Attachment C

PP12 Well Test Data
Pacific Powder Pump Test

Log Time Since Pumping Started (min)

\[ T = \frac{2.3 \cdot 10^{-5} \Delta (h_o - l)}{4 \pi \Delta (h_o - l)} = \frac{2.3 \cdot (86.2 \cdot 0.51^3/\text{day})}{4 \pi \cdot (0.62 \cdot 0.51^3)} = 241.489.6 \text{ ft}^3/\text{day} \]

\[ \Delta (h_o - l) = (44.73 - 45.12) = 0.39 \text{ ft} \]
Pacific Powder Pump Test

Log Time Since Pumping Started (min)

\[ T = \frac{2.3 \cdot Q}{4\pi \Delta (L_s - L)} = \frac{(2.3) \cdot 150 \cdot \text{gpm}}{4\pi (0.23\text{ft})} = 68.632 \text{ gpm} \]
Pacific Powder Well 6 Hand Measurements

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<tr>
<td>8/14/1997 11:28</td>
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Pacific Powder Well 12 Hand Measuremens

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</tbody>
</table>
FIGURE B-4
CHANGE IN WATER LEVEL FOR OLD WELL SINCE JULY 28, 1993
FIGURE B-5: MW-1, NEUMAN’S DELAYED YIELD

\[ T = 2.375 \text{ ft}^2/\text{min} \]
\[ S = 1.65 \times 10^{-5} \]
\[ S_y = 0.0083 \]
\[ \beta = 0.000127 \]
Attachment E

Groundwater Model
Attachment F

Groundwater Monitoring Plan
Attachment F

Groundwater Monitoring Plan

This groundwater monitoring plan is divided into two main sections: groundwater level monitoring, and groundwater quality monitoring.

No new well installations are necessary for either program. However, as a result of the site-wide contamination investigation, new monitoring wells may be established in the near future. The list of monitoring stations will be reviewed after completion of the site-wide investigation. Replacement of stations proposed herein may be warranted at that time.

Groundwater Level Monitoring

Monitoring Stations

The following stations will be used to monitor groundwater and wetland water levels:

<table>
<thead>
<tr>
<th>Wells</th>
<th>Surface Water Stations</th>
</tr>
</thead>
<tbody>
<tr>
<td>MT-5</td>
<td>DL1</td>
</tr>
<tr>
<td>MT-6</td>
<td>BC1</td>
</tr>
<tr>
<td>MT-9</td>
<td>BC2</td>
</tr>
<tr>
<td>MT-10</td>
<td>wetA1</td>
</tr>
<tr>
<td>MT-11</td>
<td></td>
</tr>
<tr>
<td>PP08</td>
<td></td>
</tr>
<tr>
<td>PP10</td>
<td></td>
</tr>
</tbody>
</table>

All wells will be physically secured to prevent entry or vandalism. Measuring points will be clearly marked and surveyed to NGVD29 datum. Unused wells will be decommissioned in accordance with Chapter 173-160 WAC regulations.

Monitoring Personnel

On-site personnel will perform the monitoring. A professional hydrogeologist will train the on-site personnel during an initial round of monitoring, and assist in setting up the data management system, as requested.

Water Level Monitoring Parameters

The time, date, measuring point, and depth-to-water will be recorded at each station, and the name of the person making the measurement. Also, related mine-activity data will be recorded to assist in the reporting discussed below.
Measuring depth-to-water in the wells will require the use of an electric water level sounder. Depth to water from the gaging stations will require a large hand tape. At wetAl, the height of water above the measuring point is read directly from the stage gage.

**Water Level Monitoring Frequency**

Water levels will be measured every other month at each station. Monitoring will begin under this program upon receipt of the mining permit and continue until one month after reclamation is complete. Monitoring will continue during periods of gravel-mine inactivity unless approved otherwise by the County.

**Data Management**

Copies of data collection forms will be kept on file at the site, or at another office of the owner. In addition, the owner will enter the data into a computer database which will record the date, time, person, and depth-to-water at each station.

**Data Analysis and Reporting**

The owner will summarize the mining and water monitoring activity in a report to the County every two years. The report will include:

- A map showing the extent of aggregate extraction (below the water table) at the beginning and end of the two-year period.
- A summary of water use during the two-year period.
- A table of water level data for the entire period of record.
- A plot of water levels over time for the entire period of record.
- Comments on mine activities or the monitoring program pertinent to interpretation of the data.

It is recommended that a hydrogeologist either generate the report or review the report and comment on the program at this two-year interval.

The owner will analyze the water monitoring data every second reporting period (every four years). The analysis will be summarized in an expanded report to the County and include the data and comments listed above plus:

- An analysis of water level changes or trends considering potential lake effects, effects from creation of additional storage, background (regional) water level changes, water level changes permitted under existing water rights, and other factors the owner recognizes as pertinent. Available regional background data include water levels
collected by Thurston County Department of Water and Waste Management as part of the Salmon Creek Basin Plan.

- Identification of significant adverse water level changes likely caused by the lake or storage effects.
- Recommended changes to sediment management in the lakes to mitigate consequential adverse water level changes, or alternative recommendations.

The report will be generated or reviewed by a professional hydrogeologist.

**Groundwater Quality Monitoring**

Many of the data recording and reporting requirements for water quality are the same as for water level monitoring. The database and reports should be combined when if convenient.

**Monitoring Stations**

The following production wells will be used to monitor groundwater quality:

PP02
PP04

PP02 is the supply well for the on-site residence and office. PP04 is one of the supply wells for the onsite industrial facilities. In both cases, samples will be collected from the spigot closest to the well (upstream of any storage or pressure tank that may be present).

All wells will be physically secured to prevent entry or vandalism. Measuring points will be clearly marked and surveyed to NGVD29 datum.

**Monitoring Personnel**

On-site personnel will perform the monitoring. A professional hydrogeologist will train the on-site personnel during an initial round of monitoring, and assist in setting up the data management system, as requested.

**Water Quality Monitoring Parameters**

Samples will analyzed for turbidity and temperature in the field. As an alternative, the operator may measure temperature in the field, but collect a sample in a container supplied by a State accredited laboratory, and send the sample to the lab in accordance with laboratory sample-preservation instructions.

The time, date, and sampling point will also be recorded at each station, and the name of the person making the measurement. Also, related mine-activity data will be recorded to assist in the reporting discussed below.
Measuring temperature and turbidity in the field will require the use of a scientific-grade thermometer and turbidity meter. The pumps in the wells must have been on for at least 5 minutes before the samples are collected.

**Water Quality Monitoring Frequency**

Water quality will be measured every other month at each station. Monitoring will begin under this program upon receipt of the mining permit and continue until one month after reclamation is complete. Monitoring will continue during periods of gravel-mine inactivity unless approved otherwise by the County.

**Data Management**

Copies of data collection forms will be kept on file at the site, or at another office of the owner. In addition, the owner will enter the data into a computer database which will record the date, time, person, water temperature and turbidity at each well.

**Data Analysis and Reporting**

The owner will summarize the mining and water monitoring activity in a report to the County every two years. The report will include:

- A map showing the extent of aggregate extraction (below the water table) at the beginning and end of the two-year period.
- A table of water quality data for the entire period of record.
- A plot of water quality trends over time for the entire period of record.
- Comments on mine activities or the monitoring program pertinent to interpretation of the data.
- Conclusions regarding changes or trends in water quality parameters.

It is recommended that a hydrogeologist either generate the report or review the report and comment on the program at this two-year interval.
update with info from J.
Looking West

**Legend**

- **Well ID** and **Owner**
  - **Drill Site**
  - **Drill Bore**
- **Water Level**
  - **Screened at**
  - **Open Interval**
  - **Bottom of Well**

**Boring Log Explanation**

- 1w = Gravel
- 2w = Sand
- 3w = Silt
- 4w = Clay
- 5w = Bedrock
- *'s = Modifier
- eg: 1,3w = sandy gravel and silt

**Hydrologic Units**

- Ovr = Yachan Reclusal
- Orr = Yachan Till
- Ovt = Yachan Advance Outwash
- Ott = Palmitolee Till
- Ovw = Palmitolee Advance Outwash
- BB = Bedrock

**Figure 5**

Hydrogeologic Section A-A'

Horizontal Scale in Feet
Vertical Exaggeration: 20X

Keytown Aggregates
J.M. Allen & Company LLC

Pacific Granite Group
Figure 10
Local Water Supply Wells

Well Density by Section, Quarter Section and Quarter-Quarter Section (see note)
- Section (gray)
- Quarter Section (yellow)
- Quarter-Quarter Section (black)

▲ Locations of nearby off-site buildings, probably served by wells not represented in Ecology records

Project Boundary
Ownership Boundary
Pit Boundaries
Pit Buffer (1,000 feet)

Roads
Streams
Sections

Note: Total number represents Washington State Dept. of Ecology well logs and corresponds to the number centered within each area of measure.
October 25, 2002

Tony Kantas
Thurston County Development Services
2000 Lakeridge Drive SW
Olympia, WA 98502-06045

Re: Maytown Aggregates Expanded Environmental Checklist
Response to Agency Comments

Dear Mr. Kantas,

This letter responds to comments offered by Department of Ecology and Thurston County Environmental Health on the Maytown Aggregates Expanded Environmental Checklist. The Ecology comments were communicated in a letter signed by Jeri Berube dated September 19, 2002. Although Ms. Berube signed the letter, we were referred to John Pearch of the Sand and Gravel Permit section for discussion of the technical comments. The Thurston County comments were communicated in memoranda from Robert Mead and John Ward, dated October 8 and 15, respectively. We met with John Pearch (Ecology) and Robert Mead (Thurston County Environmental Health) at the site on October 2, 2002 and discussed the project and comments.

We understand from these discussions that application to Ecology for an NPDES permit must follow the County-lead SEPA process and that SEPA review will continue when the comments have been addressed. The remainder of this letter summarizes our response to the comments as discussed with Ecology and the County. We trust that these responses are sufficient to allow resumption of the SEPA review process. If not, please contact me or J.M. Allen as soon as possible.

Ecology Comment No. 1: Water Monitoring and AKART

Water Monitoring
Water sampling will be conducted in conformance with the Sand and Gravel General NPDES Permit requirements along with related training of samplers and reporting. Sampling requirements include monthly testing of water in sedimentation ponds for pH, and daily visual examination for oil sheen.

In addition, the project will conduct quarterly groundwater monitoring nearby and down-gradient of the sedimentation ponds regardless of whether the volume of discharge to groundwater exceeds 15,000 gallons per day. Background samples will be collected from monitoring stations prior to mining. Groundwater analysis parameters will include temperature, specific conductance, turbidity, and possibly dissolved iron and manganese. We believe that the extensive hydrogeologic characterization conducted to date, plus the
background monitoring that will occur prior to mining, exceed the hydrogeologic standard for NPDES permitting and monitoring.

We propose collection of groundwater samples from existing on-site water supply wells because that type of well is better suited for collection of samples for turbidity and temperature analysis than are monitoring wells. Because supply wells are pumped frequently at a relatively high and consistent rate, they are well “developed,” and tend to produce water with temperature and turbidity that are representative of aquifer water. The dedicated pumps and other equipment in supply wells reduce the likelihood that personnel and equipment changes will result in data inconsistency. Monitoring wells are difficult to develop completely (they often remain “silty”) and are often sampled in inconsistent ways. Lack of complete development and the variations in sampling techniques and personnel often result in poor turbidity and temperature data from monitoring wells.

With substantial effort and cost it is possible to reduce the problems inherent with monitoring wells, but such efforts appear unnecessary given that the existing supply wells are in appropriate locations between the ponds and the (distant) off-site residential wells, are of appropriate depth (reported 38 and 36 feet for PP02 and PP04), and are likely to provide the most consistent data.

A revised water monitoring plan that incorporates these commitments and meets requirements of Section S5 of the Sand and Gravel General Permit will be generated as part of the NPDES permit application process.

Sand Liners as part of AKART
The operator will place a layer of sand along the sides and bottom of the sediment ponds to enhance settlement and filtration of fines within the ponds.

Ecology Comment No. 2: SWPPP and Monitoring Plan

A Stormwater Pollution and Prevention Plan (SWPPP) meeting requirements of Sections S9 of the Sand and Gravel General NPDES Permit, will be submitted in the NPDES application. A revised water monitoring plan that meets requirements of Section S5 of the Sand and Gravel General Permit will also be generated, as noted in response to Comment No. 1.

Ecology Comment No. 3: Aquifer Penetration and Appropriateness of the General Permit

As described in Appendix A to the Expanded Environmental Checklist, and discussed at the October 2 meeting, mining will occur only above the aquitard where the aquitard is substantial, and within the single combined aquifer that exists where the aquitard is absent. In between those areas the aquitard is thin and probably discontinuous. Mining is proposed both above and below the aquitard in that area. The hydrogeology of the site
indicates that mining above and below the aquitard will not cause hydraulic problems or water quality problems. Thus, the hydrogeology of the site supports application of the General Permit. The following paragraphs provide additional explanation.

The aquitard in question does not exist in portions of the upgradient (northeastern and eastern) areas of the site. Thus, a single thick aquifer exists in the upgradient areas and there is no reason to expect substantial vertical segregation of groundwater head or quality (although both will vary both horizontally and vertically). As the groundwater moves to the south and west, it enters an area near the eastern terminus of pits 3, 4, and 6 (figure attached) where a thin aquitard begins to separate upper and lower permeable zones. For instance, a shallow till-like aquitard was logged from 25 to 30 feet depth in MT-2, from 30 to 31 feet in MT-6, and was not present at PP12. Further west, at a boring near PP05, a silt/clay layer from 18 to 21 feet overlies a till-like silty sand and gravel from 21 to 30 feet, and at MT-1 a till-like aquitard is logged from about 27 to 44 feet depth. Note that both silt/clay lenses, and till-like layers have been included in this summary of aquitard occurrence. Near PP05 the aquitard materials occur very close to the seasonal low water table and the materials above the aquitard are not likely a viable water supply aquifer. Deeper till-like aquitard materials also occur on site rarely but are not penetrated by the proposed mine and should not be an NPDES permit issue.

Because a common source of upgradient water contributes to groundwater flow above and below the aquitard, stratification of groundwater quality is highly moderated. Although mixing of distinctly different waters will thus not occur as a result of this project, groundwater quality in glacial materials throughout the site generally meets drinking water criteria\(^1\) and downgradient groundwater users would, therefore, not be materially affected by such mixing.

The discontinuous nature of the aquitard also prevents substantial differences in head developing. For instance, there was only 0.37 feet of head difference over 73 feet of vertical separation between well PP08 and wetland A in June 2002. To the west where the aquitard is about 6 feet thick, the measured head at well PP06 contours perfectly with shallow groundwater heads, even though well PP06 is 183 feet deep and the water table is between 10 and 20 feet below grade. Both these sets of measurements indicate similar heads in the upper and lower permeable zones, regardless of the presence and thickness of the aquitard.

In summary, the mining plan has been developed with consideration of the site hydrogeology. Mining across the aquitard will not cause hydraulic or water quality problems, and, thus, the intent of the General Permit can be met.

---

\(^1\) Saline groundwater is known to occur in two instances on site, neither of which is related to the presence or absence of a shallow aquitard: 1) Well PP05 was reportedly a grounding well, and salt was likely poured into the well to increase its grounding effectiveness. That well is in very poor hydraulic connection with the aquifer and nearby groundwater is not saline. Well PP05 will be properly decommissioned as part of this project. 2) The limited groundwater within bedrock penetrated at the bottom of the borings for wells PP11 and PP12 had elevated specific conductance of over 1,000 uS.
County Environmental Health Comment No. 1
See the last paragraph of response to Ecology Comment No. 1 above.

County Environmental Health Comments No. 2 and 3
See response to Ecology Comment No. 3 above and the attached figure.

County Environmental Health Comment No. 4
See response to Ecology Comment No. 1 above. We believe our commitments to water monitoring expressed in the existing monitoring plan and this letter are clear and that they meet Ecology and County needs. Rather than maintaining a written plan that meets a moving target, we would prefer to provide a complete outline of the current plan when all is settled. This would presumably occur prior to the County’s hearing. Please let us know if this proposal is acceptable.

County Environmental Health Comment No. 5
See response to Ecology Comment No. 1 above.

County Environmental Health Comment No. 6
Linton Wildrick of Pacific Groundwater Group visited the residences at the northwest corner of the property and collected information on their water supply wells. The attached table summarizes the information. Logs are not known to exist for the wells; however, based on the well depths, it is likely that one supply well produces groundwater from above the aquitard, and one from below (assuming the aquitard exists in that area). A dug well also occurs but is unused.

Please contact us if this letter is not sufficient to allow continued progress on the County’s SEPA process.

Sincerely,
Pacific Groundwater Group

Charles Ellingson
Principal Hydrogeologist

Attachments: Map of Shallow Aquitard Thickness
Table of Downgradient Well Information

Cc: Bob Mead, John Pearch, J. Allen, George Bennett, Alison Moss
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<th>Well Log?</th>
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<td>no</td>
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<td>by 21-feet deep</td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>T16N R2W</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Batten</td>
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<td>two homes</td>
<td>10.94 feet below top of casing</td>
<td>no</td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Batten dug</td>
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<td>12-feet deep</td>
<td>unused</td>
<td>na</td>
<td>no</td>
</tr>
<tr>
<td></td>
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<td>T16N R2W</td>
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