**Groundwater and Surface Water Monitoring – Updated Conditions in Reply**

*Groundwater Monitoring Wells*

1. The Consent holder must install a new monitoring well cluster of 3 wells at the location shown in Attachment A. The wells must be screened in different geological layers, comprising the Upper Kaikorai Estuary Formation (UKEM), Lower Kaikorai Estuary Formation (LKEM), and Abbotsford Mudstone.
2. The Consent Holder must:
3. Lodge a resource consent application to drill the new groundwater monitoring wells specified in General Condition 40 within 3 months of consent being granted, if this is required to comply with the Resource Management (National Environmental Standards for Freshwater Management) 2020, or any other relevant standard or rule;
4. Construct the new wells within 3 months of any consent required under part (a) of this condition being granted, or 3 months of this resource consent being granted if no resource consent is required under part (a) of this condition; and
5. Commence groundwater monitoring from the new wells in the next monitoring cycle required under condition 45 following the completion of well construction.

*Advice note: This condition has been agreed by the Applicant.*

1. The groundwater monitoring wells shown on Attachment A. must be maintained on site to enable collection of groundwater level and groundwater quality data.
2. All groundwater monitoring wells must be maintained to prevent the ingress of surface water and to enable accurate monitoring. In the event of a well being destroyed or becoming unsuitable for sampling, the Consent Holder must replace it with a well in the same general location. The Consent Holder must first:
3. Lodge a resource consent application to drill the replacement groundwater monitoring well within 3 months of the well being destroyed or becoming unsuitable, if this is required to comply with any relevant standard or rule;
4. Construct the replacement well within 3 months of any consent required under part (a) of this condition being granted, or 3 months of the well being destroyed or becoming unsuitable if no resource consent is required under part (a) of this condition; and
5. Commence groundwater monitoring from the replacement well in the next monitoring cycle required under condition 45 following the completion of well construction.

*Monitoring Requirements*

1. The Consent Holder must undertake the sampling of leachate outlined in Table 1 below.

**Table 1 – Leachate Sampling**

|  |  |  |
| --- | --- | --- |
| **Frequency** | **Location as shown in Attachment A** | **Parameter** |
| Monthly | Leachate collection system pumpstations and manholes | Water Levels |
| Quarterly (reducing to 6 monthly, two years post closure) | Representative sample of leachate collected from PS3 sampling point. | pH (pH units)  |
| Electrical conductivity (mS/cm)  |
| Dissolved oxygen (mg/L)  |
| Dissolved Boron |
| Ammoniacal nitrogen |
| Nitrate nitrogen |
| Chloride |
| PFOS (first three years) |
| PFOA (first three years) |
| Dissolved Aluminium |
| Dissolved Arsenic |
| Dissolved Cadmium |
| Dissolved Chromium |
| Dissolved Copper |
| Dissolved Iron |
| Dissolved Lead |
| Dissolved Manganese  |
| Dissolved Nickel |
| Dissolved Zinc |
| Annually | Representative sample of leachate collected from PS3 sampling point | Sodium |
| Potassium |
| Calcium |
| Magnesium |
| Bicarbonate |
| Sulphate |
| Dissolved reactive phosphorous |
| Volatile organic compounds (VOC) |
| Semi volatile organic compounds (SVOC) |
| PFOS |
| PFOA |
| Cyanide |
| BOD |
| COD |

1. The Consent Holder must undertake the groundwater monitoring outlined in Table 2 below.

Table 2 – Groundwater Monitoring

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Frequency** | **Location as shown in Attachment A** | **Parameter** | **Trigger level required (see general conditions 49 - 51)**  | **Trigger level source** |
| Monthly | * Line 1-8 A/B/C/D wells
* BH103
* New well cluster
 | Groundwater Levels |  |  |
| Quarterly (reducing to 6 monthly, two years post closure) | * Line 1-8 A/B/C/D wells
* BH103
* New well cluster
 | pH (pH units)  |  |  |
| Electrical conductivity (mS/cm)  |  |  |
| Dissolved oxygen (mg/L) |  |  |
| Dissolved Boron | X | 5-year data set |
| Ammoniacal nitrogen | X | 5-year data set |
| Nitrate nitrogen |  |  |
| Chloride |  |  |
| PFOS (first three years) |  |  |
| PFOA (first three years) |  |  |
| Dissolved Aluminium |  |  |
| Dissolved Arsenic | X | 5-year data set |
| Dissolved Cadmium | X | 5-year data set |
| Dissolved Chromium | X | 5-year data set |
| Dissolved Copper | X | 5-year data set |
| Dissolved Iron |  | 5-year data set |
| Dissolved Lead | X | 5-year data set |
| Dissolved Manganese  | X | 5-year data set |
| Dissolved Nickel | X | 5-year data set |
| Dissolved Zinc | X | 5-year data set |
| Annually | Line 1-8 A/B/C/D wellsBH103New well cluster | Sodium |  |  |
| Potassium |  |  |
| Calcium |  |  |
| Magnesium |  |  |
| Bicarbonate |  |  |
| Sulphate |  |  |
| Dissolved reactive phosphorous | X | 5-year data set |
| Volatile organic compounds (VOC) | X | 5-year data set |
| Semi volatile organic compounds (SVOC) | X | 5-year data set |
| PFOS |  |  |
| PFOA |  |  |
| Cyanide |  |  |

1. The Consent Holder must undertake the surface water monitoring outlined in Table 3 below.

Table 3 – Surface Water Monitoring

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Monitoring Frequency** | **Location as shown in Attachment A**  | **Parameter** | **Trigger level required (see general conditions 49 - 51)** | **Trigger Level Source** |
| 3 hourly (using automatic water level pressure transducer) | GI3 | Kaikorai Stream levels |  |  |
| Quarterly (reduced to 6 monthly, two years following landfill closure) | Surface water locations GI1, GI2, GI3, GI 5 and estuary at Brighton Road bridge within three hours of low tide | pH (pH units) | X |  The lowest of 5-year (3 standard deviations) dataset values or ANZG 80% for aquatic protection or NPSFM 2020 |
| temperature |  |  |
| Electrical conductivity (mS/cm) |  |  |
| Dissolved oxygen  | X |   The lowest of 5-year (3 standard deviations) dataset values or ANZG 80% for aquatic protection or NPSFM 2020 |
| Ammoniacal nitrogen | X |  The lowest of 5-year (3 standard deviations) dataset values or ANZG 80% for aquatic protection or NPSFM 2020 |
| Nitrate nitrogen | X |  The lowest of 5-year (3 standard deviations) dataset values or ANZG 80% for aquatic protection or NPSFM 2020 |
| Boron |  |  |
| Chloride |  |  |
| PFOS (first three years) |  |  |
| PFOA (first three years) |  |  |
| Aluminum | X |  The lowest of 5-year (3 standard deviations) dataset values or ANZG 80% for aquatic protection |
| Arsenic |  |  |
| Cadmium | X |  The lowest of 5-year (3 standard deviations) dataset values or ANZG 80% for aquatic protection |
| Chromium | X |  The lowest of 5-year (3 standard deviations) dataset values or ANZG 80% for aquatic protection |
| Copper | X |  The lowest of 5-year (3 standard deviations) dataset values or ANZG 80% for aquatic protection |
| Lead | X |  The lowest of 5-year (3 standard deviations) dataset values or ANZG 80% for aquatic protection |
| Nickel | X |  The lowest of 5-year (3 standard deviations) dataset values or ANZG 80% for aquatic protection |
| Zinc | X | ANZG 80% for aquatic protection, until 5-year dataset is available  |
| Total suspended solids | X |  The lowest of 5-year (3 standard deviations) dataset values or ANZG 80% for aquatic protection |
|  |  | E. coli |  |  |
| Annual | Surface water locations GI1, GI2, GI3, GI 5 and estuary at Brighton Road bridge within three hours of low tide at low tide | Sodium |  |  |
| Potassium |  |  |
| Calcium |  |  |
| Bicarbonate |  |  |
| Sulphate |  |  |
| Dissolved reactive phosphorus | X |  The lowest of 5-year (3 standard deviations) dataset values or ANZG 80% for aquatic protection |
| Volatile organic compounds (VOC) | X | 5-year dataset |
| Semi volatile organic compounds (SVOC) | X | 5-year dataset |
| PFOS |  |  |
| PFOA |  |  |
| Cyanide |  |  |

1. The Consent Holder must undertake the sediment pond water monitoring outlined in Table 4 below.

Table 4 – Sediment Pond Water Monitoring

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Monitoring Frequency** | **Location as shown in Attachment A** | **Parameter** | **Trigger level required (see general conditions 49 - 51)**  | **Trigger Level Source** |
| Quarterly (reduced to 6 monthly, two years following landfill closure) | * Western sedimentation pond
* South western pond
* Eastern sedimentation pond
* South eastern constructed wetland
* Eastern constructed wetland
* After closure, the northern sedimentation pond.
 | pH (pH units) | X | 5-year (3 standard deviations) dataset values  |
| Temperature |  |  |
| Electrical conductivity (mS/cm) |  |  |
| Dissolved oxygen  |  |  |
| Ammoniacal nitrogen |  |  |
| Nitrate nitrogen |  |  |
| Aluminum | X |  5-year dataset  |
| Arsenic |  |  |
| Cadmium | X |  5-year dataset |
| Chromium | X |  5-year dataset  |
| Copper | X |  5-year dataset  |
| Lead | X | 5-year dataset |
| Nickel |  |  |
| Zinc | X | ANZG 80% for aquatic protection (until 5-year dataset is available and then the lowest) |
|  |  | Total suspended solids |  |  |
|  |  | *E. coli* |  |  |
|  |  | PFOS (first three years) |  |  |
|  |  | PFOA (first three years) |  |  |
|  |  | Boron |  |  |
|  |  | Chloride |  |  |
| Annual | Western sedimentation pondSouth western pondEastern sedimentation pondSouth eastern constructed wetlandEastern constructed wetlandAfter closure, the Northern sedimentation pond. | Dissolved reactive phosphorus |  |  |
| Volatile organic compounds (VOC) |  |  |
| Semi volatile organic compounds (SVOC)\* |  |  |
| PFOS |  |  |
| PFOA |  |  |

1. All leachate, groundwater, surface water, and sediment pond water sampling required under General Conditions 44 – 47 must meet the following requirements:
2. Sampling must be undertaken at the specified locations indicated in General Conditions 44 – 47.
3. Sampling of the sediment ponds under General Condition 47 must record whether the ponds are discharging freely to the downstream environment.
4. Sampling must be undertaken, or overseen by, a suitably qualified professional and collected in accordance with the relevant National Environmental Monitoring Standard (NEMS) below:
5. National Environmental Monitoring Standards Water Quality Part 1 of 4: Sampling, Measuring, Processing and Archiving of Discrete Groundwater Quality Data;
6. National Environmental Monitoring Standards Water Quality Part 2 of 4: Sampling, Measuring, Processing and Archiving of Discrete River Quality Data; and
7. All sample analysis must be performed by a laboratory that meets International Accreditation New Zealand (“IANZ”) approved laboratory.
8. Water quality trigger levels must be developed for groundwater, surface water, and sediment pond water quality and included in the Landfill Development Management Plan required under General Condition 5 and Landfill Closure Management Plan required under General Condition 9 for the indicated parameters set out in column 4 of Tables 2 – 4 in General Conditions 45 – 47.
9. Except as provided in condition 51 below, the trigger levels required by General Condition 49 must be established using the trigger level source set out in column 5 of Tables 2 – 4 in General Conditions 45 – 47. Where the trigger levels are to be established based on the 5-year data set, the trigger level must be calculated as the mean plus three standard deviations for parameter concentrations measured during the previous 5 years of monitoring (mean plus and minus three standard deviations for pH). The trigger levels must be reviewed by the Consent Holder every 5 years. The lessor of the then existing trigger levels or those calculated from the preceding 5 years monitoring data or ANZG 80% protection values (where appropriate) must thereafter be adopted and included in the Landfill Development Management Plan and Landfill Closure Plan.
10. The trigger levels required by General Condition 49 relating to the monitoring of groundwater quality:
11. From the new well cluster and BH103 in accordance with General Condition 45; and
12. For those parameters in Tables 2 – 4 in General Conditions 45 – 47 where 5 years of data is not available;

are to be calculated as the mean plus three standard deviations for parameter concentrations measured during the previous 3 years of monitoring (mean plus and minus three standard deviations for pH). The trigger levels must be reviewed by the Consent Holder every 5 years. The lessor of the then existing trigger levels or those calculated from the preceding 5 years monitoring data must thereafter be adopted and included in the Landfill Development Management Plan and Landfill Closure Plan.

1. The monitoring of groundwater, surface water, and sediment pond quality required by General Condition 45 – 47 must be assessed against the trigger levels established under General Conditions 49 – 51.
2. The Consent Holder must compile the results of any monitoring required under General Conditions 44 – 47 (including any leachate, groundwater, surface water, and sediment pond physiochemical monitoring, groundwater and surface water level monitoring, alerts from the leachate pumping system and monthly records of total leachate volumes pumped from the collection trench), into tables in digital format (excel spreadsheet file or comma separated value file). One table shall be compiled for each location that monitoring is undertaken.
3. The Consent Holder must provide the results of all monitoring under General Condition 52 to the Otago Regional Council:
4. Within 1 week of receiving laboratory results where the trigger levels established under General Conditions 49 – 51 are exceeded, except where the exceedance is at surface water monitoring sites GI1 and GI2 (which are upstream of the landfill);
5. Within 1 week of receiving laboratory results where any historical maximum recorded for the site is exceeded;
6. Otherwise on request; and
7. Provide the results of all monitoring and to both Te Rūnanga o Ōtākou, and Otago Regional Council as part of the Annual Report required by General Condition 62.

*Contingency Actions and Adaptive Management*

1. In the event that the contaminant concentrations monitored under General Condition 52 exceed the trigger levels established under General Conditions 49 – 51 at surface water sites GI3 and GI5, and the contaminant concentrations at those sites also exceed the concentrations detected at surface water sites GI1 and GI2 upstream of the landfill, the Consent Holder must undertake two additional rounds of surface water sampling at all surface water sites, no later than 1 week, and again no later than 2 weeks after receiving the results of the initial exceedance and provide the combined results of the additional sampling to Otago Regional Council within 1 week of receiving the laboratory results.
2. If following completion of the two additional rounds of sampling in General Condition 55 contaminant concentrations continue to exceed the trigger levels at surface water sites GI3 and GI5, and the concentrations continue to be elevated in comparison to the concentrations detected at surface water sites GI2 and GI2 upstream of the landfill, the Consent Holder must undertake an investigation into potential causes of the exceedances and prepare a report which must be provided to Otago Regional Council and Te Rūnanga o Ōtākou no later than 1 month after receiving the laboratory results of the additional sampling under General Condition 55. The report must outline likely causes of exceedances, statistical analysis of water quality, actions to be taken to prevent further exceedances and proposed follow up monitoring where necessary.
3. Should the groundwater level monitoring required under General Conditions 45 identify outward gradients (where water levels are higher in the trench than in the monitoring wells adjacent), or a risk identified that the gradient into the leachate collection trench may not be maintained, the consent authority must be notified within 48 hours.
4. Should the results of any monitoring required under General Conditions 44 – 56 indicate adverse effects on water quality directly attributable to landfill leachate from the Green Island landfill entering the Kaikorai Stream, the Consent Holder must within 3 months prepare an Adaptive Management Plan. The plan must include the following information at a minimum:
5. Additional investigations and groundwater and surface water monitoring required to confirm where leachate migration is occurring, including timeframes.
6. Ecotoxicology investigations to establish the chemical characterisation of the leachate and test the toxicity of these contaminants in the receiving environment on aquatic fauna.
7. Further targeted ecological investigations, if the ecotoxicology investigations find leachate contaminants are a risk to aquatic fauna.
8. Proposed measures to be implemented to avoid or mitigate effects of leachate migration, including timeframes. Potential measures may include, but are not limited to:
9. Physical barriers such as sheet piling, slurry or bentonite walls, or secant piles.
10. Targeted groundwater/leachate abstraction using wells.
11. An additional deep monitoring well on monitoring line 3.
12. Follow up monitoring to confirm the effectiveness of the implemented measures.
13. Contingency actions in the event the implemented measures are not effective.
14. A review process that includes Te Rūnanga o Ōtākou and Otago Regional Council.
15. The Adaptive Management Plan must be submitted to the Otago Regional Council for certification in accordance with General Condition 4.
16. The Adaptive Management Plan certified under General Condition 4 must be implemented in accordance with the timeframes specified in the Plan.

*Monitoring Plan*

1. The Landfill Development Management Plan required under General Condition 5 and Landfill Closure Management Plan required under General Condition 9 must include practices and procedures for the long-term monitoring of groundwater and surface water, including as a minimum:
2. Groundwater and surface water monitoring locations, parameters, trigger levels, and frequencies for each monitoring location and monitoring parameter. As a minimum this is to include monitoring requirements detailed in General Conditions 44 – 60;
3. Monitoring methodologies; and.
4. Record keeping and reporting requirements.