

Strickland River 2009 Report Card

This 2009 Report Card is the first of its kind on the health of the Porgera/Strickland River system downstream of the Porgera Gold Mine operations. The report card has been produced by the Porgera Environmental Advisory Komiti (PEAK), the independent committee overseeing the overall environmental and social sustainability of the Porgera mine's operations in PNG.

What is a Report Card?

An environmental Report Card is somewhat like the report cards we received from school. It seeks to assess the condition or health of the environment compared with what we would like it to be. Report Cards enable large and often complex amounts of technical information to be communicated to a broad range of people and provide a means of demonstrating accountability and transparency in reporting on environmental outcomes. They can be used to identify regions or issues of concern and to measure success (or failure) of efforts to protect or restore ecosystems.

Background to the first Report Card

The 2009 Report Card on the Strickland River focuses on the mine's effect on the downstream riverine environment and implications for the people who rely on this important river system. This assessment is important because the mine discharges tailings and waste rock to the river system (Porgera, Lagaip and Strickland Rivers).

The Report Card identifies how well PJV is doing in protecting important environmental values in the Strickland River system and helps to highlight any areas of concern that might warrant additional attention or action. These environmental values include water quality; health and abundance of fish, prawns and other aquatic resources; biodiversity (species loss); and ecosystem productivity. There are also human health concerns to consider, especially in relation to food security and food supply integrity. Does the mine affect the availability of specific food resources (e.g. fish)? Is it safe to drink the water or eat the fish and prawns? These aspects will be covered fully in future Report Cards.

The Porgera Gold Mine has produced an Annual Environmental Report since the commencement of operations in 1990. These reports are highly technical and a Report Card format has been adopted to provide an additional document that can be easily read and understood by a broad range of stakeholders. It is based on data presented in the 2007/2008 Annual Environmental Reports of PJV. The International Water Centre based in Brisbane Australia assisted PEAK in producing the Report Card.



Porgera Gold Mine operations



Porgera River at the Lagaip River junction

About the riverine system

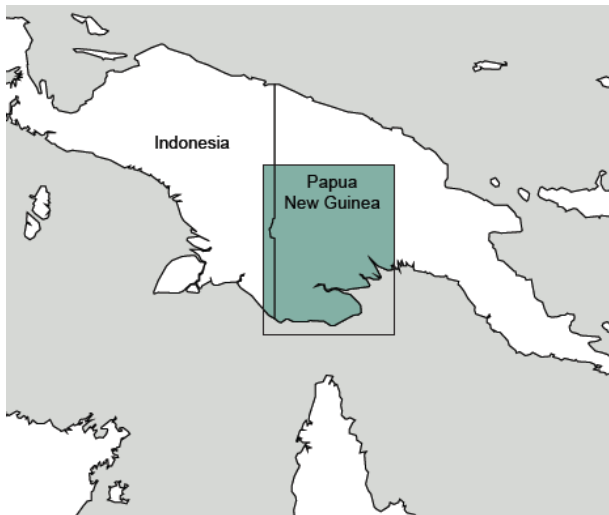
The Report Card covers the riverine system from just downstream of the Porgera mine (Porgera River) to Lake Murray on the Strickland River floodplain.

Porgera Joint Venture (PJV) discharged approximately 6.05 million tonnes of tailings in 2008 to the downstream riverine system (Porgera, Lagaip and Strickland Rivers). Additionally, an estimated 12.5 million tonnes of suspended sediment entered the riverine system from the erodible waste dumps (Anawe and Anjolek).

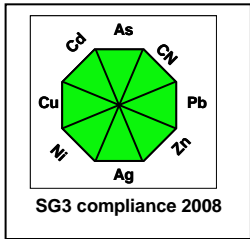
The Porgera River joins the Upper Lagaip and then flows west to join the Ok Om and then south down the Strickland River. There is significant dilution of the mine inputs along the way. The river flow at SG2 (Stream Gauging Station No.2) on the Lagaip contributes only about one third of the flow at the compliance monitoring site at SG3 and the remainder comes from Ok Om and other tributaries (e.g. Pori and Tumbudu Rivers). It is estimated that about 20% of the sediment at SG3 is mine-derived. Only about one quarter of the river flow at SG4 is from the catchment upstream of SG3.

For the Upper River, monitoring data were obtained from sites downstream of the mine (SG1, SG2, SG3, Wankipe) and from nearby reference sites (Upper Lagaip, Pori River, Kuru River, Ok Om). For the Lower River, data from the main Strickland River (SG4, SG5, Bebelubi) and two reference systems (Baia and Tomu Rivers) were used. Data from up to 25 sites in Lake Murray were combined for three regions, according to their proximity to the Herbert River inflows: Southern Lake, Middle Lake and Northern Lake. Inflows from the Herbert River into Lake Murray occur about 15% of the time at times of high flow in the Strickland River due to high rainfall in the mountains.

Total rainfall for 2008 was 4.15 m, 12% higher than the long-term average of 3.72 m (since 1974). Average daily river flows in 2008 were also higher than the long term average (e.g. 904 cumecs compared with 746 cumecs at SG3).

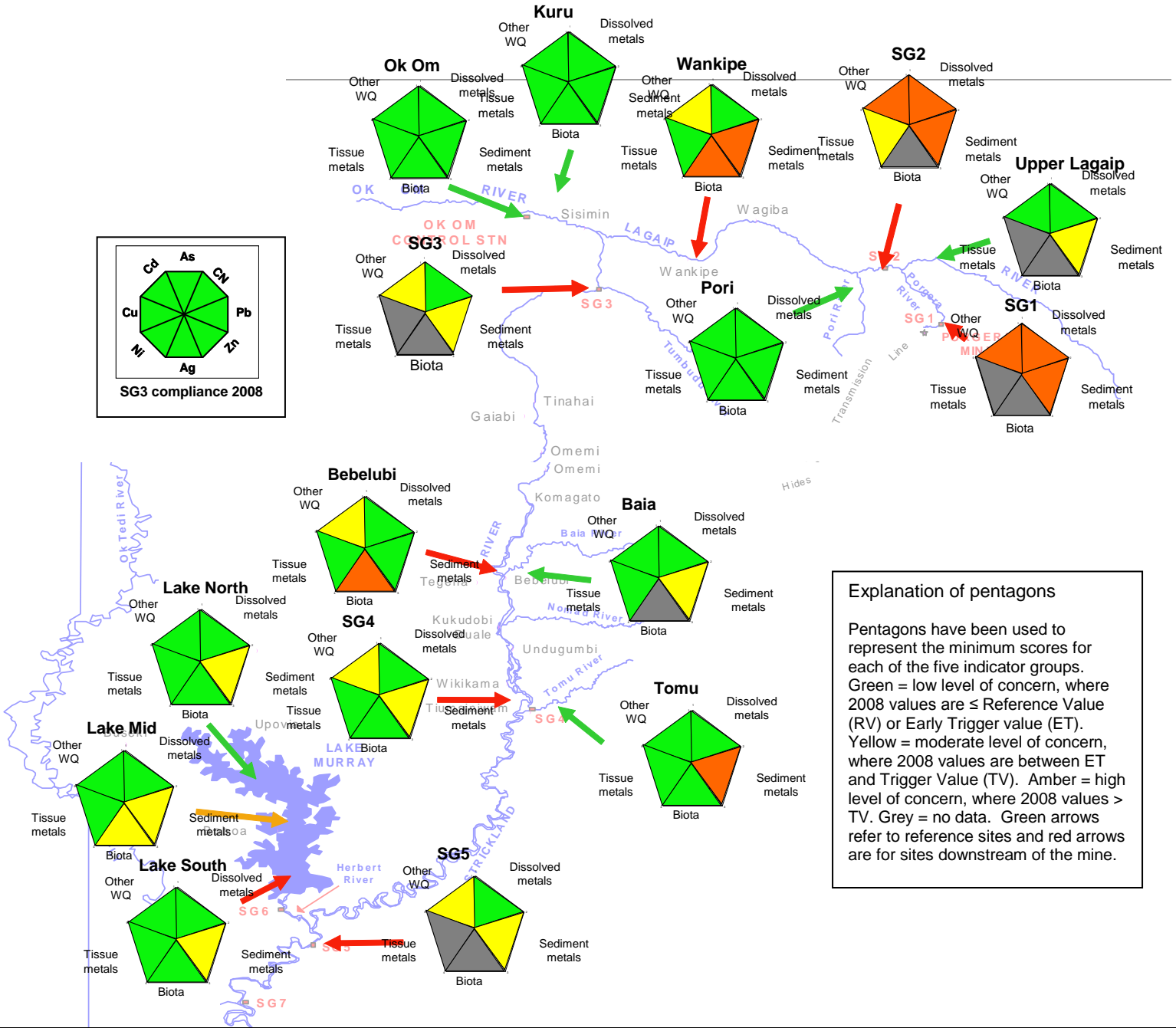


RIVER MAP AND PENTAGONS

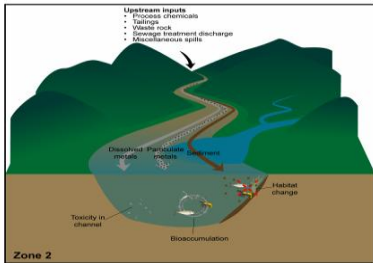


Explanation of pentagons

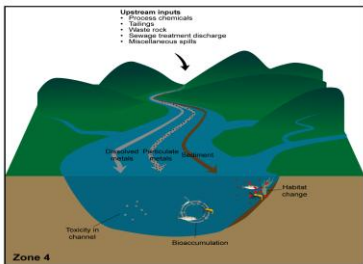
Pentagons have been used to represent the minimum scores for each of the five indicator groups. Green = low level of concern, where 2008 values are \leq Reference Value (RV) or Early Trigger value (ET). Yellow = moderate level of concern, where 2008 values are between ET and Trigger Value (TV). Amber = high level of concern, where 2008 values $>$ TV. Grey = no data. Green arrows refer to reference sites and red arrows are for sites downstream of the mine.



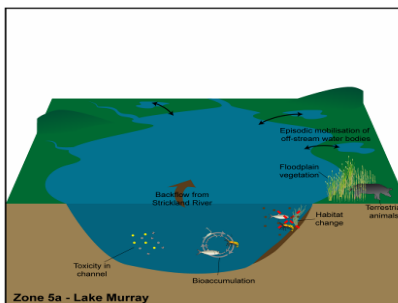
Upper River



Lower River



Lake Murray



Key messages:

- Poor scores at SG1 and SG2 for dissolved and sediment-bound metals as well as other water quality parameters and biota, compared with reference sites.
- Poor score for dissolved metals at SG1 and SG2, due to Cu levels above trigger values. Cd and Zn also at moderate levels of concern at SG1.
- Poor score for sediment-bound metals at SG1 due to As, Pb, Ag and Zn levels above trigger values. Zn was also above the TV at SG2. Most other sediment-bound metals at moderate levels at these two sites.
- Poor scores for other water quality parameters at SG1 and SG2 due to high TSS and conductivity.
- Considerable improvement in scores for dissolved metals below SG2 and all metals below levels of concern (and levels for compliance) at SG3.
- Moderate levels of concern (yellow) remain for sediment-bound metals (As, Cd, Pb, Hg and Zn) at SG3 but below trigger values.
- Tissue metals were below levels of concern at Wankipe. The lower score at Wasiba (near SG2) due to elevated As and Hg, though below trigger values.
- No data for biota were available for SG1, SG3 and upper Lagaip and data for SG2 were taken from Wasiba immediately downstream.
- The low score for biota at Wankipe was due to a low ratio of predatory fish (note – no data for this index were available at SG2).

- At all lower river sites dissolved metals and metals in fish tissue were below levels of concern.
- Moderate levels of concern for sediment-bound metals at SG4 and SG5 were largely due to elevated As and Zn, though below trigger values.
- Low scores for sediment metals at lower river reference sites (Baia and especially at Tomu) were due to elevated Cd levels.
- Moderate scores for “other” water quality at lower river sites were largely due to elevated conductivity and TSS values.
- With the exception of Bebelubi, the scores for biota were below levels of concern. The poor score at Bebelubi was due to a low ratio of predatory fish.

- Dissolved metals and metals in fish tissue at all Lake Murray sites were below levels of concern.
- Moderate levels of concern for sediment metals throughout the Lake were largely due to elevated Cd (above reference values). However, levels of Hg and Ni also were above reference values at some sites in the lower and mid sections of the Lake.
- Moderate scores for water quality in the lower lake were the result of elevated TSS.
- The moderate score for biota in the mid-Lake (Pangoa) was due to a low average biomass per individual caught.



Lagaip River at Wankipe



Ok Om River



Tomu River



Strickland River upstream of Tomu



Lake Murray near Miwa

Methods

How is the health of the River System assessed?

An extensive environmental monitoring program for the Strickland River system, including water quality, sediments and biota, has been undertaken by the Porgera Joint Venture (PJV) since 1990. The major focus of this program has been on heavy metals and other contaminants that might enter the river from mining operations; including Arsenic (As), Cadmium (Cd), Copper (Cu), Lead (Pb), Mercury (Hg), Nickel (Ni), Silver (Ag), Zinc (Zn) and Cyanide (CN).

Data on five groups of indicators were considered for the Report Card:

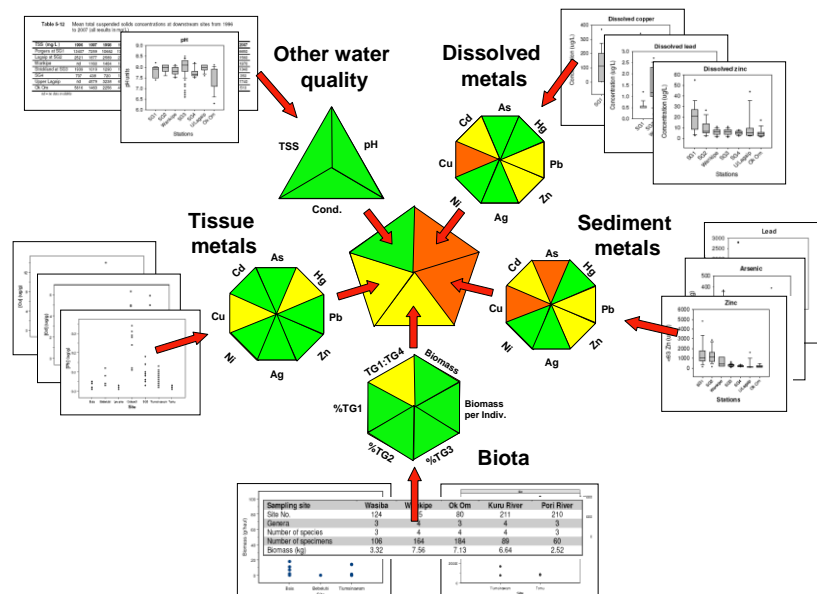
1. Dissolved metals – As, Cd, Cu, Pb, Hg, Ni, Ag and Zn
2. Metals in sediments – As, Cd, Cu, Pb, Hg, Ni, Ag and Zn
3. Other water quality parameters – Conductivity, Total suspended solids (TSS), pH and cyanide (CN).
4. Metals in fish tissues – As, Cd, Cu, Pb, Hg, Ni and Zn
5. Fish composition – six indicators: B – Biomass of fish caught in standardised sample; B/I - Average biomass per individual fish (I); TG1 - Biomass proportion of top predators (trophic group 1); TG2 - Biomass proportion of aquatic invertivores (trophic group 2); TG3 - Biomass proportion of terrestrial insectivores (trophic group 3); B1/B4 - Biomass ratio of top predators (TG1):detritivores (TG4)

Ecosystem health is reported for each of these indicator groups for sites within three regions of the Strickland River system: Upland sites, Lowland sites and Lake Murray. For reporting purposes, control sites ('reference') were those not connected to the mine by downstream flow. Otherwise, sites were considered to be potentially impacted by the mine's operations ('impacted' sites).

Data for the first three groups of indicators were from 38 sites that have been monitored since 1991. However, no data were available for 2008 for lake sites and one upper impact site (SG1) and for these sites, the report card was based on 2007 data. For metals in fish tissues, data were associated with 12 sites that have been monitored since 1988. No data were available for 2008 and the report card was based on 2007 data. Data for fish composition reporting were associated with 11 sites that have been monitored since 1991.

Reporting was based around a system of trigger levels of concern for ecosystem health. The median value for each index (e.g. dissolved As concentration) was calculated for each site in 2008 to assess its ecosystem health in relation to a pre-determined reference value (RV) and two trigger levels of concern. For each index, the 80th percentile of all data collected to date was used as the reference value (RV) for each reporting region (i.e. Upper River, Lower River and Lake). Sites with a median value in 2008 falling below the RV were considered to be at a low level of concern and reported as GREEN. Trigger values (TV) were calculated for each reporting region, based on well-established guideline values. Sites with median values outside of the TV were regarded as having a high level of concern and were reported as AMBER. An early trigger (ET) value was also used to indicate a moderate level of concern, and was reported as YELLOW for sites in which the 2008 median value fell between the ET and the true trigger value (TV). An overall site 'score' was reported using the highest level of concern for any one indicator within each indicator group. For example, if a site scored 'Green' for dissolved arsenic but 'Amber' for dissolved cadmium, the overall score for dissolved metals would be 'Amber'.

What goes into the pentagons?



BACK PAGE



Beach seining in the upper catchment (from PJV 2006 Environmental Monitoring Report)

Future plans

This is the first attempt to deliver a Report Card for the health of the Strickland River system and we believe is the first Report Card on the environmental effects of a mine. The aim will be to continue to develop and refine the reporting process. All of the technical information used to derive the indicators and scores in this Report has been derived from the considerable body of monitoring data collected since 1990 by PJV and reported in their Annual Environment Monitoring Reports. Developing the indicators for the Report Card has in turn provided an opportunity to review aspects of the annual environmental monitoring program and suggest possible options for improvement in the future.

To be confident that environmental values relating to biodiversity and important components of the aquatic biota (especially fish and prawns) are being maintained, it will be important to further develop the Biota indicators for this Report Card. Further analysis of the fish and prawn abundance and size data from the PJV Environmental Monitoring Program is required. It is possible that additional information may need to be collected in the future. In particular, it has been difficult to identify and routinely sample suitable reference sites for the biota, especially for the lower river system. This should be a priority for future monitoring.

While the focus of this Report Card is on environmental health in the broadest sense, much of the data obtained from the PJV Environmental Monitoring Program can also be used to assess the potential risks to human health. For some of the indicators, this can be achieved by setting the TVs to known guideline values for human health and preparing indicator scores in a similar way. An intensive water quality monitoring program is also undertaken by PJV around the Porgera mine site. These data could also be used to assess the potential human health risks associated with local streams adjacent to the mine area. There are additional sensitivities of course, when preparing a Report Card that considers human health risks. PEAK will need to work closely with PJV and local communities to ensure that an appropriate system of reporting can be developed.

Although this Report Card has focused on data collected for the PJV 2007 and 2008 Environmental Monitoring Reports, much more information is still available on the longer term changes in water quality and ecosystem health in the Strickland River system. In future years, a more detailed analysis of trends in report card scores will provide a much more comprehensive picture of how the system has responded to changes in mining operations over time.

Finally, this Report Card has been developed with assistance from the International Water Centre in Brisbane, Australia (www.watercentre.org). The scientists in IWC have extensive experience in the development of monitoring programs and maintain an ongoing involvement in the production of the highly acclaimed "Healthy Waterways" Report Card in southeast Queensland (www.healthywaterways.org). PEAK's aim is to build similar capacity in PNG so that the routine development and production of the Report Card for the Strickland River, and perhaps in the future other river systems, can be undertaken in country.

Contact and further information

PEAK is interested in your feedback on ways in which the Report Card can be improved. If you would like to find out more of the program, or have any questions about the information contained in this Report Card, please contact:

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