CapeAlumina

Supplementary submission to the Department of Environment and Resource Management (DERM) in response to the proposed declaration of the Wenlock River Basin as a Wild River Area

Date prepared: Friday, 19 February 2010.

Table of Contents

1. Executive summary

Cape Alumina believes the Queensland Government's proposed declaration of the Wenlock River Basin as a wild river area must be amended, and relevant legislation clarified, to ensure that a balance between responsible mining, economic development and protection of the natural values of the Wenlock River Basin in western Cape York is achieved.

Cape Alumina believes that the so-called High Preservation Area (HPA) in the proposed Wenlock Basin wild river area must be set to reflect the results of detailed analysis of the environmental features in the vicinity of Pisolite Hills, and with reference to published literature on the protection of wetlands and water courses from mining and development activities. Specifically, Cape Alumina believes that the widths of the proposed buffer zones for the HPA surrounding the special feature referred to as the Coolibah Springs Complex have been set without reference to specific criteria relevant to these features and can be safely reduced from over 500 metres to a maximum of 200 metres – determined on a case by case basis. A maximum 200 metre buffer zone meets, and in most cases exceeds, all the necessary environmental safeguards. This is supported by numerous detailed environmental studies which have been based upon site-specific hydrology, ecology, flora, fauna, and soil geochemistry data from the area. Setting the buffer zone of the HPA for the Coolibah Springs Complex to a maximum of 200 metres will not impact on the hydrological connectivity between the evergreen springs, their source aquifer and the Wenlock River.

Cape Alumina's position is substantiated by the Queensland Government's independent expert who stated that "the data to hand … is largely supportive of the hydro-geological scheme proposed by [Cape Alumina]." The Queensland Government's independent expert has also stated that it "appears on the basis of the data to hand that bauxite mining as proposed [by Cape Alumina] will have relatively little impact on the groundwater hydrology of the springs. There appears to be no clear justification of the magnitude of the HPA setbacks."[1]

Cape Alumina has developed and continues to improve the Surface Water Management Plan for the Pisolite Hills project, which shall be assessed through the Environmental Impact Statement (EIS) process by both the State and Commonwealth governments. Cape Alumina knows that, under its management plans, the springs will be fully protected against any potential adverse changes in water quality. Cape Alumina's proposed amendments to the HPA will, therefore, ensure full protection of the hydrology, water quality, riparian function and wildlife corridor functions of the springs, tributaries and the Wenlock River and ensure that the integrity of those features are preserved.

If the Queensland Government proceeds with the declaration of the Wenlock River Basin as a wild river area without the amendments suggested by Cape Alumina (and overwhelmingly supported by scientific evidence - including the views of the Queensland Government's own independent expert)

[1] Environmental Hydrology Associates Pty Ltd, "Review of Submissions relating to the hydrology and ecosystems functions of 'bauxite Springs on and in the vicinity of Bertiehaugh Station, Cape York Peninsula: Interim report after initial field inspections", report prepared for Queensland Department of Environment and Resource Management (DERM), 4 December 2009.

the Pisolite Hills project may be rendered uneconomic. This will mean that the opportunity to create hundreds of construction jobs and many more permanent, full-time jobs in the Cape York region will be lost, so too will the resultant Government revenue and a whole host of other economic and social benefits. This loss will be felt most severely in the Aboriginal community of Mapoon.

Cape Alumina agrees that the Wenlock River catchment contains some areas of natural environmental values that are worthy of protection. Equally, protecting the natural environment is an integral part of our approach to business. However, Cape Alumina has no plans to mine any wetlands, rivers, springs or areas of high conservation value and the Wenlock River will be fully protected under our operational and environmental management plans.

2. Introduction

Since 29 May 2009, when Cape Alumina Limited (ASX Code: CBX) lodged its submission to the Queensland Government in response to the Wenlock Basin Wild River Declaration Proposal, the Company has taken significant steps towards the development of its Pisolite Hills project. Cape Alumina's position with regard to the proposed declaration of the Wenlock River Basin as a wild river area has not altered. That is, we strongly believe the proposal must be amended and relevant legislation clarified to ensure that a balance is achieved between responsible mining economic development and protection of the natural values of the Wenlock River in western Cape York to best serve the interests of all stakeholders.

Cape Alumina was disappointed that the Queensland Government decided to defer a final decision on the proposed Wenlock River Basin wild river declaration for up to twelve months to 10 December, 2010.[2] Notwithstanding this, Cape Alumina understands that a decision is likely to be made by March, 2010 and we remain committed to providing the Queensland Government with the best scientific information to ensure appropriate decisions are made with respect to the proposal.

This supplementary submission complements Cape Alumina's submission dated 29 May, 2009 and provides an update on the hydrology of the Pisolite Hills area. It describes the existing ground and surface water quality in the area and the measures to protect those waters around the Company's proposed mining and infrastructure areas. It also provides an overview of Cape Alumina's business activities and highlights the significant social and economic benefits that the Pisolite Hills project will produce for all Australians – in particular the Traditional Land Owners of western Cape York and the Aboriginal people of Mapoon.

[2] Queensland Government Media Statement, Minister for Natural Resources, Mines and Energy and Minister for Trade The Honourable Stephen Robertson, "Wenlock Wild River decision deferred", Tuesday, 15 December 2009.

2.1. About Cape Alumina

Cape Alumina was established in February 2004 and is now Australia's leading pure-play bauxite company, evaluating one of Australia's largest undeveloped export-quality bauxite deposits at Pisolite Hills. The Brisbane-based company controls approximately 2,100km^2 of exploration tenements in western Cape York. This is the largest tenement holding in the region outside the Rio Tinto Alcan (RTA) mining leases. To date, Cape Alumina has identified seven priority bauxite exploration areas over its tenements but has only conducted drilling on one – the Pisolite Hills bauxite deposit, which is located 50 km north-east of Weipa. The company will systematically assess the remaining exploration areas over the next two years, at which time it will be able to more thoroughly assess opportunities for participation in a refinery project. Figure 1 below provides an overview of Cape Alumina's tenements in western Cape York.

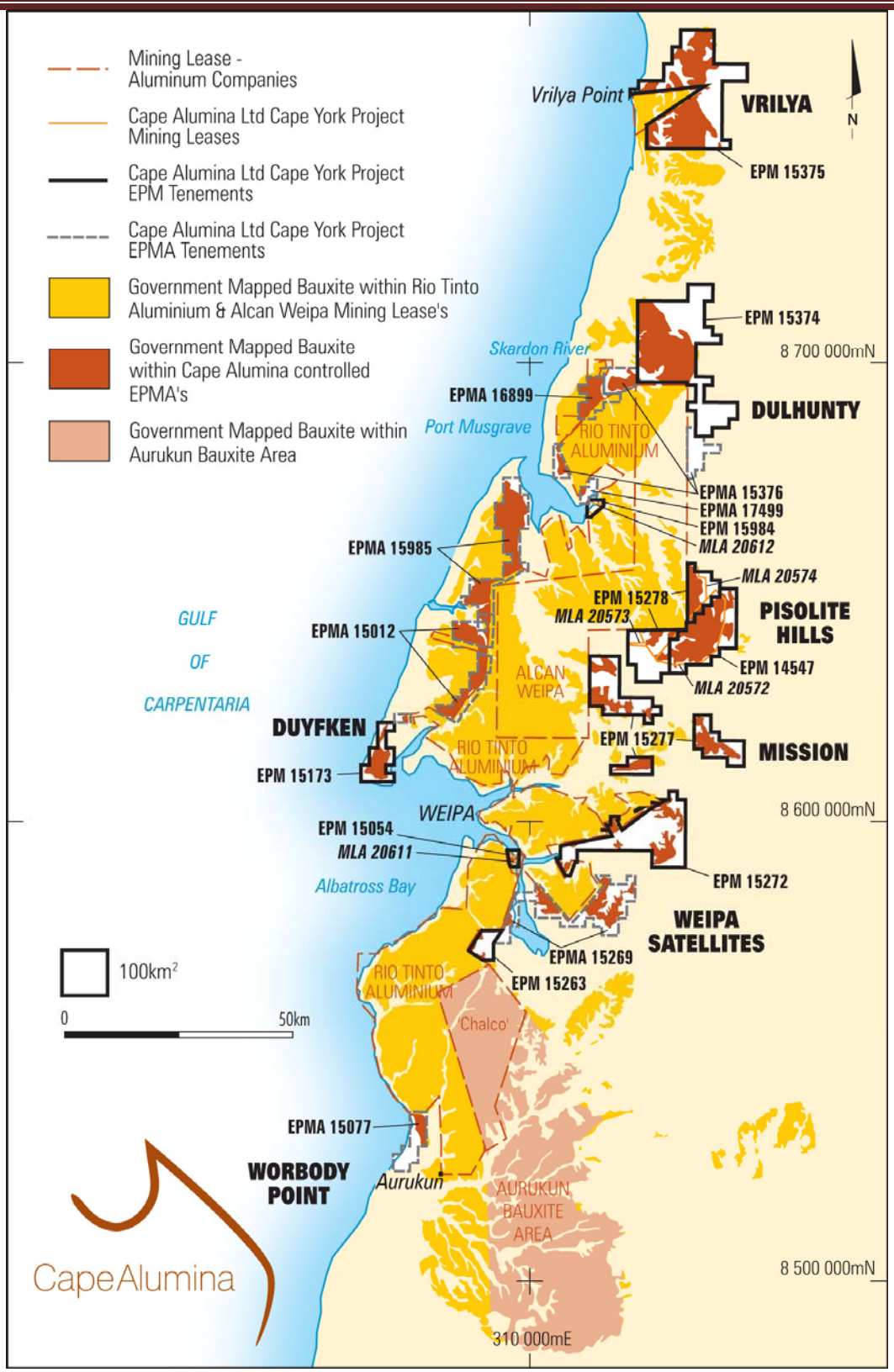

Figure 1: Cape Alumina's tenements in western Cape York.

2.2. About Pisolite Hills

Cape Alumina's business model is built around the initial development of the Pisolite Hills deposit – the Company's most advanced and promising project. The Pisolite Hills resource base is approximately 130 million tonnes (Mt) of *in situ* bauxite. Since 2004, Cape Alumina has invested more than $15 million into the Pisolite Hills project and expects to spend a further $15 million prior to committing to project development (the current estimate of project capital expenditure is approximately $400-500 million). Cape Alumina aims to position the Pisolite Hills project as one of the largest bauxite exporters in the world and to become one of the major suppliers to the rapidly growing Asia-Pacific region.

The Pisolite Hills bauxite project is centred on an elevated, open, dry bauxite plateau approximately 50km northeast of Weipa in western Cape York, Queensland. Based on known reserves, the Pisolite Hills bauxite mine and port project will export up to seven million tonnes per annum (Mtpa) of dry bauxite over an initial 14 year mine life. This project alone will position Cape Alumina among the top ten bauxite producers in the world and one of the major suppliers in the Asia-Pacific region. A schematic overview of the Pisolite Hills mine and port project is shown below in Figure 2.

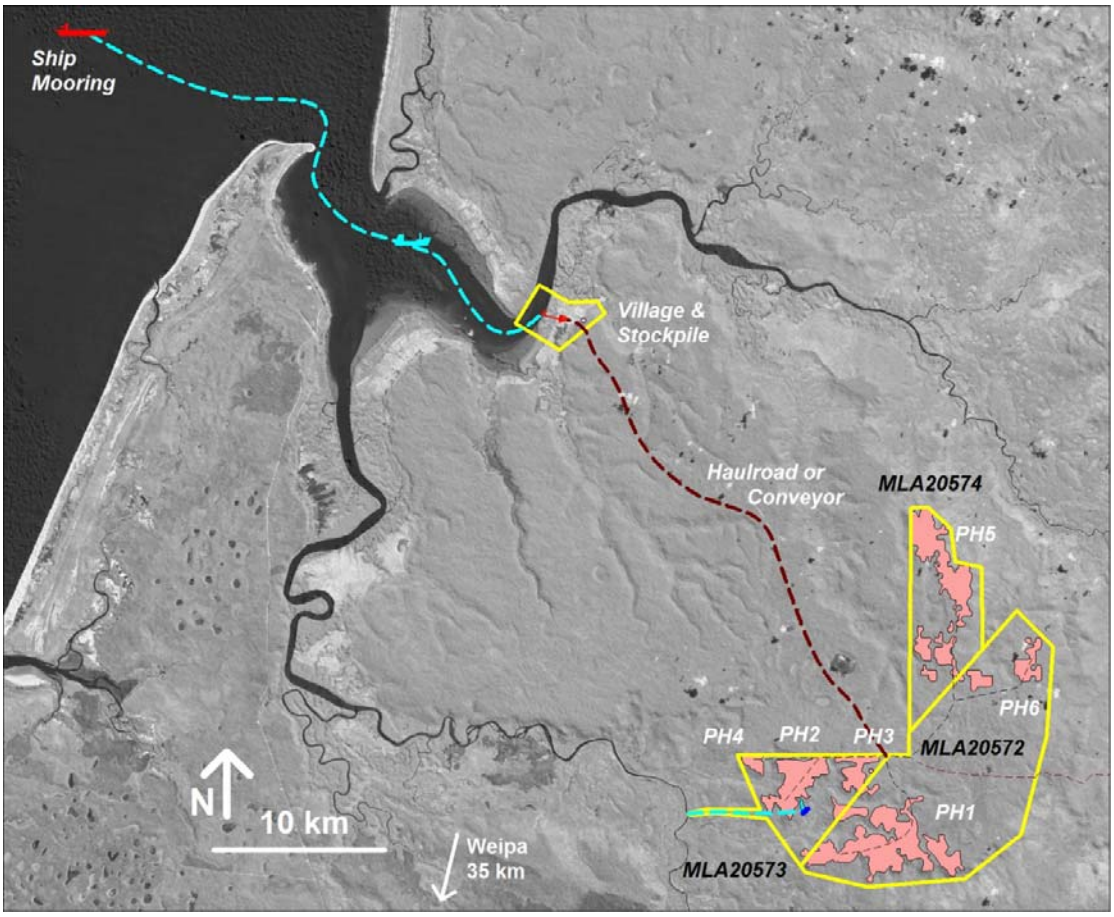

Figure 2: Pisolite Hills mine and port project overview.

2.2.1. Economic benefits of the Pisolite Hills bauxite project

The Pisolite Hills project will produce significant economic benefits for all Australians - in particular the Traditional Land Owners of western Cape York and the Aboriginal people of Mapoon. It will create approximately 500 jobs during construction and hundreds of permanent, full-time jobs during the 14 year life of the project. A 2007 report commissioned by the Queensland Government illustrates that our project will have far greater flow on effects for the Queensland economy. For example, during the construction phase, up to 1,706 indirect regional jobs and 1,065 indirect jobs throughout Queensland could be created. While during the operational phase those figures would be up to 1,056 indirect regional jobs and 639 indirect jobs throughout Queensland.[3]

The employment benefits of Cape Alumina's Pisolite Hills project are particularly important given that many of the jobs will be created in areas of high unemployment – Cairns and Mapoon. Cairns' unemployment rate (as at October 2009) is almost double the Queensland average at 12.5 per cent, while unemployment at Mapoon is endemic. Cape Alumina already employs many local Aboriginal people in all of its field operations including exploration, cultural heritage surveys, environmental studies, and environmental monitoring. The Pisolite Hills operation will draw people from the western Cape York area and has the potential to significantly boost skills and reduce unemployment rates in the region. Cape Alumina will invest in infrastructure as well as support local businesses, further boosting community development and employment in Far North Queensland. Pisolite Hills represents a tangible opportunity to dramatically boost the employment prospects of hundreds of working families in Cairns and indigenous Australians at Mapoon and western Cape York, which in turn will drive diversity in the Far North Queensland economy.

Cape Alumina's Pisolite Hills project will generate up to $4 billion in export revenue from bauxite sales and hundreds of millions of dollars in Queensland Government royalties and Commonwealth Government taxes (Table 1). The primary export market for the Pisolite Hills bauxite is China. The mineralisation of Cape Alumina's bauxite deposits is suitable for blending feed for the new generation of Chinese low-temperature alumina refineries. Cape Alumina presently has a legally-binding, take-or-pay off-take agreement with Chiping Xinfa Huaya Alumina Company (Xinfa) – China's second largest alumina-aluminium company – for the supply of one million tonne per annum (Mtpa) of bauxite over an initial five year period. Xinfa has made clear its desire to increase this annual contract tonnage of bauxite and Cape Alumina has also received expressions of interest from a number of other companies regarding off-take agreements, including Shandong Weiqiao Aluminum and Electricity Company Limited. Our project will also bring much-needed competition to the bauxite industry, which will ultimately benefit consumers of aluminium products with lower prices.

[3] ACIL Tasman, "Queensland mining industries: A report on the economic significance of mining and mineral processing to the Northern region", prepared for the Queensland Government, 2007.

Table 1: Base case estimated economic benefits to the Australian economy of the Pisolite Hills project	
Income source	**Value in AUD (over the life of the project)**
Export revenue	$3,200 million
Qld Government royalties	$320 million
Federal and State government taxes and charges	$335 million

The economic credentials of the Pisolite Hills project are particularly important for the Queensland economy and support the Queensland Government's stated goals of creating 100,000 jobs over a three-year period. Cape Alumina's project is also a perfect avenue for both the Queensland and Commonwealth governments to meet their policy objectives with respect to "closing the gap on Indigenous disadvantage."[4]

2.2.2. Social benefits of the Pisolite Hills Project

In addition to the substantial economic benefits of the project, there will be significant social benefits from Cape Alumina's activities in the western Cape York region. Our Pisolite Hills project is well-supported by the Aboriginal people of western Cape York. For more than four years Cape Alumina has been developing the Pisolite Hills project in full and open consultation with the Traditional Land Owners and Aboriginal community. The company has already negotiated four exploration agreements with Aboriginal parties in western Cape York, including two agreements with the Mapoon Deed of Grant in Trust (DOGIT) Trustees and Mapoon Council. Cape Alumina is in the very advances stages of negotiation of an Indigenous Land Use Agreement (ILUA) with the Aboriginal Trustees and Traditional Land Owners. Cape Alumina is also working with the local community to deliver programs that will lift the education and skills base and business opportunities for many within the Mapoon community. Preliminary data collected during the EIS process shows that greater than 80 per cent of the local Mapoon community is supportive of the project and believe that it will be highly beneficial for their community, particularly with respect to job creation and economic development of the region. Specific details of the social and economic benefits will be outlined in greater detail over the coming months and as the Company presents its Environmental Impact Statement (EIS) for the Queensland Government's consideration.

2.3. Wenlock Basin wild river declaration proposal

The Minister for Natural Resources, Mines and Energy and Minister for Trade, the Honourable Stephen Robertson, said in the Queensland Parliament late last year that:

[4] Queensland Government Media Statement, Minister for Local Government and Aboriginal and Torres Strait Islander Partnerships, The Honourable Desley Boyle "Closing the gap on Indigenous disadvantage remains a key focus", Monday, 15 February 2009.

> "Nobody has been able to provide details of one project that has been stopped as a result of Wild River declarations. It is time to actually deal with the facts."[5]

This statement has been made several times, and by several other government members, since. Cape Alumina hopes that, in the future, Government members will still be able to make such a claim. However, the proposed declaration of the Wenlock River Basin as a wild river area will, if it proceeds without amendments, seriously jeopardise the Pisolite Hills project and may render the project uneconomic. This will mean that the opportunity to create hundreds of construction jobs and many more permanent, full-time jobs in the Cape York region will be lost, so too will the resultant Government revenue and a whole host of other economic and social benefits. This loss will be felt most severely in the Aboriginal community of Mapoon.

Cape Alumina agrees that the Wenlock River catchment contains some areas of natural environmental value that are worthy of protection. Equally, protecting the natural environment is an integral part of our approach to business. However, the Queensland Government has failed to make any justification, on the basis of sound scientific evidence, for the application of the proposed arbitrary High Preservation Areas (HPA) as environmental buffers around the small springs and tributaries in the vicinity of Pisolite Hills.

In Cape Alumina's original submission to the Queensland Government, the Company proposed that the HPA in the proposed Wenlock Basin Wild River area be set to reflect the results of detailed analysis of the environmental features in the vicinity of Pisolite Hills, and with reference to published literature on the protection of wetlands and water courses from mining and development activities. This remains the Company's position. Specifically, Cape Alumina believes that the widths of the buffer zones outlined in the Wild Rivers Area Declaration Proposal for the HPA surrounding the special feature referred to as the Coolibah Springs Complex have been set without reference to specific criteria relevant to these features and can be safely reduced from over 500 metres to a maximum of 200 metres – determined on a case by case basis. A maximum 200 metres buffer zone meets, and in most cases exceeds, all the necessary environmental safeguards. This is supported by numerous detailed environmental studies which have been based upon site-specific hydrology, ecology, flora, fauna, and soil geochemistry data from the area. Setting the buffer zone of the HPA for the Coolibah Springs Complex to a maximum of 200 metres will not impact on the hydrological connectivity between the evergreen springs, their source aquifer and the Wenlock River. This will also:

- more than adequately preserve the entire riparian zone and, therefore, the riparian function of the springs and associated waterways;
- provide ample protection of the wildlife corridor associated with the tributaries; and
- ensure the integrity and water quality of the system.

[5] Minister for Natural Resources, Mines and Energy and Minister for Trade The Honourable Stephen Robertson, "Wild Rivers", statement made to the Queensland Parliament, Tuesday, 27 October 2009.

Naturally the ultimate development of our Pisolite Hills project will be subject to the requirements of, and the safeguards built into, the Queensland Government's EIS process and any guidelines under the Commonwealth Government's *Environment Protection and Biodiversity Conservation Act.* But setting the HPA to a maximum of 200 metres is consistent with both the Technical Guidelines for the *Environmental Management of Exploration and Mining in Queensland – Exploration and Mining in Watercourses (DME 1995); and the Guideline for the Determination of Wetland Buffer Requirements (Department for Planning and Infrastructure, State of Western Australia 2005).*

As part of the EIS, Cape Alumina has collected detailed hydrological data from 26 hydrological monitoring bores that, together with more than 4,000 exploration drill holes, have been used to generate a robust hydrological model for the Pisolite Hills area. This model clearly demonstrates there would be negligible, if any, impact on the hydrology of the springs from our planned mining operation. The Queensland Government engaged an independent expert to assess all of the substantial submissions on the Wenlock nomination and the expert concurred with Cape Alumina's interpretation of the groundwater hydrology of the area. The hydrologic model has been further refined and more details about the hydrology of the area are set out in Section 3 of this supplementary submission.

In summary, the scientific studies undertaken by Cape Alumina confirm that responsible and sustainable economic development of the Pisolite Hills project and environmental protection of the Wenlock River can both be achieved. These views are supported by the Queensland Government's own independent expert. Cape Alumina has no plans to mine any wetlands, rivers, springs or areas of high conservation value and the Wenlock River will be fully protected under our operational and environmental management plans. The elevated dry Stringybark country earmarked for shallow mining will be fully rehabilitated progressively throughout the life of the operation.

2.3.1. Socio-economic cost-benefit analysis of the Wenlock River Basin wild river proposal

While Cape Alumina agrees with the Government that there are natural environmental values in the Wenlock River Basin that are worthy of protection, Cape Alumina has been advised by the Department of Environment and Resource Management (DERM) that there has been no attempt by the Queensland Government to properly analyse the public policy benefits of declaring the area a wild river. For example, while the Government's Wenlock Basin Overview Report described the natural values of wild rivers and the negative impacts of development, it does not attempt to quantify these values. This report, and the subsequent report summarising the results of consultation, describes a large range of potential positive and negative impacts of declaration, which, it has been said, the Minister will consider in his decision on whether or not to declare the Wenlock River Basin a wild river area. The Minister's task in comparing positive and negative impacts without quantification must be highly subjective. It will also be impossible to make the decision-making process transparent to stakeholders unless the Minister is able to order his weightings of the positive

and negative impacts in his decision. Moreover, the process of declaration and collecting stakeholders' views without some attempt to quantify benefits and costs is at odds with the standard process increasingly used in regulation assessments. This point has also been made by the Queensland Resources Council (QRC). QRC chief executive officer Michael Roche was quoted in the media recently as saying the "big flaw in the Wild Rivers legislation was its potential to be used to prohibit the future development of mineral resources without first assessing the economic and social impacts of doing so." He said:

> "The QRC has no objection to the concept of identifying wild rivers, particularly as Queensland already has comprehensive laws available to protect them. However, we do draw the line at blanket prohibitions that are not subject to sound environmental, economic and social impact scrutiny. To date the operation of the legislation has not cost Queensland any significant mining projects however, the risk of damaging the economics of mining projects is real and the QRC is closely monitoring the government's deliberations over the Wenlock River in western Cape York."[6]

2.3.2. Environmental Hydrology Associates Pty Ltd (EHA) Report – December 2009

In December 2009, the Queensland Government presented to Cape Alumina an interim report prepared by Mr Peter Evans of Environmental Hydrology Associates Pty Ltd (EHA). This report was commissioned by the Department of Environment and Resource Management (DERM) to provide an independent analysis of various public submissions made to the Government concerning the proposed Wenlock Basin wild river area and to specifically assess hydrological aspects of the proposed declaration.

In summary, this report stated that "the data to hand at the time of preparation of this report is largely supportive of the hydro-geological scheme proposed by [Cape Alumina]." It went on to say that "it appears on the basis of the data to hand that bauxite mining as proposed will have relatively little impact on the groundwater hydrology of the springs. There appears to be no clear justification of the magnitude of the HPA setbacks." This report also indicated that the evidence did not support the contention made by Australia Zoo, on behalf of Silverback Properties Pty Ltd, that the bauxite acts as a sponge and is the source of water for the nearby springs.

3. Hydrology of the Pisolite Hills area

This section provides an update on the hydrology of the Pisolite Hills area based on studies conducted on behalf of Cape Alumina by Australasian Groundwater and Environmental Consultants Pty Ltd and Dr Massimo Gasparon of The University of Queensland. It includes assessment of

[6] Roche, M., cited in "Threat to mining's growth", by Nicola Gage, North-West Star, Tuesday, 19 January 2010.

stratigraphic logs, chemical analyses of rock and water samples and groundwater monitoring of a total of 26 hydrological monitoring bores drilled by Cape Alumina between late 2008 and late 2009.

3.1. Pisolite Hills groundwater regime

3.1.1. Geological setting

The Pisolite Hills bauxite deposits are located within the Carpentaria Basin, a sub-basin of the Great Artesian Basin (GAB). The Mesozoic sedimentary units dip to the west from the eastern edge of the basin, becoming thicker towards the centre of the basin which extends under the Gulf of Carpentaria. In the Weipa-Aurukun area the Mesozoic sequence is 800-1000 metres thick and consists of shales, siltstones and sandstones. The major artesian aquifers include the Gilbert River Formation and the Garraway Sandstone which occur towards the base of the sedimentary sequence at an estimated depth below the Pisolite Hills area of 400-600 metres. The aquifers, which are continuous over almost all of Cape York Peninsula west of the Great Dividing Range, consist of a series of thin, permeable sandstone beds distributed over a total thickness of about 150 metres. The bauxite, which is formed from weathering and leaching of shales and siltstones of the underlying Tertiary/Cretaceous Bulimba Formation and Lower Cretaceous Rolling Downs Group, occurs on plateaus as the upper part of a Quaternary/Tertiary loose, pisolitic, laterite profile that is up to 15 metres thick. Drilling of monitoring bores on the bauxite plateaus at Pisolite Hills has shown the general stratigraphy of the lateritic profile to consist of:

0 – 0.6m	topsoil
0.6 – 5m	bauxite
5 – 6m	ferricrete
6 – 10m	kaolin
10 – 15m	sand and gravel
15+	mottled silty clay

3.1.2. Sand-gravel aquifers

Drilling in 2008 intersected a coarse, white quartz sand-gravel horizon below a kaolinitic clay layer in all three monitoring boreholes drilled on the Pisolite Hills 1 (PH1) bauxite plateau and two of the three monitoring boreholes drilled on the Pisolite Hills 2 (PH2) plateau. The water table was intersected in the sand-gravel horizon wherever this unit was intersected. The sand-gravel layer passes directly into stiff mottled and fissured clay which is the upper weathered profile of the underlying Cretaceous bedrock. A similar sand-gravel layer occurs in the Bulimba Formation at Weipa and is the source of the town's domestic water supply. Smart (1977) states that the sand-gravel horizon within the Bulimba Formation may be due to the preservation of old stream channels, filled with coarser and less argillaceous material.[7]

[7] Smart J., (1977), *"Weipa Queensland, 1:250,000 Geological Series Explanatory Notes"*, Sheet SD/54-3.

Pseudokarst sinkhole features, known locally as "melon holes" occur to the north and north east of the Pisolite Hills bauxite area and are recorded throughout the lateritic plateau of western Cape York. Laffan (2001) interpreted the "melon holes", which are up to 1 kilometre in diameter, to have formed through collapse due to erosion of the regolith material by preferential flow along pipes and fissures, leaving behind large shallow depressions.[8] Drilling investigation and monitoring of the "melon hole" area north-east of Pisolite Hills in 2009 indicates that the sand-gravel aquifer extends at least five kilometers beyond the limit of bauxite mineralisation to the north-east (PHMB8 in Figure 5). Furthermore, although the sand-gravel aquifer was intersected in three of the recently completed monitoring boreholes drilled outside the limit of bauxite mineralisation, it was not intersected in seven other boreholes drilled in the area north-east of Pisolite Hills. Where the sand-gravel aquifer was absent, the kaolinitic ironstone profile was found to be underlain by claystone. The hydrogeological drilling in the Pisolite Hills area together with the sub-surface distribution of the sand-gravel aquifer indicates a similar geological setting to the Weipa Peninsula and is consistent with a braided palaeo-channel depositional model for the shallow sand-gravel units.

3.1.3. Recharge and groundwater flow

Monitoring of groundwater levels within the sand-gravel aquifer and pisolite zone during the 2008-09 wet and dry season on Cape York and the hydrographs produced from these data indicates that within the PH1 and PH2 plateau areas the kaolin layer does not act as an impermeable barrier to groundwater infiltration. The hydrographs (see Figure 3 for an example) indicate that rainfall which infiltrates the pisolite (bauxite) passes through the underlying kaolin layer to recharge the sand-gravel aquifer. The hydrographs indicate that the pisolite layer did not saturate during the wet season with the exception being site PH1 in the centre of the PH1 plateau, where the groundwater table did rise above the kaolin layer providing a 1 metre of saturated thickness within the pisolite zone. However, the pisolite remained saturated at this location for only a very short period of time, a two-month period from 7 February to 9 April 2009, before drying out. The data indicates that:

- the pisolitic bauxite layer does not act as a sponge or store/reservoir of rainfall infiltration; and
- the kaolin layer is permeable (consistent with the observation that it is typically a sandy clay horizon).

Recent groundwater drilling in the "melon hole" area indicates that the groundwater forms a mound due to infiltration of water stored in the melon holes from wet season runoff, with groundwater gradients radiating from this mound towards the springs, as shown on Figure 4.

[8] Laffan, S.W., (Dec. 2001)), "Inferring the Spatial Distribution of Regolith Properties Using Surface and Measurable Features", a thesis submitted for the degree of Doctor of Philosophy of the Australian National University.

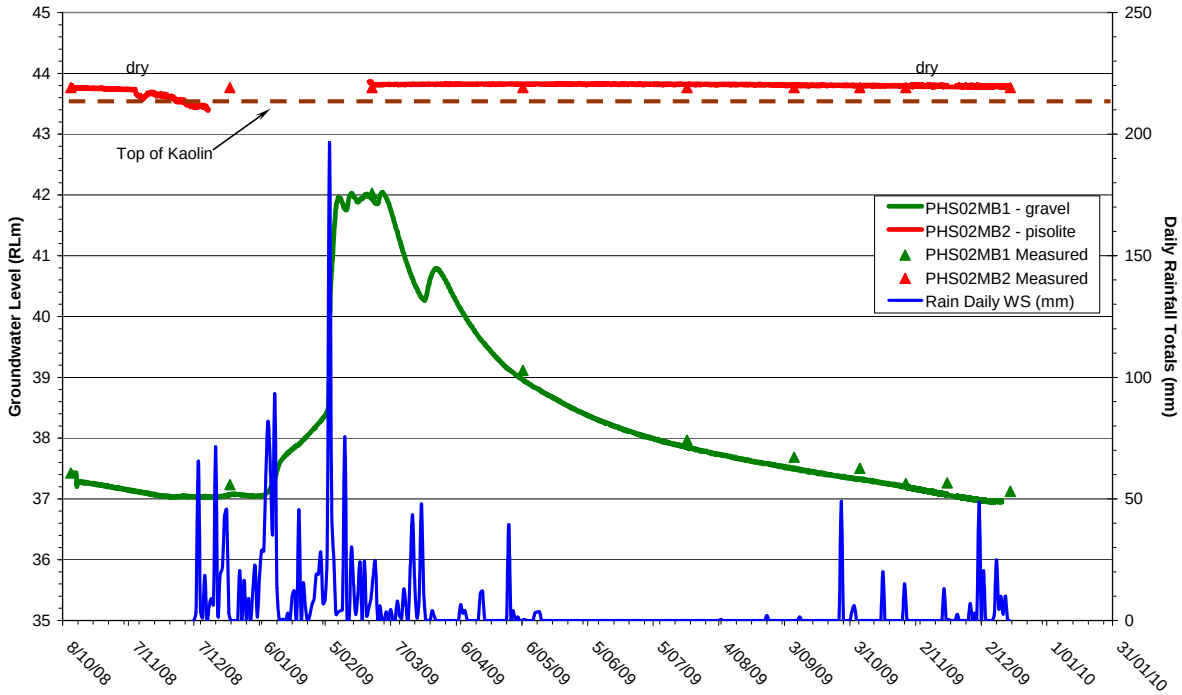

Figure 3: Hydrograph of response of gravel aquifer and bauxite to rainfall recharge

Groundwater discharges in discrete areas where the sand-gravel horizon "daylights" around the dissected margins of the plateaus forming springs (Figure 3). The sand-gravel aquifer maintains groundwater flow to these springs throughout the dry season. Based on these findings it is demonstrated that the bauxite layer at Pisolite Hills is not the source of groundwater flow to springs, tributaries or the Wenlock River. The bauxite and underlying kaolin does not act as a sponge but is highly permeable and rapidly transmits rainfall infiltration to the sand-gravel aquifer. This statement is supported by Volker and Crees (1993) who studied the Weipa bauxite mining area, which has a similar groundwater regime to that of Pisolite Hills, and found that, "due to its high porosity, most drainage … is throughflow via the regolith."[9] The bauxite is dry throughout the dry season and only locally saturates for short periods during the wet season, whereas the underlying sand-gravel aquifer holds water throughout the year. Groundwater flow to the springs is maintained by depletion of water stored in the sand-gravel aquifer and by flow to the aquifer from the groundwater mound located in the "melon hole" area.

[9] Volker R.E. & Crees M.R., (1993), "Recharge Estimates for an Unconfined Aquifer Affected by Surface Mining and Rehabilitation" Hydrology of Warm Humid Regions, IAHS Publ. No. 216, 1993.

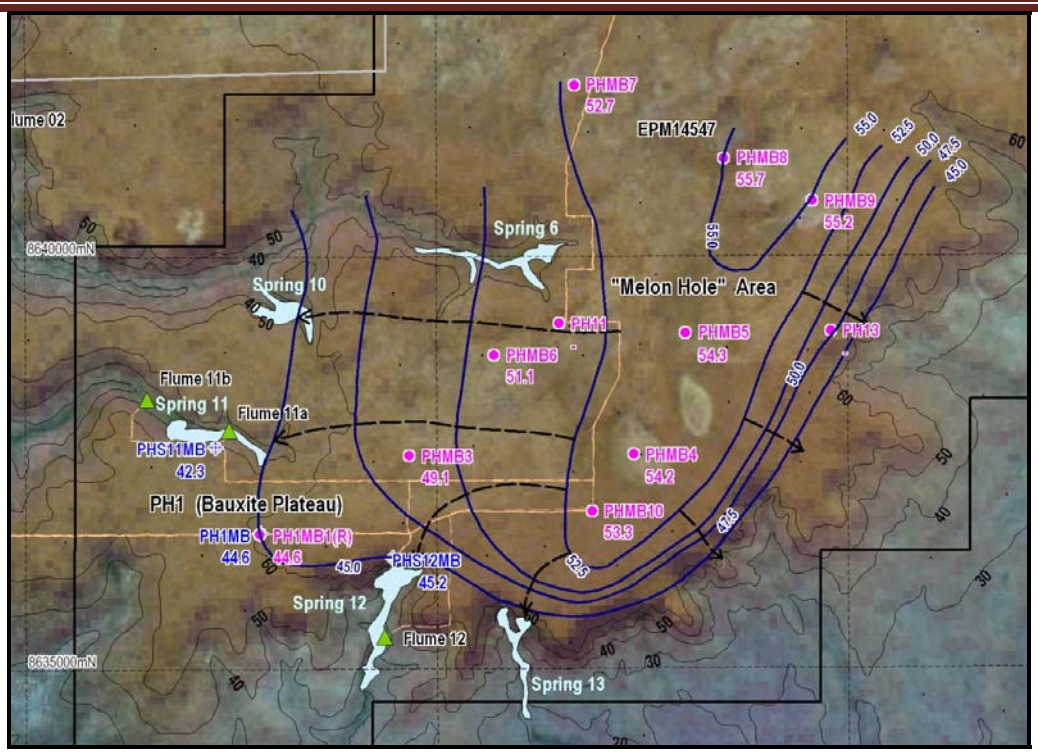

Figure 4: Water table contours and direction of groundwater flow.

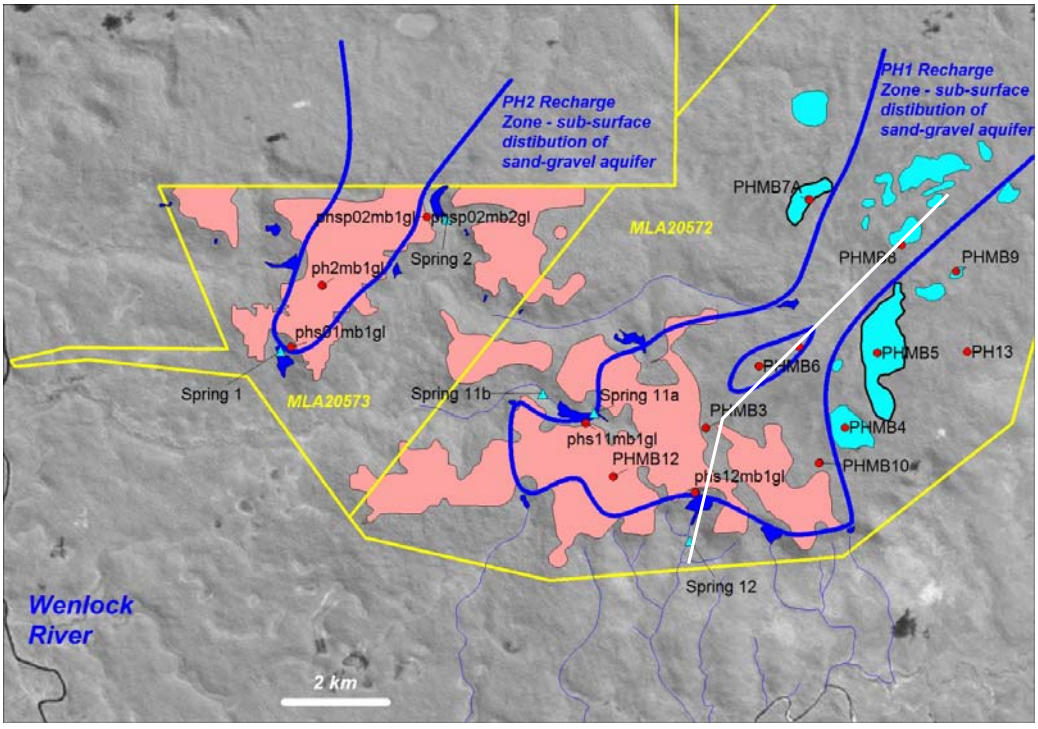

Figure 5: Hydrology and groundwater model of the Pisolite Hills area.

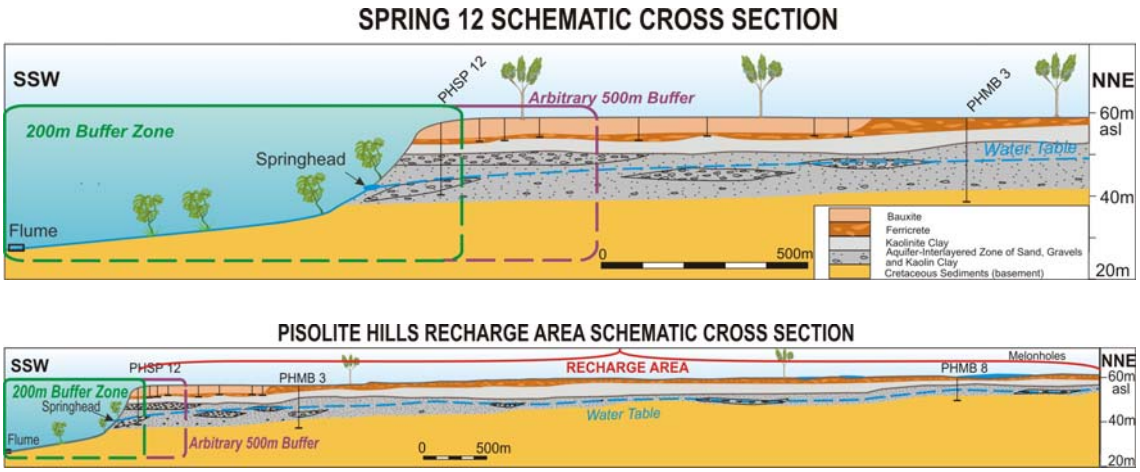

Figure 6: Cross section through Spring 12, the Pisolite Hills plateau and surrounding area (white line in Figure 5). The lower figure illustrates that the aquifer recharge zone extends far beyond the limit of bauxite mineralisation.

3.2. Potential impacts of bauxite mining on the groundwater regime

The bauxite layer has been shown to be a transport medium for rainfall infiltration only, it does not act as a sponge or reservoir of wet season rainfall which then discharges to the springs during the dry season. Furthermore, rainwater infiltration to the aquifer is not restricted to the bauxite areas and has been shown to be far more widespread. Therefore, recharge of the sand-gravel aquifer will not be impacted by removal of bauxite during the mining operation. In a study of the impact of bauxite mining at Weipa on a similar underlying sand-gravel aquifer, Volker and Crees (1993) concluded that "there are no marked differences between recharges for the natural landscape and for mined and revegetated areas".[9]

Figures 5 and 6 illustrate that there is no foundation for the arbitrary 500 metre buffer zone proposed in the Wenlock Wild River nomination proposal on the basis of hydrological connectivity. They show that the arbitrary 500 metre buffer zone will provide no additional environmental protection to the hydrological connectivity compared with the maximum 200 metre buffer proposed by Cape Alumina. Furthermore, Cape Alumina has provided conclusive evidence that mining with compliance to a maximum 200 metre environmental buffer as proposed will have no detrimental impact on the hydrological connectivity between the groundwater and the springs.

4. Water quality and surface water management

In addition to the potential impact of mining on the hydrological regime of the area, the determination of appropriate environmental buffers under the Wild River Act should consider potential impacts on water quality from any future development. This section describes the existing ground and surface water quality in the area, the measures proposed to protect those waters around the proposed mining and infrastructure areas and appropriate environmental buffers to ensure their protection.

4.1. Groundwater quality

Dr Massimo Gasparon of The University of Queensland was engaged by Cape Alumina to undertake a study of the geochemical characterisation of the surface waters at Pisolite Hills and to document and assess the acidic nature of spring water in the vicinity of Pisolite Hills[10]. This work, undertaken during the 2009 field season, involved:

- geochemical and mineralogical analyses of lithological samples from boreholes and surface outcrops;
- field measurements of pH, electrical conductivity and redox conditions of spring and surface waters;
- geochemical analyses of surface waters; and
- leaching experiments aimed at simulating the interaction of rainwater with the various lithologies represented in the area.

The results of this work are summarised as follows:

1. pH values of the springs are typical of meteoric water;
2. low pH 'acid' waters, where present, are localised and due to organic material within springs;
3. The surface water pH and electrical conductivity (salinity) values are similar to those of the quartz gravel aquifer groundwaters;
4. the bauxite sequence mineral phases are stable under surficial conditions and are, therefore, unlikely to react with meteoric or groundwater to change the original composition of the water;
5. both gibbsite and kaolinite are strong adsorbents and any waters coming into contact with them may lose much of their cation load due to surface adsorption;
6. the reaction of meteoric water with the bauxite sequence does not change the original pH of the water;
7. the X-ray Diffraction (XRD) mineralogy data, geochemical analyses and geochemical models indicate the bauxite lithologies contribute very little to the spring waters chemistry because they are geochemically very stable;
8. the most bauxite rich rock samples show a marked Ce (REE) positive anomaly which is not present in the water samples and confirms the absence of a unique geochemical link between the pisolitic bauxite and the spring waters.

Therefore, there is no scientific basis for claims that removal of the bauxite during mining will have any direct impact on water quality.

[10] Gasparon 2009 *Draft report Geochemical characterisation of waters in EPM14547 and EPM15278, Pisolite Hills, Cape York Peninsula, Australia.*

Australasian Groundwater and Environmental Consultants Pty Ltd are engaged by Cape Alumina to conduct groundwater modeling of the hydrological regime in the vicinity for Pisolite Hills[11] including the recharge area well away from the planned mining areas. The total dissolved solids (TDS) of spring waters in the vicinity of Pisolite Hills vary between 14-108mg/L TDS. The TDS of the groundwater in the sand-gravel aquifer varies between 21-272 mg/L TDS.

The TDS of groundwater in the "melon hole" area where the aquifer was intersected is 102-272 mg/L being highest immediately adjacent to one of the melon holes late in the dry season. The TDS of groundwater in the "melon hole" area where the aquifer was not intersected is significantly higher being 273-1040 mg/L. The highest readings were recorded from boreholes drilled within the "melon holes". Groundwater salinity is higher in the immediate vicinity of the "melon holes" and increases as the dry season advances, and this is thought to be due to the effects of prolonged evaporation. It is, therefore, postulated that groundwater flow from the "melon hole" area mixes with higher quality water (lower in TDS), which infiltrated the more widespread sand-gravel aquifer away from the "melon holes" resulting in the observed natural variability of TDS in the springs.

The pH of groundwater and spring water samples are generally in the range pH 5.32 – 6.75 and pH 5.39 – 6.42 respectively. Hounslow (1995) states "rain unaffected by mans activities will have a pH of 5.5 – 6.5 because of dissolved CO_2" and this matches the generally recorded data very closely. [12] Spring water samples taken at the headwaters of the spring generally have a higher pH, than those samples collected at the flumes located downstream of the spring head and of the highly vegetated swamp area created by the spring. It is, therefore, clear that this increase in acidity is not related to infiltration through the bauxite plateau areas but is most likely due to the decomposition of organic material within the swamp environment resulting in the local production of humic acid. Towards the end of the dry season the water quality in some bores becomes more acidic, particularly in the "melon hole" area and this is attributed to acidity derived from rotting vegetation in the swamp environment of the "melon holes". Evaporation and increased acidity is even more pronounced in those boreholes in or near "melon" holes where the sand-gravel aquifer was not intersected and this is consistent with a reduced groundwater flow rate in areas away from the aquifer and the consequent impact of prolonged evaporation.

The TDS and composition of the major cations and anions of the groundwater and springs at Pisolite Hills were compared with groundwater from the Great Artesian Basin (GAB) aquifers extracted from 800 metre deep bores on the Weipa Peninsula. The water from the sand-gravel aquifer at Pisolite Hills is chemically different from the GAB aquifer, which has a much higher TDS concentration of about 740mg/L and an alkaline pH (>7), providing evidence that there is no connection with the deep artesian aquifers.

[11] Australasian Groundwater and Environmental Consultants Pty Ltd, 2010. Pisolite Hills Project Hydrological study of springs impact assessment – Review of existing data.
[12] Hounslow A.W. (1995), "Water Quality Data, Analysis and Interpretation".

In conclusion, the springs near Pisolite Hills are fed by a sand-gravel aquifer originally deposited in an ancient stream bed (palaeo-channel) on claystone of the Rolling Downs Formation. The sub-surface distribution of the sand-gravel aquifer is significantly more widespread than the bauxite and is known to extend at least 5 kilometres north-east from the limit of bauxite mineralisation. Recharge of the sand-gravel layer occurs by direct and rapid infiltration of rainfall on the plateau, the infiltrating water passes through the overlying stratigraphy including through the bauxite, ironstone and kaolin horizons where present. A groundwater mound occurs in the vicinity of the "melon holes" as a result of water infiltrating from the "melon holes" to the low permeability fissured claystones which are predominant in the area. Slow release of water from the "melon holes" and claystones to the sand-gravel aquifer, together with depletion of storage from the sand-gravel aquifer, maintains spring flow throughout the dry season.

Therefore, removal of bauxite from within a relatively small portion of the recharge area will have no direct impact on the recharge of the aquifer or the degree of mixing within the aquifer and therefore will have no impact on water quality in the springs and tributaries.

4.2. Surface water management

The environmental buffers previously proposed by Cape Alumina are consistent with the *Technical Guidelines for environmental management of exploration and mining in Queensland – Exploration and Mining in Watercourses*, which have been established to protect waterways from the impact of mining through appropriate setbacks. In addition, the Pisolite Hills surface water management plan is being developed as part of the EIS process under the project's Environmental Management Plan and will be subject to the proper assessment by DERM and DEWHA under relevant legislation.

The proposed bauxite mine areas Pisolite Hills 1 (PH1) to Pisolite Hills 4 (PH4) are located along ridgelines and encroach into several local catchments, including Ling Creek, Sandfly Creek, Charger Creek and other minor creeks draining to the Wenlock River to the south and west. The proposed mine areas Pisolite Hills 5 (PH5) and Pisolite Hills 6 (PH6) are located along ridgelines near the headwaters of major creeks draining northwards to the Ducie River. Any potential changes in the natural drainage sub-catchment boundaries will be localised and will not have a significant impact on the natural drainage in Ling Creek or Sandfly Creek beyond the mining precincts or in the Wenlock River downstream of the mine area. The risk of increased storm runoff flows resulting from the additional areas transferred into drainage sub-catchments as a result of mining activities are to be mitigated through the establishment of erosion and sediment control basins and storages to be formed in the rehabilitated areas. Such mitigation measures will prevent increased erosion along the natural drainage lines downstream of the outlets.

There are a number of springs located near the bases of the ridgelines below the proposed mine areas. The springs are ecologically sensitive areas and the drainage of the mine precincts is to result in minimal impacts on the springs as outlined below. The proposed storm water management strategy for the mine excavation areas aims to:

- divert surface runoff from adjoining areas around the excavation;
- minimise impact on mine operations;
- control erosion and sedimentation on rehabilitated areas; and
- minimise impact on the springs and natural drainage lines.

Where mining is planned in the vicinity of a spring, top soil will initially be stockpiled adjacent to the proposed mining area. Bauxite overburden will then be pushed into a series of bunds creating a surface barrier between the mine area and the top of the plateau escarpment adjacent to the spring. This bund will include a biomass layer derived from vegetation cleared from the mine area, which will be compacted against the overburden bund. Sediment basins will be formed adjacent to these bunds. The outlets from the sediment basins will be located at the existing natural drainage lines and will incorporate erosion protection measures in accordance with Queensland erosion and sediment control guidelines.

Surface runoff from areas outside the mine operation areas will be diverted by the excavation of swale drains or the construction of earth bunds, as appropriate for site conditions. The diverted runoff will be discharged to existing natural drainage lines at suitable locations. Flow spreader devices will be provided at the outlets to distribute the flow as shallow overland flow and thus prevent erosion.

In order to minimise disruption to mining operations during wet weather, the floor of the excavation may be graded to a sump drain along the side of the excavation. The runoff contained in the sump drain may be pumped to the sediment basins on the rehabilitated areas prior to discharge to the natural drainage if it does not soak into the underlying strata.

The primary focus of the long term storm-water quality management for the mining operations area is erosion and sediment control of runoff from the rehabilitated areas. This is to be achieved through revegetation and provision of sediment traps in the finished surface topography. The rehabilitation of the site will aim to replicate the topographic characteristics of the undisturbed natural land surface in order to minimise overland flow velocities and to avoid concentrated flows. Sediment basins will be constructed near the drainage outlets from the rehabilitation areas.

Runoff from the beneficiation plant areas and mine administration and maintenance facility areas is to be collected and conveyed to sediment basins via shallow swale drains. Overflows from the sediment basins are to be discharged to the existing natural drainage lines as shallow overland flow. Erosion control devices including check dams and flow spreaders will be provided on the basin outlets. The sediment basins are to be designed and constructed in accordance with procedures outlined in the Brisbane City Council guidelines for rapid settling of coarse sediment having a low clay content, which were developed from similar guidelines used interstate and widely used throughout Queensland. The basins will be removed from the rehabilitation areas once the vegetation has established a stable cover over the areas. The proposed drainage, erosion and sediment control strategies will minimise:

- changes in storm runoff flow rates;
- sediment loads in storm runoff; and
- potential impacts on the springs.

The environmental buffers proposed by Cape Alumina in its submission dated 29 May, 2009 are sufficient to contain all of the mitigation measures proposed in the surface water management plan and which the company expects will be imposed by DERM under the Environmental Authority and Mining Lease conditions. To ensure that the special features are protected and that HPA are set on the basis of sound scientific principles, the HPA in the vicinity of Pisolite Hills should be amended to the widths previously proposed by Cape Alumina.

5. Examples of bauxite mining adjacent to water features – precedents from Weipa

Bauxite mining has occurred in the Weipa region continuously for almost 50 years. Mining areas are typically setback from active drainage lines and wetland features by approximately 200 metres. However, a number of examples are known where historical and active mining has occurred at distances of 150 metres or less from wetland features without any apparent evidence of detrimental impacts on the wetland features from the adjacent mining activity.

Figure 7 and 8 show a recently developed bauxite mining pit as close as 150m from a major wetland area on the Weipa Peninsula at 12°38'03.05" south, 141°55'03.54" east. Wetland vegetation communities under stress resulting from adverse impacts of mining would be expected to show signs such as drowned trees, dead trees, oxidation of organic soils or relocation of vegetation patterns. These high resolution images show no evidence of such stress on the vegetation community immediately adjacent to active mining.

Figure 7: Weipa mine at 12°38’03.05” south 141°55’03.54” east. The white line in lower centre is 150 metres long.

Figure 8: Close-up of Figure 7. The white line in lower left centre is 150 metres long.

Figure 9 shows another example where a large mining pit measuring 8.5 kilometres x 1.5 kilometres is situated on average about 250 metres away from a major wetland area, but which approaches as close as 70 metres from the wetland. Both active mining and rehabilitated and re-vegetated areas are situated immediately adjacent to the wetland and, therefore, any long-term mining-related impacts should be visible from the high resolution Google Earth imagery. Furthermore, a fully rehabilitated and re-vegetated mined-out area measuring 4.2 kilometres x 1.2 kilometres lies immediately south of the wetland and is separated by an environmental buffer averaging 200 metres in width. The degree of re-vegetation of this mine indicates that mining has been active for many years adjacent to this important wetland with no apparent visible impacts.

Figure 9: Weipa mine at 12°37'15" south 141°58'00" east. Red dots in centre of image are 70 metres apart indicating the distance between the mine and the wetland.

6. Conclusions

Substantial progress has been made on the Pisolite Hills EIS, which has enabled refinement of the hydrologic model and provides further confidence in the conclusions presented by Cape Alumina in its submission dated 29 May, 2009. In particular, data obtained from the expanded network of 26 hydrological monitoring bores confirms that:

1. the pisolitic bauxite layer does not act as a sponge or store/reservoir of rainfall infiltration; and
2. the kaolin layer is permeable (consistent with the observation that it is typically a sandy clay horizon).

In addition, surface and ground water quality studies have shown:

3. pH values of the springs are typical of meteoric water;
4. low pH 'acid' waters are localised and due to organic material within springs;
5. The surface water pH and electrical conductivity (salinity) values are similar to those of the quartz gravel aquifer ground-waters;
6. the bauxite sequence mineral phases are stable under surficial conditions and are therefore unlikely to react with meteoric or groundwater to change the original composition of the water;
7. both gibbsite and kaolinite are strong adsorbents and any waters coming into contact with them may lose much of their cation load due to surface adsorption;
8. the reaction of meteoric water with the bauxite sequence does not change the original pH of the water; and
9. the XRD mineralogy data, geochemical analyses and geochemical models indicate the bauxite lithologies contribute very little to the spring waters chemistry because they are geochemically very stable.

This work emphasises the fact that the spring water is not unique and that the bauxite has no influence on its chemistry and that there will, therefore, be no impact on either the water quality of the springs or the hydrologic connectivity between the ground water and the springs as a result of the planned mining operation at Pisolite Hills. Furthermore, the operational management plans, including a Surface Water Management Plan, being developed by Cape Alumina for assessment by both DERM and DEWHA will ensure minimal, if any, impact on the water quality of the springs as a result of the planned mining operations. The scientific consensus is that the proposed Pisolite Hills project will have no impact on the Coolibah Springs Complex or the Wenlock River. There is no scientific justification for application of the proposed arbitrary buffers at Pisolite Hills and the HPA at the Coolibah Springs should be reduced to reflect the buffers proposed by Cape Alumina on the basis of scientific analysis of the environment, existing guidelines and operational practice.

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