ATTN JOHN BASTIN 08-8303-0753
TIM KAHN, 02-6274-1620

FROM: JOHN HALLAM
FRIENDS OF THE EARTH SYDNEY

RE: BEVERLEY DRAFT ENVIRONMENTAL IMPACT STATEMENT.

FRIENDS OF THE EARTH SYDNEY COMMENTS ON BEVERLEY DRAFT ENVIRONMENTAL IMPACT STATEMENT.

1)The ISL Mining method.

The mining method proposed, in-situ-leaching, is one which the company argues is well tried. This is not the case.

ISL in any form has not been used for full-scale mining operations anywhere in Australia, though trial operations have been carried out at Honeymoon and Beverley. The Honeymoon trial ISL operation, carried out in the early 1980s, revealed a number of technical problems with the specific form of ISL adopted, acid leaching. The Field leach trial currently being carried out at Beverley, has resulted already in a significant leak.

Acid leaching has been used as a mining method in the US, Eastern Europe, and in the CIS/Soviet Union.

However, while US experience and practice is normally taken as the ‘reference’ for Australian operations, the method used in the US has normally been an alkaline instead of an acid, leach, chemically completely different.

The owner of Heathgate Resources, General Atomics, while it has extensive experience in the field of gas-cooled reactors, has no experience either in the field of uranium mining, or in the field of ISL mining, either in the US or elsewhere. Beverley is thus GA/Heathgates first ever operation of this kind.

ISL operations in the US, using the alkaline leach process, have not been problem- free. Major ‘excursions’ of leach liquor have occurred at the Irigaray project in Wyoming, in which leach liquor has ended up polluting aquifers used for drinking-water supply. FOE will comment on this in more detail by 28/Aug.

The acid leach process has it seems, mainly been used in the Soviet/CIS countries and in Eastern Europe. The problem with this method is that it mobilises some heavy metals more easily than does the alkaline leach process used in the US.

The DEIS says that this is not going to be a problem at the Beverley deposit, but it is not clear that this is true. No detailed comparison between US, CIS, and Australian ores is offered.

Experience with the acid-leach method is inadequate, at least in the west, and GA/Heathgate does not posses the experience base to compensate for this.

1.a)ISL Technology
1.b) US Experience In ISL
1.c.)CIS And Other ISL Experience

1.a.) ISL Technology

The DEIS states in 4.1.2., that in the ISL process, natural groundwater is ‘fortified’ with an oxidising agent, and either an acidic or an alkaline complexing agent. This is a strange and devious terminology, which fails absolutely to describe a process that in effect, produces unacceptably contaminated groundwater, even in places in which its initial baseline condition had been entirely satisfactory.

The statement in 4.1.4., that:

> " As of May 1998, it was anticipated that alkaline leaching would not be tested since the trial results for acid leaching were positive. Prior chemical analysis and laboratory testing had indicated that using alkaline leaching chemistry would necessarily be inferior to using acid leaching chemistry"

- is odd, given the fact that the overwhelming bulk of ISL experience in the US is of alkaline leach type, and given that acid leaching experience in both the US and the CIS where it has been used more extensively, has been strongly negative in terms of its effect on groundwater. The statement that acid leach is the preferred method in conventional uranium milling operations is irrelevant, since what is at stake is the long-term effect on groundwater.

The DEIS as a whole tries to give the impression that ISL in general, and acid leaching in particular, is a well-established and reliable technology with little environmental impact and not much that can go wrong. This is not the case. Thus, according to 4.1.2.,

> "In-Situ Leach mining is a relatively low impact mining method in that there is minimal surface disturbance, no tailings disposal requirements, simple plant removal on completion of mining, relatively simple rehabilitation once a well field has completed its operational phase, and comparatively little contaminated waste produced."

None of the above are true.

Major problems have been experienced, both in the US and elsewhere, with both acid and alkaline leach methods. Rehabilitation of contaminated aquifers has been anything but simple, and often has proved impossible. The 'relatively simple rehabilitation' referred to, presumably refers to the rehabilitation planned by Heathgate for the Namba Formation, which is of course, no rehabilitation at all. Heathgate/GA's failure to provide a rehabilitation plan for the Namba Formation aquifer after mining is a major failure of the DEIS and is of critical importance.

1.b) US Experience In ISL

The US and CIS probably have between them the worlds most experience in ISL mining of uranium, using both alkaline and acid methods. US experience has been largely but not exclusively, of the alkaline leach method.

Problems at ISL sites in the US have included:

--The precipitation of minerals such as calcite and gypsum, causing blockages and problems in solution control leading to 'excursions'.
--The re-precipitation of uranium
--Buildup of toxic heavy metals in leach solutions (esp in acid leach)
--Difficulties in restoring groundwater quality after the ceasing of ISL mining.
--Clogging of the aquifer near production wells.
--Loss of control over solution movement.

With reference to the 'relatively simple rehabilitation' statement in 4.1.2. of the DEIS, the DEIS then goes on to say that in the US, the sole acid leach project trialled under US regulations for restoration 'was regarded as successful'.

This is not an accurate picture. In fact, there were many difficulties with this project. A number of different wellfield configurations were used, and a number of 'excursions' took place into overlying aquifers.

Even though groundwater restoration at Nine-Mile Lake was supposed to have been successful, in fact, increased levels of zinc, vanadium, selenium, iron, uranium, and calcium were still present afterwards, and the groundwater remains acidic and oxidising. The Nine-Mile Lake site seems to have been regarded as a trial, and never seems to have become a commercial operation.

Mines in Texas and Wyoming in the US have also experienced problems with the restoration of groundwater, contrary to the statements in 4.1.2., concerning ‘relatively simple rehabilitation’. Wyoming Minerals has admitted that:

> “...developments in restoration technology have not advanced as far as was hoped, and after several years experience in mining and restoration, we now have a more realistic understanding of the limitations of this technology...Original standards were known to be strict, but were accepted with the expectation that the state of the art would solve some problems, and the standards could be re-negotiated (especially the standard for NH_4) in the light of further experience and understanding.”

Quite contrary to what has been said in the DEIS, groundwater restoration has been found to be by far the most difficult and costly aspect of ISL mining, absorbing an average of 40% of total decommissioning expenditure.

Wyoming Minerals Bruni project, when restoration was first attempted in 1981, still had 120mg/l or 160 times, its original levels of ammonia after the aquifer had been flushed 25 times.

In Wyoming itself, the problems experienced with the Irigaray project, constitute an indictment of the entire ISL technique.

On March 14 1979, chloride levels in a shallow monitor well were above the ‘upper control limit’.

By March 27 1979, chloride and total alkalinity were above limits, and one well was thought to be leaking.

2-3 weeks later, over-pumping had failed to correct the problem.

On April 12-20, two units were shut down and two other wells were pinpointed as leaking.

By July 5th, it was postulated that the casings of wells were being cracked by the ISL solution.

The ISL experience in the US contradicts the impression which the DEIS tries to convey, that ISL is a well-established, noncontroversial, and trouble-free technique. In fact, the US and other countries experience of ISL is that major problems exist with both operation and restoration.

1.c.)CIS And Other ISL Experience

As well as in the US, the ISL technique has been used extensively in the CIS and in Eastern Europe, where the use of acid leach technique has been much more prevalent.

From 1984 to 1990 in Königstein, in what was then East Germany, acid leaching was used. During that time, about 100,000 tonnes of H_2SO_4 were injected into the groundwater. As of 1998, the water in the mined aquifer had still 400 times the German drinking water standard for cadmium, 280 times the standard for arsenic, 130 times the standard for nickel, and 83 times the standard for uranium.

At the Devladovo deposit in the Ukraine, which was leached with a mixture of H_2SO_4 and HNO_3 from 1968 to 1983, there are still 7,090,000,000l of acid, which it is estimated, will reach the nearest village in 25-40 years.

2) Geohydrology

The DEIS states that the water in the ore formation is 'stagnant'. However, little evidence is bought to substantiate this claim, and other statements made elsewhere in the DEIS and in the DEF for the Field Leach Trial (FLT) contradict this.

The DEF for the FLT states specifically that the ore formation is in a southward flowing 'paleochannel', whereas the DEIS states that it is rather in a series of 'shelves', in which there is essentially no flow.

However, even the DEIS itself states that water flows upward from the GAB, through faults and via aquifers closer to the surface, toward Lake Frome. If this is the case, then over extremely long periods contaminated water from the ore formation may be assumed to move down-gradient toward Lake Frome.

The DEIS has been at great pains to emphasise that the water in the Namba formation (i.e. the orebody) is 'stagnant', and that the impression of a 'paleochannel' with significant flow is not correct. Thus, according to p6-9 of the DEIS,

> "The term 'Beverley Paleochannel has been used extensively in previous literature (e.g. as late as Heathgate Resources 1997b). The term was created in recognition of a generalised distribution of medium to fine sands and silts following north-south trends. It carried the assumption of a north-south paleo- drainage system cutting across regional trends which are all generally west-east. The recent Heathgate studies however, indicate that the host

> sediments are shelf- like, with a westerly boundary controlled by the Poontana fault zone and an unrecognised eastern boundary at least 2km distant. This current deposition model does not require the assumption of a north-south paleo-drainage channel, at odds with regional trends."

There a number of points worthy of note here. One is that this statement is contradicted by much of the rest of the DEIS. Another is that neither in the stratigraphic cross-section (fig.6.5) nor in the computer simulation of the alpha mudstone paleosurface, can one say that the Beverley sands are 'shelflike'. Rather, a number of channels tending south to SE, have been substituted for a single N-SE channel. Thirdly, the fig.6.6, shows a relatively limited number of data points on which any simulation of the paleosurface can rest. The actual course of both the Tewalina channel and the central channel is in essence, pure speculation - as is the existence of 'shelflike' deposits. In fact, given the number of data points and their distribution, there is little or no reason to assume that fig6.6 has much relationship to reality whatsoever.

Finally, if the Beverley orebody sands are indeed 'shelflike', and with an 'undefined' eastern boundary, then it will be more difficult than ever to show that the highly contaminated and acidic groundwater that will be left will be confined at all. On the other hand, if there is a 'paleochannel' it will presumably tend to remain within the channel, or within the 'channel within a channel' of the braided channels. If there is no channel, the contaminated aquifer could go anywhere. In fact as we have seen, the data of the FLT do substantiate the idea of a channel, suggesting that N-S movement is in fact easier than w-e movement.

There are inconsistencies within the DEIS itself, as well as between the DEIS and the DEF for the FLT.

The first problem is that if the Namba Formation water has always been stagnant, (as distinct from flowing very slowly) it is impossible to see how the uranium got there in the first place, since it is acknowledged that it has been transported in oxidising solution from elsewhere, (probably from the Mt Painter region) - and then precipitated in an oxidising environment.

That movement of groundwater has to be assumed to account for the very presence of the orebody itself is shown by the statement in 6.2.4. (6-12) according to which:

> "The presumed origin for the uranium in the Beverley deposit is the basement proterozoic rocks which are known to host small, hydrothermal ironstone breccia uranium deposits near Arkaroola (Coates et Al 1969) While a satisfactory transport mechanism is not readily demonstrable at the present time, a paleo-hydrogeological connection is implied."

The DEIS itself notes that there are strong differences in the salinity of the aquifer from north to south. According to 6.9.11 p6-65,

> "The semi-regional scale distribution of salinity within the sand can possibly be accounted for on the basis of an historic interaction between water in the channel sands, and brines associated with an evaporative sink near the site of the present day Lake Frome...An alternative interpretation of the salinity distribution requires historic flow within the channel sands (although present-day gradients indicate that the aquifers are stagnant) at a low rate and originating to the north and east. This infusion of fresher water could have originated as recharge to the Willawortina formation, leading to much higher water levels and some vertical leakage, or flowthrough from basement."

The point to note here is that in fact, ALL these explanations involve flow through the supposedly nonexistent channel at some point or at some rate, albeit slowly, through the aquifer.

Elsewhere, the DEIS clearly sees the orebody as a paleochannel.

Thus, 6.9.6. notes that:

> "...These two channels may represent the course of a single drainage channel that has shifted with time as old meanders became filled with sediments"

While further down we are told that:

> "From the observed hydraulic behaviour of the channel aquifers, both during pumping tests and in the early stages of operation of the FLT, it appears that any of the above (lateral limits imposed by the sloping surface of the alpha mudstone, facies change from stream sediments to clay bank sediments, and lateral limits of the mineralised sand body in a 'channel within a channel' sequence)- are effective lateral constraints that restrict groundwater flow normal to the channel axis."

The important point here again, is that there IS a channel, and that there IS a channel axis - an impression that the DEIS is keen to deny elsewhere.

Still further, the DEIS notes that:

> "...There is a directional contrast in permeability, with values observed in pumping tests along the channel being higher by a factor of 1.5 than those across it. This reflects the depositional environment of a braided stream."

Indeed so!
The statement that the Namba Formation waters are entirely stagnant is also contradicted by the regional groundwater flow model according to which (6-42)

> "Water lost from the great Artesian Basin aquifer by diffuse upward vertical leakage enters aquifers higher in the sequence, and is eventually lost to evaporation."

If this is the case, we can assume, at least over the very long time-scales that are relevant (100-300,000 years) that Namba Formation water has, and will, move toward the Lake Frome sink, and that over a very long period, possibly aided by leakage, contaminated and acidified water from the unrehabilitated orezone will do likewise. It is not safe nor realistic to assume that Namba Formation waters will literally never move, since the very presence of the orebody as well as the existence of one or possibly more paleochannels indicates that it has done so in the past.

What is clear is that, over the ultra-long time-scales for which the contaminated aquifer would have to be contained, the waters in the Namba formation have NOT been stagnant, and the assumption of one or more paleochannels tending S-SE, provides the best fit to the data presented in the DEIS itself, whose authors in spite of the denial in p6-9, (6.2.1.) show that they too, believe in the paleochannel theory.

3)Rehabilitation

The DEIS has assumed that since the water in the ore formation is not suitable for human or stock consumption, that no rehabilitation whatsoever is required.

This is not the US practice, where even if water in the ore formation was not suitable for consumption, comprehensive rehabilitation measures have to be done. The ore formation should not be left in the highly acidified and contaminated state in which it will be without rehabilitation. The assumption that large areas of aquifer can be 'sacrificed' is not acceptable.

The DEIS states that the water in the Namba Formation is uniformly unsuitable for human or cattle consumption.

It states that the maximum allowable TDS for cattle are:

--5,000 to 6,000mg/l for lactating cattle.
--10,000mg/l for 'dry' cattle.

It then says that:

> "On the basis of TDS alone, groundwater in the Namba Formation at Beverley is generally unsuitable as stock water. In the North mineralised zone, the majority of samples have a TDS beyond the tolerances of lactating cows and calves although still within the TDS limit for 'dry' cattle. In the central mineralised zone, all samples have a TDS beyond the tolerances of lactating cows and calves, and are at or close to the upper limit for 'dry' cattle. In the south mineralised zone, total dissolved solids are well in excess of the limit for 'dry' cattle."

In fact, the actual data provided by the DEIS show something rather different. What Fig 6.34 shows is that in all of the northern ore zone, all samples except one are below the 6000mg/l limit, and all except 2 out of 21 samples are below 5,000mg/l. The waters of the northern ore zone are thus entirely suitable for the use of lactating cattle, and the statement in the DEIS is false. In the central ore zone, all samples are between 6,000mg/l and 10,000mg/l and thus suitable for 'dry' cattle. In the southern zone, all samples are well in excess of the limits. However, <u>only</u> the southern zone is unambiguously unsuitable for use.

This is of critical importance, since the DEIS argues that it is the unsuitability of the Namba Formation groundwater for stock use, along with its confined and 'stagnant' nature, that justifies the lack of any real attempt to rehabilitate Namba Formation (orebody) groundwater other than by a simple re-injection of 'native' groundwater after the acidic leach solution is moved on to the next staggered line of wells.

In fact, all this must be treated with great scepticism. The DEIS says that, after removal of the acid leach solution with a pH of about 2, and its re-injection into the next area to be mined, the mined-out area will be 'flushed' with water from areas that are about to be mined, raising the pH to 3.7, and then, after interaction with 'aquifer minerals' (It is not specified what these minerals are nor how they have managed not to have already combined with acid during the much more acid conditions during active leaching) - to a pH of 4.5.

There seems to be absolutely no reason to assume that the pH will ever be better than 3.7, and no reason to assume it will reach 4.5. There is no reason to believe that the ‘aquifer minerals’ referred to exist at all.

The casual, not to say downright slipshod, approach of the DEIS is as previously remarked, predicated on the assumption that the Namba Formation water is absolutely useless - something which is contradicted by the DEIS’s own sample data.

A completely different approach has been taken in the US, where the largest cost item in decommissioning is wellfield restoration, a process that involves cleaning groundwater in the affected zone by flushing it with large volumes of clean water obtained by reverse osmosis.

In Wyoming, restoration requirements demand that when a permit to perform ISL mining is sought, the proponent must supply:
--The information necessary to demonstrate that the operation will return all affected groundwater within the permit area to a condition such that its quality of use is equal to or better then and consistent with, the uses for which the water was suitable prior to the operation by employing the best practicable technology.

--The condition and quality of all affected groundwater must be returned to background or better.

--In the event that the above cannot be achieved, the condition and quality of all affected groundwater will at a minimum be returned to a quality of use equal to and consistent with uses for which the water was suitable prior to mining.

> --An aquifer is exempt from these requirements only if:
> --It does not currently serve as a source of water
> --It cannot now, and will not in future, serve as a source of water because of depth, levels of contamination, or contains commercial minerals or hydrocarbons.

The Namba formation aquifer is suitable for both dry and lactating cattle (except for the south zone), is not too deep to use, and contains no minerals other than the uranium itself. under these regulations, it would have to be fully restored.

Restoration of groundwater as previously noted is the largest single item in decommissioning costs for ISL operations, averaging about 40% of total decommissioning costs. According to a US-DOE report of 1995, costs ranged from $15.9million at Burns Ranch/Clay west, to $350,000, and averaged about $2.8million. Some of these difficulties have already been referred to in correcting the impression given by the DEIS that rehabilitation is ‘simple’.

An example (which has also already been referred to) of the kinds of problems associated with groundwater restoration is at the Bruni mine, where in 1981, Wyoming Minerals said they had attempted groundwater restoration using 25 pore volumes of water. NH_3/NH_4 levels which had been at 0.75mg/l, were still at 120mg/l as previously noted. As of 1989, regulators were still not satisfied with restoration efforts.

Similar difficulties were encountered at the Straz Pod Ralskem deposit in the Czech republic, where 5 pore volumes of flushing were required to remove 90% of the contamination in groundwater.

The consistent failure of the DEIS to acknowledge or deal with the difficulties in restoring groundwater quality, and its failure to acknowledge the necessity to do so is reason to reject it as inadequate. The restoration measures proposed by the DEIS are hopelessly inadequate.

The DEIS should therefore be rejected.

John Hallam
Friends of the Earth Sydney.