 2,000 feet or 0.40 miles, with John Gamon, Natural Heritage Program Manager for the Washington Department of Natural Resources. We waded along the shore in water depths of several inches to about 2.5 feet and visually inspected the inundated areas for howellia. We located two main areas of howellia along the northern margins of Finger 4. The first howellia observation consisted of several to many individuals growing in association with reed canarygrass. The second howellia observation consisted of approximately 30 individuals scattered along the shore in average water depths of 0.8 feet during our field visit. The howellia population within Finger 4 likely is categorized as "low," according to the abundance classes established by Mantas (2002).

Based on a literature review, aerial photo analysis, and our field survey, suitable howellia habitat is located along the shoreline of Finger 4 and toward its interior in areas that typically dry during the late growing season (Figure 1). The suitable howellia habitat on-site ranges from several inches to about 2 feet water depths based on the water elevations at the time of our field survey (Figure 1). The suitable howellia habitat in Finger 4 varies based on annual changes in hydrology due to the macro-climate. The literature reports typical water depths of 0.8 to 3 feet for suitable howellia habitat (Shelly and Gamon 1996; Roe and Shelly 1992), although the species has been occasionally observed in depths of up to 6 feet (Shelly and Gamon; Lesica et al. 1988).
The on-site suitable howellia habitat also is located in areas that have deciduous scrub-shrub vegetation, which is consistent with typical howellia habitat recognized in the literature (USFWS 1994; Shelly and Moseley 1988). Based on our field observations, we have also correlated the suitable habitat of howellia more or less with the distribution of reed canarygrass (Figure 1). Reed canarygrass tolerates fluctuating water elevations but does not withstand year-round inundation (Cooke 1991), and may be a species that is indicative of water regimes similar to howellia. If so, the existing distribution of reed canarygrass may approximate the suitable habitat for howellia in Finger 4, although the more shaded areas along the shore have less reed canarygrass and still likely afford suitable howellia habitat (Figure 1).

In the past, the on-site habitat for howellia likely differed from today’s suitable habitat. Historical aerial photos of the 1940s and 1950s show that Finger 4 of Wetland A was a mixed coniferous-deciduous forested wetland. Western redcedar snags present in Finger 4 today are remnants of the once forested wetland. Finger 4 has obviously transitioned from forested vegetation to scrub-shrub and emergent vegetation as water elevations increased, most likely due to beaver activity. We assume that howellia was historically present in the wetland but occupied other suitable niches, such as along the fringes of the deeper ponds and other deeper depressions within Finger 4. Some of the deeper ponds are profiled in the cross-section of Finger 4 (Figure 1).

**Impact Assessment**

Howellia is located in Finger 4 of Wetland A; Fingers 1, 2, and 3 of Wetland A do not provide suitable habitat. Howellia is rare among aquatic plants in that its seeds will not germinate unless exposed to the air. Thus, the species requires a late summer-fall water level decline that exposes substrates and coincides with fluctuating cooler temperatures to reproduce. As described previously, the species can tolerate a drying cycle that occurs over a range of months in the late summer-fall because it has adapted several strategies (submerged/emergent flowers and seed viability over several seasons) to buffer against water cycles that depart from the norm, such as excessively wet or dry conditions. Howellia also appears to be adaptive to changing habitat conditions—either too wet or too dry—and we assume that the species historically occupied other suitable niches within the wetland when Finger 4 was less wet and was dominated by deciduous and coniferous trees.

The hydrologic cycle within Finger 4 of Wetland A is dynamic and has naturally fluctuated for many years due to the changing macro-climate and beaver activity. The PGG baseline data for 2002-2005 demonstrate that the water elevations in Finger 4 fluctuate widely (approximately 5 feet). The lowest water elevations in Finger 4 occurred in October based on the 2.5-year baseline data (PGG 2005b, 2004). The highest water elevations occurred in December over the same period. Our aerial photo analysis over a 60-year period corroborates that the water elevations have
fluctuated widely, and also shows a trend of increasing water elevations, most likely due to beaver activity (Figure 2). As explained in our April 2004 supplemental report (ELS 2004), beavers have hydrologically manipulated the wetland system and, coupled with the natural seasonal water level decline, likely have contributed to the favorable habitat for howellia in Finger 4 of Wetland A.

Based on PGG’s hydrologic data, our review of literature and aerial photos, consultation with agency botanists, and field survey results, the proposed project is not likely to adversely affect howellia or its suitable habitat. We have employed our best professional judgment, given the inability to predict the macro-climate and beaver activity, in making the effect determination for howellia. The effect determination is based on the updated hydrologic model in two scenarios: one that assumes all eight pit lakes are developed with the expected, unmitigated lake skin and one that assumes no lake skin (PGG 2005a). This effect determination is warranted because:

- Assuming the expected lake skin and no mitigation condition, the predicted long-term water elevation increase in Finger 4 of Wetland A is a maximum of 1.1 feet from existing conditions. The long-term water elevation increase represents the maximum predicted increase. The water elevation increase with the expected skin condition will continue to provide areas of inundation during the growing season and exposed areas for germination during the late summer-fall based on the profile shown in Figure 1. Consequently, the predicted water elevation increase will not significantly impact howellia habitat.

- Assuming the no lake skin condition, the long-term water elevation decrease in Finger 4 of Wetland A, is a maximum of 1.9 feet from existing conditions. The long-term water elevation decrease represents the maximum possible decrease at full development of the mine; this is an extreme case and the actual water elevation change is predicted to be closer to zero. Nevertheless, the simulated maximum water elevation decrease with the no skin condition will continue to provide inundated areas during the growing season and exposed areas for germination during the late summer-fall based on the profile shown in Figure 1. Therefore, the water elevation decrease under the extreme, no lake skin condition will not significantly impact howellia habitat.

- The predicted annual seasonal change is less than 0.1 foot and is not substantially different from existing conditions. The lowest seasonal water elevations that expose substrates will continue to occur in late summer and fall when howellia requires aerobic conditions for its seeds to germinate.

- Wetland A, including Finger 4, will have a 300-foot no-disturbance buffer. This buffer will continue to allow wildlife to migrate through the wetland and its buffer and potentially disperse seeds of howellia to other parts of Finger 4.
As shown by historical analysis, suitable habitat for howellia has remained even with significant fluctuations in water elevations caused by naturally occurring conditions—including both beaver damming activities and microclimatic changes (Figure 2). The project proposes water elevation changes that are within the range of naturally occurring fluctuations and, thus, will not significantly impact howellia habitat.
OREGON SPOTTED FROG & OLYMPIC MUDMINNOW ANALYSIS

HABITAT ON-SITE
Beaver Creek, Allen Creek, and Wetland A are the areas that currently have habitat to support the Oregon spotted frog (*Rana pretiosa*) and Olympic mudminnow (*Novumbra hubbsi*). These areas provide a mosaic of open water and emergent vegetation during the appropriate times of the year that is necessary to support these species. The remaining area within the wetland system, e.g. Fingers 1, 2, and 3, have forested and scrub-shrub vegetation with inadequate open water to provide sufficient habitat to support either species. The following information provides a synopsis of the Oregon spotted frog and Olympic mudminnow habitat and their sensitivity to water elevation changes.

OREGON SPOTTED FROG HABITAT REQUIREMENTS
The Oregon spotted frog inhabits marshes and marshy edges of ponds, streams, and lakes (Nordstrom and Milner 1997). This highly aquatic frog seldom strays from standing water (McAllister and Leonard 1997). According to Lehnard *et al.* (1993), the Oregon spotted frog is frequently found in or near a perennial water body, such as a spring, pond, lake or sluggish stream, and is most often associated with nonwoody wetland plant communities. Watson *et al.* (2000) report that frogs prefer areas that have moderate open water (50-75 percent water) and emergent vegetation components, and avoid areas with dense vegetation and expansive open water. According to Watson *et al.* (2000), Oregon spotted frog habitat should include the following features: 1) an extensive (at least 20 acres), contiguous, and shallow palustrine emergent wetland habitat, 2) a low gradient stream course or ditch that drains the wetland, and 3) high seasonal hydrologic fluctuations so that surface water is extensive in winter and early spring and extremely limited in late summer.

Oregon spotted frogs breed in the warm, shallow margins of marshes, ponds, or rivers, or in temporary pools. The same breeding site may be used in successive years. Eggs are laid in water that is less than 12 inches deep. The rounded masses, usually half-exposed to direct air, are not attached to vegetation, but rest on the bottom in shallow water (Nussbaum *et al.* 1983). Based on the scenarios of developing all eight pits lakes with the expected, unmitigated lake skin or the no lake skin, the lowest annual water elevation will continue to be in late summer and fall (PGG 2005a). The low water elevation period is beyond the period to potentially strand Oregon spotted frog eggs or tadpole. The tadpole metamorphose and become small frogs in late June and early July, at which time they are mobile and able to move overland, for short distances, to more permanent pools to escape drying conditions. Watson *et al.* (2000) found Oregon spotted frogs throughout the year in surface water with temperatures averaging 14.7 °C (mean monthly range = 5.6 to 19.1 °C) and average subsurface temperature of 13.4 °C (mean monthly range = 6.1 to 18.5
°C). Embryo mortality occurs if water temperatures fall below 7 °C (45 °F) or rises above 28 °C (82 °F).

**OLYMPIC MUDMINNOW HABITAT REQUIREMENTS**

Habitat requirements for the Olympic mudminnows are usually found in slow-moving streams, wetlands, and ponds. Three habitat characteristics appear to be required for this species: 1) several centimeters of soft mud bottom substrate, 2) little to no water flow, and 3) abundant aquatic vegetation. If any of these habitat characteristics were missing, no mudminnows were found (Mongillo and Hallock 1999, Friese 1972).

Mongillo and Hallock (1999) investigated other habitat variables influencing the Olympic mudminnow and found that the mudminnow had a restricted tolerance range of water current and salinity. In habitats with suitable current and salinity, the amount of light was the most important factor, followed by substrate type (mud), plants, and temperature. These variables are important all year, but Mongillo and Hallock observed that an interaction among them during the summer was even more important. Low tolerance to water current has restricted Olympic mudminnows to lowlands. Generally, as elevation increases so do slope and water current. Over 60 percent of the mudminnow collection sites are under 162 feet elevation (Mongillo and Hallock 1999).

**IMPACT ASSESSMENT**

Oregon spotted frog and Olympic mudminnow prefer similar environmental conditions and habitat. Because the frog has been documented to inhabit the areas within the subject drainages, it is likely that the Olympic mudminnow is also present. Based on the information gathered from the literature search for these species and a field evaluation of the existing habitat and environmental conditions, it is determined there is abundant preferred habitat for both the Oregon spotted frog and the Olympic mudminnow in Wetland A and its associated stream systems.

Based on PGG’s hydrologic data, our review of literature and aerial photos, consultation with a wildlife biologist, and field survey results, the proposed project is not likely to adversely affect either the Oregon spotted frog or the Olympic mudminnow or their suitable habitat. We have employed our best professional judgment, given the inability to predict the macro-climate and beaver activity, in making the effect determination for these two species. The effect determination is based on the updated hydrologic model in two scenarios: one that assumes all eight pit lakes are developed with the expected, unmitigated lake skin and one that assumes no lake skin (PGG 2005a). The effect determination is warranted because:

- Assumining the expected, unmitigated lake skin and no mitigation scenario, the maximum predicted long-term rise in water elevations of approximately 1 foot in Finger 4 of Wetland A (approximately 0.5 feet in Beaver Creek) will have little to no negative effect on either of these species’ preferred habitat. In fact, any long-
term water level rise may actually cause a small increase in the area of preferred habitat for both of these species.

- Assuming the extreme no lake skin condition, the maximum, long-term decline in water elevations of approximately 1.9 feet in Finger 4 of Wetland A (approximately 1 foot in Beaver Creek) will have little to no negative effect on either of these species’ preferred habitat because water levels will continue to provide suitable habitat and the lowest water elevations will continue to occur in the late summer-fall, beyond the time period to cause stranding of eggs or tadpoles.

- The predicted seasonal effect is less than 0.1 foot and is, therefore, not significant (PGG 2005a) and will not affect the preferred habitat for these species.

- Observed beaver activity within the drainages of Beaver and Allen Creeks and their associated wetlands has revealed significant alteration in water elevations over the last 60 years. Nevertheless, preferred habitat continues to flourish even with significant fluctuations in water elevations caused by naturally occurring conditions (Figure 2). It is obvious beavers are physically controlling water elevations in these drainage systems, increasing ponding and water depths, as well as expanding the wetland boundaries into adjacent areas by their continued damming activity.

- Wetland A will have a 300-foot no-disturbance buffer. This buffer will protect the wetland and its associated drainages, including areas that contain preferred habitat for the Oregon spotted frog and the Olympic mudminnow.

Due to the conditions discussed above, it is our professional opinion that preferred habitat for the Olympic mudminnow and Oregon spotted frog will remain with the predicted rise in water elevations with the expected lake skin and no mitigation condition or the predicted decrease with the no lake skin condition. This is in consideration of the extent of habitat already available and the natural fluctuations in water elevations occurring from annual climatic changes and alterations to the drainage caused by beaver activity. This opinion is based on the scenario of all eight pits developed and an expected, unmitigated lake skin with a maximum 1.1-foot rise in Finger 4 of Wetland A over the long-term or the maximum 1.9-foot decline in Finger 4 with the no lake skin condition (PGG 2005a). The predicted maximum, long-term water elevation changes are less for Beaver Creek. In any event, it can be expected that beaver damming will continue to largely control water elevations in the aforementioned drainage systems thereby minimizing potential effects of mining by controlling the amount of water and the duration of ponding that occurs in the system. Beaver damming has increased the Olympic mudminnow’s potential habitat and decreased the potential for stranding of the
minnow. As history has shown, beaver activity within these drainages is actually increasing preferred habitat for the Olympic mudminnow and Oregon spotted frog.

REFERENCES


Gamon, J. June 22, 2004 and July 9, 2004. Field visit on-site and email correspondence with John Gamon, Natural Heritage Program Manager for the Washington Department of Natural Resources. Olympia, Washington.


Pacific Groundwater Group (PGG). April 6, 2005b. Personal correspondence with Charles Ellingson regarding additional baseline hydrograph data.


Vrilakas, S. 14 June 2004. Email correspondence with Sue Vrilakas, Botanist/Data Manager, Oregon Natural Heritage Information Center, Oregon State University. Portland, Oregon.


FIGURES
Figure 2
Estimated Water Elevation by Historical Aerial Photo Analysis
Portion of Sec. 1, 2, 3, 11 & 12, T. 16N, R. 2W, W.M.
Thurston County, Washington
Monroe Waterfront Improvement Plan

Estimated water elevation in feet above sea level (NGVD 29)

1. Estimated water elevation at northern part of Finger 4 of Wetland A in select years between 1941 and 1999. Data
(March-April-May) for a given year based on monthly total
precipitation data by the Western Regional Climate Center. Olympia WSP AP, Washington.

2. Numbers in parentheses are combined spring precipitation.

3. NA = Not Applicable
ND = No Data.

NOTES: