

# Summary of Environmental Monitoring Program Progress

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# Main Practice Areas

2



Stormwater Management



Hydrology and River Engineering



Geology and Geotechnics



Groundwater



Contaminated Land  
and Hazardous Waste



Aquatic Ecology



Wastewater Treatment



Solid Waste Management



Civil Engineering



Air Quality



Consents and  
Environmental Management



Coastal

# PDP are specialists in

3





# Independent Advice

- PDP has a reputation for integrity, technical superiority, and a high standard of work.
- We work for a wide range of clients in the public and private sectors, including central and local government agencies, international and home-grown companies, other consultants, and members of the public.
- It is important to us to maintain our objectivity and independence when engaged by a client as any perception of bias towards the client harms the value and usefulness of our work to everyone involved.

# Puhipuhi project selection rationale

5

- New Zealand owned company rather than multinational
- Experienced in assessing and managing the impacts of different types of drilling
  - Geotechnical
  - Water supply
  - Mineral exploration
- Experience in mercury
  - Mercury Inventory for New Zealand report for MfE
  - Monitoring of Tui gold mine including mercury and ARD
  - Working on groundwater at the Ngawha power plant

# Scope: 9 Individual Programs

1. Groundwater sampling
2. Surface water sampling, stream sediment, aquatic organisms and habitats
3. Hydrology & hydrogeology
4. Environmental management strategy
5. Noise monitoring
6. Dust monitoring
7. Surface water monitoring program development
- 8a. Terrestrial Ecology
- 8b. Soil Characterisation
9. Environment management program

# Completed to Date

1. Groundwater sampling
2. Geology
3. Hydrology & hydrogeology
4. Environmental management strategy

# In Progress

- 2. Surface water sampling, stream sediment, aquatic organisms and habitats  
(sampling completed, awaiting laboratory results and report)
  
- 6. Dust monitoring (in progress)
  
- 8a. Terrestrial Ecology (survey completed, report awaited)



# Remaining Programs

- 5. Noise monitoring
- 7. Surface water monitoring program development
- 8b. Soil Characterisation
- 9. Environmental management program

# 1. Groundwater sampling

10



Water bores



Springs



# 1. Groundwater sampling

11

## In the field:

- Photo, GPS mark
- Standing water level
- pH
- Electrical conductivity
- Temperature
- Ferrous iron
- Visual
- smell

## Laboratory parameters

- pH
- Electrical conductivity
- Major dissolved ions (Mg, K, Na, Ca, Cl, ..)
- Dissolved nutrients (nitrate, nitrite, ...)
- Dissolved and total metals (As, Hg, Cu, Zn Pb, ...)
- E. coli
- Faecal coliforms
- Stygofauna

# 1. Groundwater sampling

12

Sampling for physical and chemical analyses sampling of Stygofauna



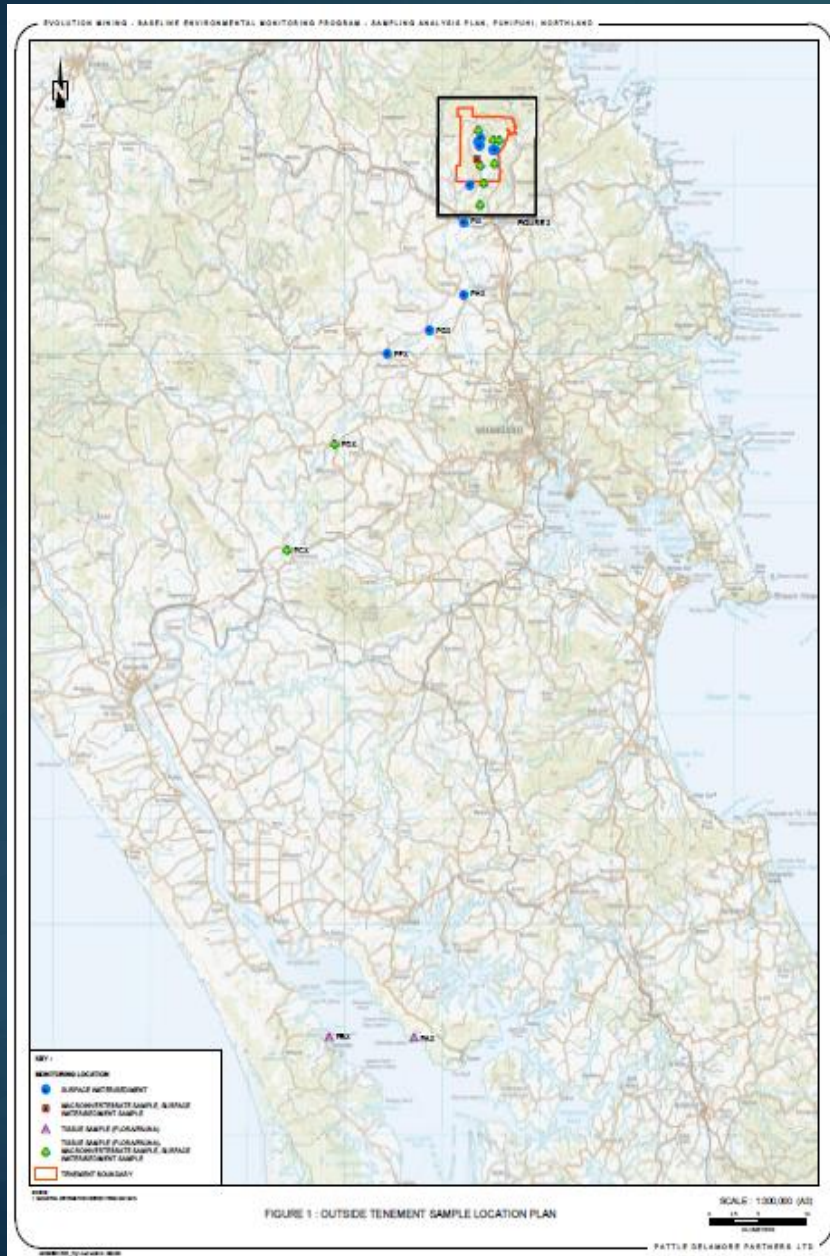


# 1. Groundwater sampling

- Stygofauna are small animals that live in groundwater systems
- It is not usual to test for Stygofauna as so little is known about Stygofauna in New Zealand compared to overseas
- May give an indication of the health of the groundwater system in the same sort of way macroinvertebrates do for the health of surface waterways
- This study provides some baseline data for future reference

## 2. Surface water sampling, stream sediment, aquatic organisms

14



- Surface water and stream sediment sampling:
  - within and downstream of tenement
  - ~20 locations
  - stream flow gauging
- Fauna tissue analysis for mercury
- Stream macroinvertebrate study
- Habitat assessment and desktop survey of potential barriers to fish passage

## 2. Surface water sampling, stream sediment, aquatic organisms

15

### Physical and chemical assessment:

#### In the field:

- photo + GPS mark
- pH
- electrical conductivity
- temperature
- turbidity
- dissolved oxygen
- ferrous iron
- visual

#### Water lab parameters:

- pH
- electrical conductivity
- hardness
- major dissolved ions
- dissolved nutrients
- dissolved and total metals

#### Sediment lab parameters:

- total recoverable metals
- methyl mercury
- acid volatile sulphide – simultaneously extractable metals



## 2. Surface water sampling, stream sediment, aquatic organisms

16



Stream  
sediment  
samples



Protective suits worn by  
staff to avoid accidentally  
contaminating the water  
they are sampling



Stream flow  
measurement



## 2. Surface water sampling, stream sediment, aquatic organisms

17

- Knew from historical work that majority of metals and ions we were trying to measure are only present at very low levels
- Took measures to get most accurate measurements possible
  - Began downstream, furthest away from mercury source
  - Worked upstream to minimise risk of contaminating next sample
  - Replaced sample tubing and fittings between sites
  - Field staff wore clean suits (white overalls) and masks to minimise sample contamination NOT to protect themselves from anything they were handling
  - Used international laboratory with lowest detection limits

## 2. Surface water sampling, stream sediment, aquatic organisms

18





## 2. Surface water sampling, stream sediment, aquatic organisms

19

- In addition to water quality, there is stakeholder interest in the potential for metals such as mercury to accumulate in aquatic life
- Eels and freshwater crayfish were caught to provide samples
- No eels were caught above the waterfall on the Waikariki Stream indicating that the waterfall may be barrier to eel migration
- Similar sized (and hopefully age) eels and crayfish were taken to enable comparison between sites
- Awaiting laboratory results

## 2a. Macroinvertebrate survey and habitat assessment

20





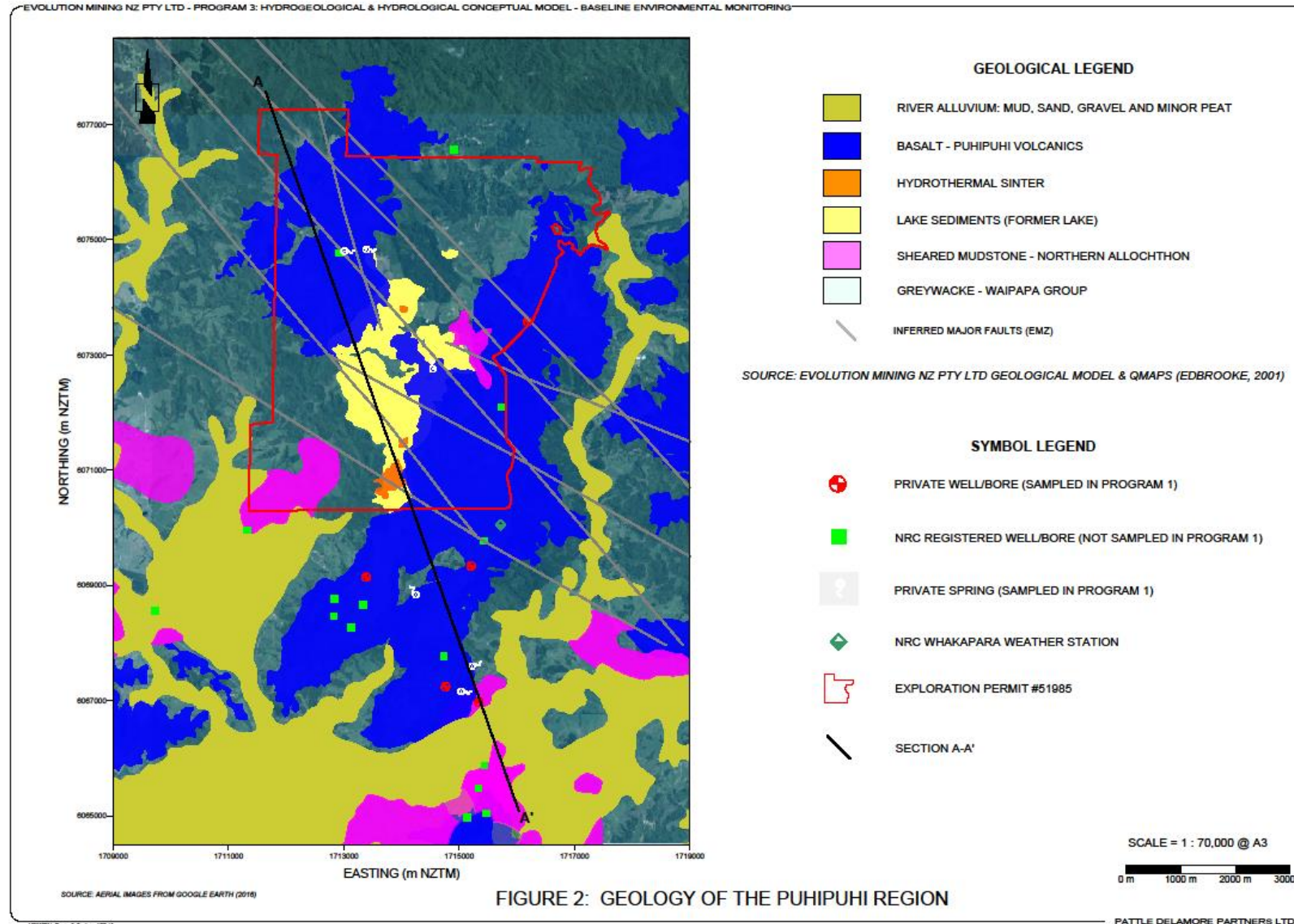
## 2a. Macroinvertebrate survey and habitat assessment

21

- Macroinvertebrates are small animals that live in surface waterways
- Macroinvertebrate surveys are commonly undertaken and they are widely used for environmental monitoring
- Their wide use enables assessment of the health of surface waterways and to compare between different sites

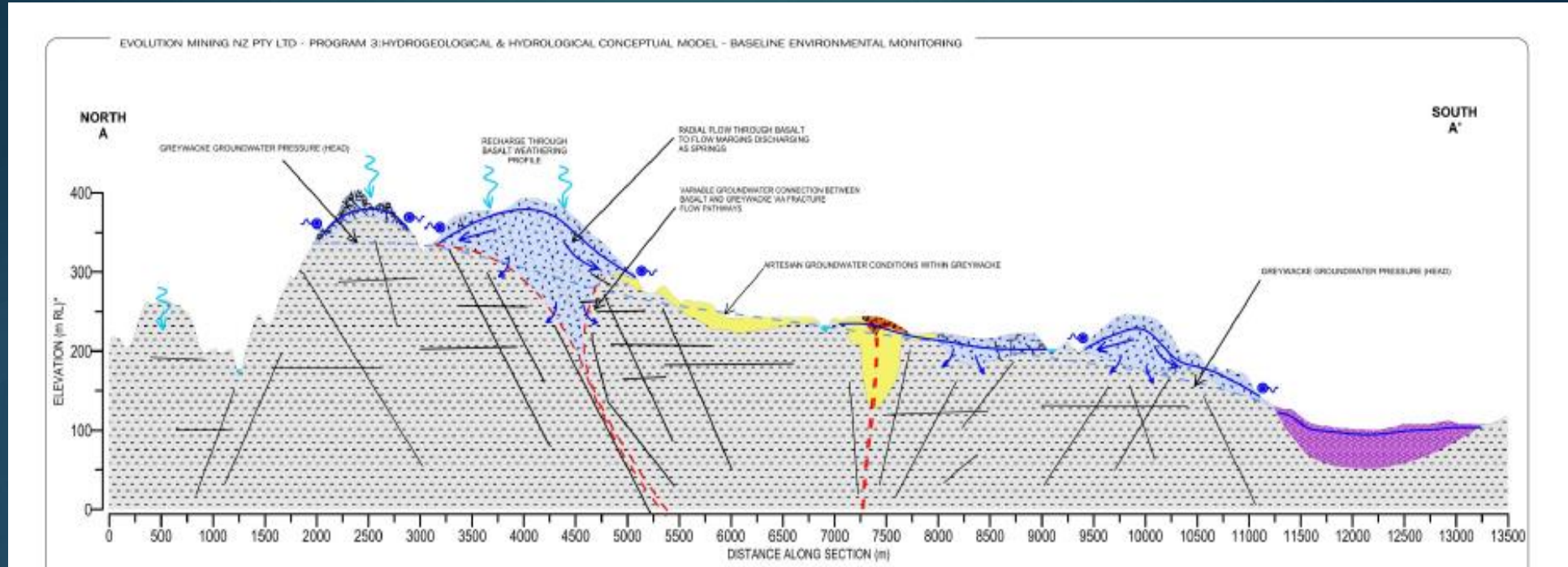
### 3. Hydrology and hydrogeology

22



### 3. Hydrology and hydrogeology

23



### 3. Hydrology and hydrogeology

- Greywacke aquifer
  - Lies below the Puhipuhi volcanic basalts
  - Rainwater enters aquifer largely from exposed greywacke to north of tenement
  - Flow of groundwater is NE to SW
  - Long residence times
  - Good quality water, all mercury below detection limit ( $<0.0001$  mg/litre or  $<0.1$  part per billion)
  - Appears to have little impact on surface waterways (all springs sampled contained water from basalt aquifer)



### 3. Hydrology and hydrogeology

- Basalt aquifer
  - Sits above the greywacke aquifer
  - Rainwater fed, good quality
  - Feeds streams and springs
  - Main source of water supply in the area
  - One spring had mercury greater than detection limit (0.0002 vs <0.0001 mg/litre). NZ Drinking water standard is 0.007 mg/litre so concentration measured was 3% of the standard
- Lake bed sediment aquifer
  - Water quality unknown, likely to feed streams

# 4. Environmental management strategy for exploration drilling

26

- Identify key environmental risks
- Establish baseline environmental conditions
- Formulate management plans to eliminate, isolate or minimise the risks
- Monitor to assess the effectiveness of controls
- Revise management plans as required to maximise their effectiveness



## 4. Environmental management strategy for exploration drilling

27



### Key environmental risks:

- Increased soil erosion
- Discharge of sediment to waterway
- Interconnection of aquifers

### Controls:

- Drill rig selection
- Minimise soil disturbance
- Seal and grout holes
- Above-ground sumps for fluid reticulation
- Zero discharge at site
- Offsite disposal of waste at approved landfill



## 5. Noise monitoring

28



## 6. Dust monitoring

29





## 7. Surface water monitoring program development

30

- Will be developed once early programs are complete
- Evolution plan to train local people to conduct ongoing routine monitoring

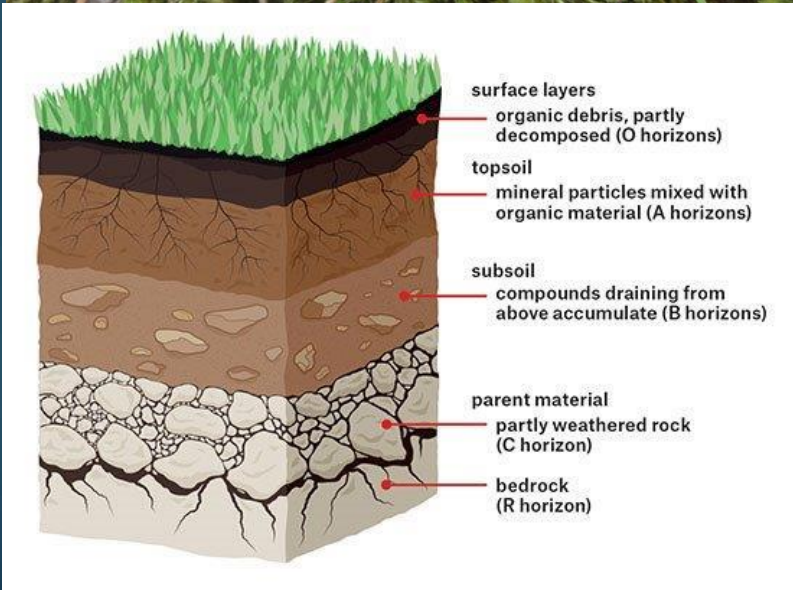




## 8. Physical environmental survey

31

### Flora & Fauna



### Soils



## 9. Final Consultant Report

32

- Will combine all individual reports together
- Integrate findings in one place
- Present overall conclusions