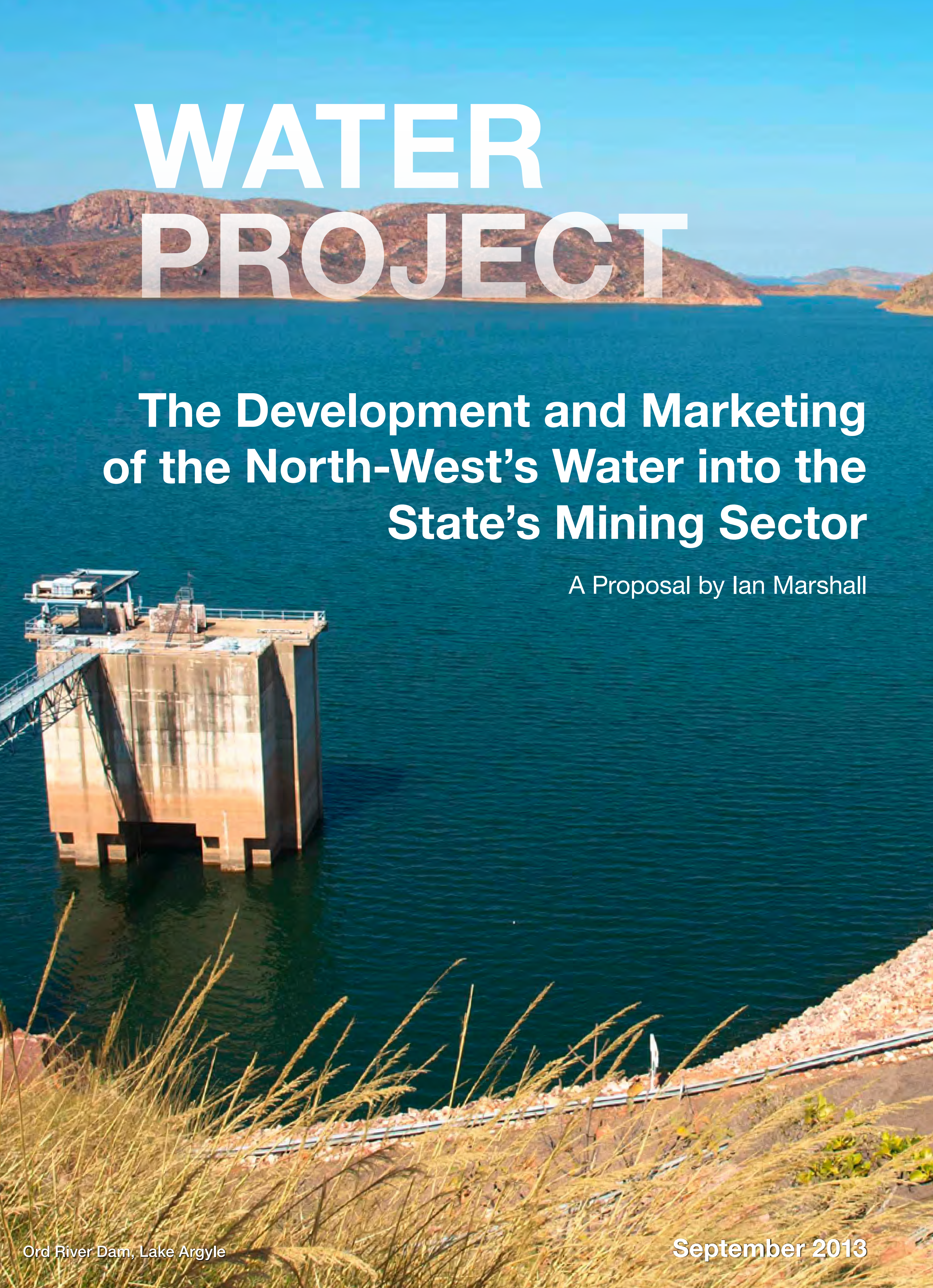

WATER PROJECT

The Development and Marketing of the North-West's Water into the State's Mining Sector

A Proposal by Ian Marshall

Ord River Dam, Lake Argyle

September 2013

The Development and Marketing of the North-West's Water into the State's Mining Sector

Abstract:

The North West of WA has historically had an oversupply of water. The mining sectors of the Pilbara, Goldfields and the Mid-West of WA have historically had an under-supply.

This paper proposes a mechanism that will allow this imbalance to be addressed economically, sustainably, and environmentally and to the benefit of a broad range of stakeholders.

Prepared by:
Ian Marshall
B.Ag Sci;B.Bus(Man, Eco, Mkting);MBA

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Executive Overview

The purpose of this paper is to demonstrate that there is a serious situation starting to develop in regards to the supply of water to the Western Australia's mining sector, that there is a potential solution and that this solution is economically viable over both the short and the longer terms. The offer is being made to be involved in this endeavor.

This project proposes to make the massive water resources of Australia's North West available to existing and future mining ventures, native vegetation tree farms and other as-yet-undefined uses in the significantly under developed spaces of Western Australia. However the primary target is seen as the mining sector in the Pilbara, Mid-West and in the Goldfields.

It has long been the dream of many visionary thinkers to do this, but they have all been prevented from proceeding by the difficulty of raising the required funds. I am not a visionary thinker – the ideas presented here have been proposed and developed on a number of occasions. What I feel that I have developed is a mechanism to fund the development, construction and management of an infrastructure project capable of doing what the visionary thinkers visualized.

This project proposes to make the massive water resources of Australia's North West available to existing and future mining ventures

This project proposes that water users will be offered the opportunity to buy Individual Water Rights (IWR); the right to one megalitre (ML) of water supplied every year for 55 years. Each Individual Water Right will cost $24,750. These rights will be tradable and one million Individual Water Rights will be made available for purchase. (1,000 GL supply in total).

This mechanism is new for water in Western Australia and will mean that the entire infrastructure is cost neutral to both the government and effectively the developer. There may be a small delivery cost for water supplied that will be additional to the Individual Water Right.

If all Individual Water Rights are taken up (sold) the total capital raised will be $24.75 billion which financial modeling and cost analysis would suggest is more than sufficient to build and operate the necessary engineering works to deliver the water to the target market. This cost[1] will include:

- The construction of the water delivery infrastructure
- All power generational capacity. Calculated at 3,500 MW; solar and wind preferred. Integrated PV Solar panel /wind turbine combination will mean minimal ongoing fuel costs for power generation and minimal carbon emissions.
- An extensive tree farm to offset carbon emissions over the life of the project.
- Land access costs and initial water royalty cost paid up-fount, to both the state government and the traditional owners of the water.
- The cost of finance until water is physically supplied to Individual Water Right holders.

This paper demonstrates that:

- The current supply for water supplied or available to the sector is either in critical decline, is of increasingly low quality or is becoming more and more expensive to extract.
- That the proposed source of supply of water into the project is sustainable over both the short and longer terms.

- That the solution being proposed does not see the mining sector as a cash cow and that the pricing is a cost recovery one and economical to the mining sector.
- The proposed mechanism to implement the project is both sustainable and viable to both the operator and the market.
- There will be very significant benefits to early investors to the project.

The mining sector has provided very significant benefits to both the state of Western Australia and to the nation as a whole. The mining sector has developed over the past 40 years in often a very hostile geographical, political, economic and industrial market. During that period one of the issues that was not significantly major was the supply of water. On the whole the underground aquifers were adequate, permits to access the resource were reasonably readily available and there was perceived to be an inexhaustible supply of water in the resources generally.

While some of the early issues with establishing mining in the state have become less critical and or hostile the once quiet issue of water is about to raise its head as a critical issue. What was once thought of as an inexhaustible supply is beginning to appear less so. The WA State government recently announced the commissioning of a report into the Pilbara water situation (7th August 2012) and I am aware that all three major Pilbara miners are investigating aspects of the water situation.[2]

With relatively high commodity prices, coupled with relatively high demand and quality current returns on investment now may be a very good time for the mining sector to collectively act to address this issue

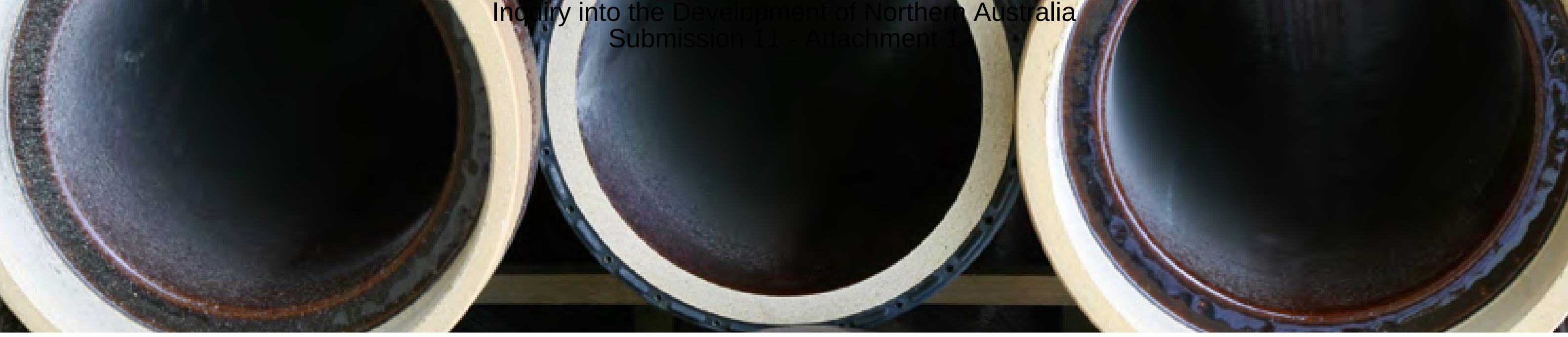
With relatively high commodity prices, coupled with relatively high demand and quality current returns on investment now may be a very good time for the mining sector to collectively act to address this issue. There is obvious volatility in all aspects of the marketing mix; price and demand fluctuate over relatively short periods while planning for growth within the sector is often a decade long process of planning and development.

This project is one such planning project that should not be put off simply as there is a pressure sore in the demand curve for the commodities generally. There is a real risk that if industry does nothing and government identifies a problem and instigates a solution then the cost to those deemed to have the capacity to pay will far out way the economic cost of the solution.

In my view this would be a poor out-come and an out-come that can be avoided. I have been researching the water supply issue in WA rural areas for the past 10 years and over the past 6 years I am convinced that there is a looming supply problem that will impact very significantly on the sector in the next 15 to 25 years. I also feel that any solution not generated by the sector themselves will be inappropriately costed to the sector to fully fund and or support fund other users of water within the regions.

The proposal presented here has been prepared and presented to 350 of the wealthier Australians with either a direct investment link to the Western Australian mining sector and or a perceived interest in the sector. The hope is that some of these people will invest in a small seed capital project that will initially commence the development of this project.

Unfortunately with all significant projects the initial steps are both small and tentative. This is one small tentative step to initiate the project and I am hopeful that you will provide it some consideration. It is an offer to become involved financially and I feel that the rewards of doing so will be significant, both for the individuals involved and for the mining operations.



A Brief History of the Proposals to Transport Water South from the North West of WA.

The very thought of proposing a scheme, a business proposal to bring water from the North-West of Western Australia to the south is always going to be difficult. Ever since the Ord River dam was constructed and the geese proved that rice was never going to be the savior and grubs devoured the cotton, there have been plans presented to transport the water south. So much so that the whole concept is clouded with a whole range of grey.

It has been said that “it cannot be done”, “it can be done”, “it could be done if…”, “it needs to be done by…”, “it will only work if…”, “the market is sustainable if…”, the market is unsustainable because…”, “the supply is sustainable...”, “the supply is unsustainable...”, the list goes on, and on. There are even suggestions that the Western Australian market is ignored totally and the Lake Argyle water be shipped to the Eastern States. Those making contributions to the debate with suggestions and or proposals have been ridiculed to some extent which is a shame as it has stifled the debate generally.

Into this murky water I will cast another stone.

Since the development of the Ord River irrigation scheme, people in Western Australia have harbored the thought to transport water south for a raft of reasons and projects. Various option polls conducted for a range of reasons over the past 25 years have indicated that over 90% of West Australians support the use of North West water in Perth. The option polls tend to avoid the issues of paying for the projects and if the support would be as generous if water prices would be triple as a result – but that’s the ambiguity of option polls.

In nearly all of the proposals to transport water south from the North West, Perth appears to be the intended market. In my view this has always been a fatal flaw in the majority of the proposals presented. The Perth water market is almost impossible to break into due to the dominant position of the monopoly supplier, and the current economics (cost barrier of entry) and storage infrastructure available to the current supplier – Water Corporation. The supply of water to Perth is dominated by a well-organized, quarsi government organization that’s position is partially protected by regulation. While the Economic Review Board has supported a more open water market however it will always be a very tough dam to breach. Add to this the production of water from the desalination plants and the availability of significant supplies of underground water then it would be exceedingly difficult to break into the Perth water market.

The supply position of the Water Corporation is difficult logistically. The Perth market for water is relatively small, however coupled to the 150 GL Perth market is the need to supply water to a host of water users spread across a broad section of the state. Due predominately to the work of the Water Corporation and its predecessors over the past 100 years Perth has one of the best storage capacities (per capita) in Australia, and a very extensive distribution network. The Water Corporation has successfully strategically planned and supplied water into greater Perth during a period in which natural supply has fallen over 25% and demand has increased a similar amount without the need for very significant water rationing. While this position may change over the coming years the overall size and structure of the greater Perth water market is not large enough to be a single target market for water supplied from outside the area.

Over the past 30 years the level of rainfall has fallen by over 30% in the Perth catchment area. Coupled to this has been an environmental push to allow re-growth in the same catchment areas which has reduced run off and the resulting inflow into storage dams has decreased approximately 40% (annually) over the 30 year period.

The Water Corporation has, I understand, independently reviewed transporting water south to supply the Perth market and apparently come to the conclusion that it was uneconomical to do so[3]. The Professor Appleyard report reviewed a series of proposals that have been developed and put forward at various times to supply the Perth market with water with a similar outcome. These will be reviewed towards the end of this paper.

There is little real doubt that it is basically un-economical to transport relatively smaller volumes of water exclusively to the Perth market. To transport larger volumes of water to Perth is non-viable as the market cannot absorb the volumes, and making another proposal to do so would be foolish, (i.e. transport a relatively small quantity of water 2,500 km to supply the Perth water market.)

In the past the second major issue that brought most of the concepts undone was both the cost of the infrastructure, and how the cost would be covered. The cost structure proposed for each scheme varied significantly but as none has ever been built then determining the accuracy of the estimates as to costs and price of product is difficult. This will always be an issue as most projects have varying degrees of variance between proposed cost and final cost. With the schemes presented over the past 30 years, the issue has often been with “who would carry the cost?”. Water is an expensive product to transport and has a relatively long lead time to develop projects and relatively long life cycles. This means that some level of guarantee needs to be factored into the prices paid. Proposals have been presented where the government funded the whole lot, where the government contracted to purchase varying quantities of the water, or where government was prepared to guaranteed any short fall in sales. None of these concepts was all that attractive to government and while the Water Corporation was marketing water at around $0.80 (at the time) to a proposed delivered water cost that was to be triple this price then there was little prospect of the concepts ever getting much air play.

The lessons here are that the Perth water market is unlikely to be a viable one, that the cost of building the project should not be linked to a government buy back of water and that the supply of water should be at a cost proportional to the economic benefit derived from the product.

This proposal presents to:

1. Focus on all markets for water outside of the Water Corporations traditional markets and to provide a mechanism for the infrastructure to supply casual Water Corporation markets if these arise in the future.
2. The proposal is to be fully funded by the sale of the Individual Water Rights and requires no government funding.
3. The cost of water to all end users will be the same for all users, will be set for the full period of individual water rights, and the pricing will not be based on a capacity to pay structure.

The Current Position.

The three key elements essential for the success of the concept proposed are:

- the availability of water
- sufficient long term demand
- a price of water that is competitive to the end users

Availability of Water – Source of Water

The North West of Australia (Kimberly region and parts of the Northern Territory) receives approximately one third all of the rainfall that falls on the Australian mainland. The majority of this resource is lost into the sea. The Timor Sea to the west and the high temperatures associated with the area act as a huge natural solar desalination plant. Scientific modeling associated with the climate warming debate would suggest that the amount of rainfall experienced in the region will increase in the area. However, this will be coupled with a larger number of storm or violent climatic events, storms, tropical cyclones and the like.

ABARE[4], CSIRO[5] and the Ord River Co-Operative[6] all report that Lake Argyle has a total current capacity of 11,700 GL. Annual gross inflows are over 4,500 GL of which 300 GL is made available for irrigation under current allocations; stage one. A further 400 GL is allocated to the second stage of the Ord River irrigation scheme.[7] In addition, 1,700 GL is lost to evaporation[8] during the dry season and over a 1,000 GL is released for power generation. A further 1,100 GL is released over the spillway during the wet season.

While there are some claims that the water is fully allocated this analysis will be disputed in this paper. This paper will also demonstrate that there are other additional sources of water:

- The pipe infrastructure itself which will hold over 105 GL and can be filled during the "wet" season,
- Small reservoirs at each pumping station, and,
- Additional supplies from the Fitzroy River immediately following the "wet" season. (not a preferred option but potentially an available one)
- Additional storage in Ord Dam which is currently under review for 4000GL

Annual rainfall [9] within the Ord River catchment is stable to slightly increasing, meaning that the source is a reliable one for this volume of supply, and over the time frame. Climate change is expected to affect[10] the annual rainfall in both the Kimberly and Pilbara. In both cases the rainfall is expected to rise, but in both cases the rise will not be excessive and be the result of more frequent storm or cyclone events. Rainfall in the Goldfields and in the mid-west is forecasted, by the same modeling, to drop slightly over current levels, however this is unlikely to be a significant impact on water for mining operations as surface water is not a significant contributor to water used.

Climate change modeling also tends to suggest that while rain fall will rise slightly in the Pilbara this will be off-set to a large degree by higher temperatures that will result in higher levels of evaporation that could result in a higher demand for water generally from industry within the region. In addition as the forecast increases in rainfall will be the general result of more frequent and server storm events then to be of any use water will have to be captured and stored which can be as expensive as other methods of self- sourcing water.

In the Mid-West a lack of a significant underground water source is impacting on mine development with several developments being placed on hold by the Environmental Protection Agency (EPA) until a viable long term water source can be identified that is acceptable to the agency. One mid-west mining operation is constructing an 80GL desalination plant to service their operation. Water costs in this case are estimated to be in the order of $1.65 per kl (as at 2010) and demonstrate the extent that some operations will go to ensure a water source. Desalination is not an option to most WA mining operations due to distance from a water source and energy costs associated with desalination.

This paper proposes that supply of water from the Ord River is, sustainable over the proposed life of the project, the only logical source of water to supply the growing industry in the Pilbara, Goldfields and the Mid-West, and, the only source and mechanism that will supply water at a long-term sustainable cost to that industry.

Sufficient Long Term Demand for Water

Demand for water in the Pilbara and in the Mid-West of WA is increasing significantly due to the growth from mining and associated infrastructure requirements of that mining. Demand for water in the Goldfields is showing modest growth however this may change if uranium mining and processing is successful. Demand for water will continue to rise as demand for the output from the regions' mines continue to rise and or remains stable at levels forecast for 2020. ABARE research suggests that total demand for water based on commodity production in 2020 will be in the order of 1,600 GL, predominately based on output across all commodities within the three nominated regions.

Growth in the Western Australian mining sector has been driven predominately by growth in China; and their resulting demand for mining commodities. As demand for water is linked to mine output, it is worthwhile reviewing my economic rationale as to longer term demand for commodities in China and other Asian markets. While the initial market was Japan, this has been overtaken by the Chinese market and it will be the underlying economic strength of this market that will underpin the Western Australian mining sector for the next 50 to 100 years.

In 1949, when the Cultural Revolution was completed the Chinese population was described in most geography and economic texts as an underperforming agrarian economy where nearly a billion relatively poor peasant farmers tended small communal plots of land. The population was predominately rural with 90% living in rural communities with virtually no access to services. By 1985 (36 years later) and 25% of the population lived in the cities and by 2010 (25 years) the ratio is 50% in the cities. It has been forecast that by 2032 a further 200 million people will re-locate from the Chinese country side to the cities to take advantage of the better lifestyles available in the cities. The Blue Book of Cities in China reported that over AUD$ 7.4 trillion will be required over the next 20 years to develop the infrastructure for these people which is a market in itself; however this is really a side show to what is actually happening.

The United Nations, the World Bank and the International Monetary Fund all publish Gross Domestic Product figures for a range of economies and in 1960 China's GDP was $61.3779 billion, by 1980 this had grown to $189.42 billion, in 2000 GDP was $1.1985 trillion, and in 2011 the GDP was reported[11] at $7.2981 trillion. The Chinese economy measured as GDP grew $1.372 trillion in 2010-2011. (For comparison, Australia's GDP (2011) is currently $1.3718 trillion).

Demand for a broad range of commodities will continue at an increasing rate. There will be fluctuations (some natural, some engineered) that will cause concern, however it is virtually impossible to stop or slow economic growth of this magnitude without very significant social upheaval. The reason for this is in the structure of elements of the economy.

According to the Blue Book of Cities in China that was released on the 3rd August 2012, Chinese cities currently house more that 230 million middle-class residents or 37% of the urban population. While there is some debate as to what is "middle-class", the definition accepted for the Chinese Academy of Social Sciences study defines middle class as individuals that live in a household were annual per-capita disposable income is between (reported as 2012 AUD$ equivalent) $3,000 to $10,000 in which 30% to 37% is spent directly on food.

In a Beijing Review cover story 17th August 2012, a number of examples of middle class wage earners were provided. In all cases, the level of saving was significant (in the order of 25% to 29% of after tax disposable income). If we assume that the average middle class salary is AUD$8,000 p.a. and that 27% is saved annually then the annual saving of the current middle class will be around AUD$496 billion annually. If we assume that the rest of the population (a billion people) saves a similar amount then the annual national saving level will be over $1 trillion. This will be added to at a rate of $50 billion as 20 million additional Chinese attain middle class status annually. At this level of saving over the next 20 years an excess of $30 trillion will have been saved which will be a significant source of investment finance for development. It also means that the required expenditure of $7.8 trillion required for building cities over the next 20 years will easily be covered from domestic savings.

The other interesting economic fact in the reports is on the shift from rural to urban and the development of a middle class is the structure of spending. The 28% saving has been discussed, however in the reports the spending patterns are predominately – rent, food, clothing, power, telephones, transport and the like i.e. direct consumables). The fact that people are either saving or spending directly on locally produced services is a very significant economic benefit to Chinese planners. Most Western economies have very significant leakage which can disrupt their economies.

China's national economic growth will continue at around the 8% to 11% pa mark. China currently has 170 cities with over a million people. By 2030 it is estimated that there will be over 300 such cities. China currently has five mega cities with populations approaching 35 million Chengdu (population just under 35 million), Chongqing, Shanghai, Beijing and Shenzen. Some of these are new created cities such as Shenzen with a population of 14 million that did not exist in 1979 except as a sleepy fishing village on the Chinese mainland opposite Hong Kong.

China's capacity to plan for growth is outstanding. The Chinese Communist Party was formed in 1922. The Chinese political elite is just finalizing the format of the 18th five year plan and the dates are significant – 2012 take (18 five year plans) 90 years is 1922. This means that in 1922 the organizational structure developed a plan and stuck to it through a world war, and a cultural revolution, and major changes in direction. Each five years a formal strategic plan is developed, approved and actively worked towards where one plan is developed based on that preceding it and with long term strategic goals set. This is really very powerful strategic planning and should not be discounted.

Since the mid 1980's when the Chinese government (Communist Party) embraced a policy of openness, growth has been on-going and phenomenal. It would be logical that this growth will continue (as it is in the plan) and as such demand for commodities will continue at the current rate or increase progressively over the coming 30 to 50 years.

The Chinese Academy of Social Sciences have sounded a number of warnings that the wealth gap in China is significant and that it will be almost certain that the next five year plan to be approved December 2012 will include measures to reduce or at best stabilize the development of this gap. To allow for the continued economic growth of the middle classes and in addressing the wealth gap within the population will require that the Chinese economy continues to develop at about 8% annually even if this requires government stimulation.

Whether or not Australia is a primary supplier is really a different matter. At this point I feel that we are a preferred supplier however this can always change. I would suspect just who supplies the products that china needs is not in the plan.

While there will be some ups and downs in the Chinese economy over the next 25 – 50 years it will remain strong enough and well organized enough to be an on-going purchaser of mine output for the next 50 – 60 years. In my view – based on my economic analysis, demand will rise over the next 15 – 20 years however this is relatively academic as we (Australia) appear unable to bring projects on any faster to satisfy this demand. In my view, and my crystal ball is as cloudy as the next, China's growth will:

- Continue at roughly between 7.5% and 11.5% (GDP annual growth)
- Iron Ore prices in the shorter term (next 3 to 6 months) will recover to stabiles at roughly $120.00 to $130.00 per tonne. Overall demand for iron ore will increase at around 10% per annum however prices will remain basically stable over the next 2 to 3 years as additional supplies enter the market.[12]
- In 2016, iron ore prices will be relatively stable at $145.00 to $155.00 per tonne based on 65% Fe criteria.

- There is a 50% probability that the Chinese currency will be floated in the next Strategic (18th) plan. This potentially has significant implications on Chinese demand which could result in an increase in iron ore prices paid to Australian miners.
- The Chinese economy does not need stimulus packages to promote demand. Internal growth will achieve this.
- The Chinese economy will use stimulus packages if the speed of economic growth is not allowing for a planned reduction in the wealth gap due to the socially disruptive consequences of the wealth gap.

The Organization for Economic Co-operation (OEDC) has predicted[13] that by 2030, the Chinese economy will represent 28% of the Global economy with India controlling a predicted 11% of the global economy. This effectively doubles the Chinese economy over the next 17 years, meaning minimum annual growth of around the 7.5% to 8.5% has to occur to meet this prediction. It also means that India potentially is a significant market. The two countries will effectively control 50% of the Global economy (supported with alliances and such) which really needs to be planned for.

Other Markets & Suppliers

Currently Australia has an economic competitive advantage over a range of other countries in the supply of mining commodities that are being sought by China. There is potentially competition from a range of countries however the price difference will need to become significantly greater before there is a noticeable impact on general demand for the Australian product.

India is potentially a significant market for Australian mining commodities. India has a billion plus population with a rapidly growing middle class. Two-way trade between Australia and India has grown from $2.5 billion to $22.8 billion in the past 9 years with most of the growth in Indian Coal imports.

India has a range of logistical problems that will prevent it becoming a significant iron ore market in the shorter term:

- It has a poorly performing government revenue collection system (Taxation) that restricts the capacity for significant public works.
- India has a relatively poor electricity generation and supply system which restricts the capacity to develop heavy industry.
- India has a relatively poorly performing public service that is restricted by layers of red tape that will prevent significant growth in the medium term.

India has the potential of being a very significant market for gold, diamonds and silver. A range of estimates tend to suggest that India is developing a middle class at a rate of roughly 25 million annually. In India, gold is seen as a wealth store and one and a half ounces of gold is average for each middle class citizen. Effectively a gold market of 37.5 million ounces annually. An effective support mechanism for the current gold price, or possibly an indicator that bullion prices will trend up over the next two to five years.

In my view, as ore deposits are discovered and developed in Africa, it is a more likely to supply the Indian Sub-Continent market as this develops rather than the Chinese market.

South American countries - Brazil and Argentina predominately will be significant competitors to Australian supply to China however the transport distance and the current marketing relationship will be a significant barrier for some considerable time.

Competition will provide some supply side pressure on general prices however overall I feel that the evidence is indicating that demand for Australian mining commodities will continue to rise over the next 30 to 40 years.

In conclusion, demand for mining commodities will trend up wards in line with a range of projections. For the purposes of this project this paper will illustrate that demand for water in the mining operations is trending up-wards to meet increased production levels at a rate that will make current supply mechanisms uneconomical and un-sustainable in the very near future – with-in the next five to ten years.

This could impact on the pricing structure generally and more specifically on our general ability to supply the product at all. Water is an essential component and if supply dries up or becomes uneconomical to supply then the capacity to supply will fold. I feel that there are some structural issues in supply that Australian producers generally need to address that will impact on longer term competitiveness and capacity to supply. It should be stressed that "un-economical to supply" may not be totally a financial economical restriction but also includes the environmental cost of the supply of water once supply from the current aquifers becomes restricted and or controlled.

Sustainable Price for Water Supplied to the Market

In my view for a project of this nature to be a success the water sold must be at an economical cost, a sustainable cost to the users. Each mining operation has its own cost/benefit analysis on water. As will be demonstrated later in this paper the general cost structure for water is not currently an excessively high cost and if it was not the fear of the supply running out then the current extraction method would possibly be viable long term.

The current variable cost of self-sourcing water from a range of sources (predominately underground) has a weighted average cost of around the $2.70 per kl. This does not include the capital cost which can be as high as $16.50 per kl extracted over a 20 year project life. A study undertaken for the Mining Council of WA in 2009 tended to suggest that the current capital cost of water supply systems to Pilbara and Gold Field miners who had responded to their study was in the order of $3.5 billion meaning an overall capital cost to extracted kl of over $10.00.

	GL	$/kl	%	$
Pilbara	**125**	**2.85**	**28.28%**	**$0.81**
	81	**3.02**	**18.33%**	**$0.55**
	37	**2.85**	**8.37%**	**$0.24**
Gold Fields	**12**	**3.12**	**2.71%**	**$0.08**
	22	**3.09**	**4.98%**	**$0.15**
	18	**3.41**	**4.07%**	**$0.14**
	19	**3.05**	**4.30%**	**$0.13**
	31	**3.04**	**7.01%**	**$0.21**
Mid-West	**91**	**1.85**	**2.04%**	**$0.04**
	15	**1.95**	**3.39%**	**$0.07**
	22	**1.45**	**4.98%**	**$0.07**
	11	**1.66**	**2.49%**	**$0.04**
	18	**1.82**	**4.07%**	**$0.07**
	22	**1.92**	**4.98%**	**$0.10**
	Weighted Cost of Self Sourced Water			**$2.71**

Table 1: Weighted Cost of Self Sourced Water in Three WA Regions.

To be viable longer term this project must value water at a rate less than these costs to the end users. This project, through the Individual Water Right concept values water delivered to the owner's site at $0.45 cents per kl – based on current planning. This cost will remain constant to the Individual Water Right owner through-out the life of the Individual Water Rights which, on current planning is 55 years.

Obviously, if water rights are traded the figure will vary however the price will be constant to the original purchaser. This price will be inclusive of the capital cost and as such the proposed cost is 6 times less than the current weighted average variable cost for water and if combined with the capital cost is 40 times less than the combined average weighted capital and average weighted variable cost currently being paid by the sector. This should mean that the Individual Water Rights are a reasonable alternative to the current supply option for the sector.

However (and there is always a however), even this cost does not make the water a viable alternative in most agricultural uses. The weighted cost of water to Ord River irrigators is $0.0125 to $0.015 cents per kl delivered to farm gate. Average irrigator (Ord River) utilizes roughly 2,000 mm (2 meters) of irrigation water or 20 ML per ha. Current use is approximately 150 GL to the farm gate (300 GL released) and this will increase to 700GL released with the completion of Stage II, with distribution piped so efficiency rates should be higher.

The cost per Ha of establishing Ord Stage II is over $30,000 per Ha and has taken over 25 years of planning to develop to this point. It is exceedingly unlikely that a larger irrigation scheme (Ord River) will be developed in the next 50 years that will have the capacity to utilize more water economically. The Agricultural sector is often identified as the natural user of all water which in Australia is reasonably accurate with 67.1% of total water (2010 ABS data) use.

This is often not a viable case as the economic return on water used in agriculture is often not very high. The weighted average return on a kl of water in agriculture is just over 42 cents which means that the total yields from water use in the sector is around $7 billion (2010 figures). This is developed further in this paper however agriculture is unlikely to be a large competitor for water supplied by this project.

Justification of the Price of the Individual Water Right

There are several essential components of this project and central to this is the concept of the Individual Water Right. The individual water right is a created legally binding contract to provide specific amounts of water in the future for a payment made in advance. These individual water rights will be tradable and transferable.

Current planning has the individual water rights priced at $24,750.00 – which prices water supplied at 45 cents per kl per year for a 55 year period. Marketing the water at this rate will generate sufficient funds to develop the project and supply water at a sustainable price for most businesses being targeted. Individual water rights will be marketed in megalitre (ML) volumes. There will be a total of one million individual water rights available to be marketed.

Marketing the individual water rights in this way will raise sufficient funds to build the infrastructure and allow the purchasers certainty of supply. In addition the purchasers of individual water rights have the potential to profit from trading out of the contract in the future. In a generally similar way that a range of futures are traded within a broad range of organisations and structures.

This project proposes to supply water as a component of production into three segments of the WA economy:

- Mining Sectors of the Pilbara, Goldfields and the Mid-West
- The Agricultural Sectors within the same geographic regions
- Domestic water supply incorporating general industry within the same regions

If this project is to be commercially successful the supply of the water needs to be sustainable over the 55 to 60 year life of the project and the supply of water and carbon credits needs to be commercially sustainable over the same period.

Regardless of what may happen to the climate in relation to temperature, storm events and/or rainfall levels, if the cost to the intended water users is above their capacity to make a profit from the purchase of the water then there will not be a sustainable market for the product. The Individual Water Rights will be marketed as a fixed supply over a fixed period of time. Current planning is to market water at a unit price of 45 cents per kiloliter (kl) fixed for a 55 year period. Individual Water Rights will be sold in Megalitre (ML) units.

Each Individual Water Rights will be marketed with a tonne carbon dioxide equivalent (t CO_2^{-e}).

All Individual Water Rights will have the capacity to be traded with three options:

1. The Individual Water Right ownership.
2. The carbon right attached to the Individual Water Rights. (1 xt CO_2^{-e})
3. The water right attached to the Individual Water Rights.

In almost all of all other projects suggested to bring water to the south from the north of WA the price of water is disproportionally high, the Government is required to fund the project and or the government is required to enter into a contractual arrangement to take a pre-determined amount of water that will be purchased annually.

Why trading of Individual Water Rights is Seen as Essential.

The Water Corporation is required under state law to provide water on a state wide base rate into all areas of the state. The corporation currently supplies water at roughly $0.85 to $1.05per kl. This is forecasted to rise to roughly $1.25 per kl in the next two years due to the impact of the desalination plant and other costs. I envisage that the Water Corporation is unlikely to purchase Individual Water Rights outright however is potentially likely to be a net purchaser of water traded to allow domestic supply to areas where it is costing up to $6.00 per kl to supply domestic water that is then subsidized to the state wide supply value of around the $1.00 per kl.

In my opinion, this water will be purchased from water trades rather than as Individual Water Rights and as such assists to provide a capacity for holders of Individual Water Rights to move into and out of their water positions, and or trade un-used water for individual time periods.

Moving In and Out of a Water Position.

Most mines have a life of mine less than the proposed 55 year life of an Individual Water Right. As such it is essential that Individual Water Rights can be traded to allow right owners to sell unused water and to move out of a water position. It is also essential that owners of Individual Water Rights have the capacity to transfer the right within linked companies and or operations. However while they own the position the water can be used in whatever method the right owner requires. The Individual Water Rights will not allow a carryover of water from one year to the next. A “use it, trade it, or lose it” structure will apply.

There is the potential to profit from the Individual Water Right concept. Initial purchasers of the water will do so at around 45 cents per kl. Prices for water are projected to rise in line with CPI on an annual basis, or greater than CPI depending on the supply / demand modeling utilized. This means that the potential exists for a water right purchased at around 45 cents per kl to have a value of 90 cents per kl in 12 years’ time. This could be traded for the remainder of the life of the individual water right. Potentially the profit is greater than the initial purchase price of the Individual Water Right.

The Current Position – Water Supply in the Pilbara, Mid-West and Goldfields

Most of the industry within the indicated regions centers on mining. On the whole the sectors in these regions is responsible for its own water needs and the majority is sourced from ground water reserves. There is not a significant supply of surface water available in the region.

The Pilbara fractured rock aquifer and the Officer aquifer supply the majority of this water in the Pilbara and Goldfields respectively. The Mid-West does not have a single aquifer but is supplied from a range of underground sources. The mid-west water is relatively unreliable when large volumes are required however both the Pilbara and Officer aquifers are currently a relatively reliable supply source for larger volumes.

Various researches have indicated that water uses within the mining sector are as follows (Rounded in each case):

Pilbara Iron Ore	Mine to ship including all non-mining use	1 x GL per Mt Fe
Mid-west Iron Ore	Mine to ship including all non-mining use	1.03GL Per Mt Fe
Gold Fields	Mine processing and camp use	.00125 ML per tonne ore processed

The amounts include all water used in production including de-watering operations and are averages in each case. Reliable data is difficult to source as many mines do not release information or have limited knowledge of actual use. I am confident that the figures indicated are accurate to within 95% but there could be variances.

At these levels of usage the overall direct cost of water on the cost of production is minimal. In iron ore it runs at roughly 1.25% to 2.12% of the shipped value (depending on published cash costs). However as the principle cost is fuel and pumps /bore maintenance[14] which is difficult to differentiate from other mine operational cost center analysis then the actual direct cost will often not register as a significant cost.

This level of water usage is significant across the industry. Based on this level of water usage, then the Pilbara iron ore sector has a current total water requirement (2012) of 553 GL, the Gold Fields (mining sector) has a current water requirement (2012) of 292 GL, and the Mid-West 317 GL. In 4 years' time (2016) the collective requirement for water in the Pilbara, Mid-West and Gold fields will be 685, 339, and 307 GL respectively, and in 2018 the water requirements will be 765, 338, and 338 GL respectively. While some of this water is sourced from run-off and mine dewatering the majority (85%) is from underground sources. While the Officer Aquifer system should be able to sustain this level of extraction, neither the Pilbara aquifer, nor Mid-West aquifer systems will have the capacity to sustain these levels of extraction.

There is considerable debate as to what are the longer term sustainable levels of extraction from the Pilbara Aquifer. Estimates have been generated ranging from 250 GL to 410 GL annual extractions. As current water extractions are greater than both these estimates then it should be concluded that the aquifer is degenerating significantly.

The real question that needs to be asked is if the current self-sourcing option is really the most viable for operators. It is currently as there is (or are) no real viable alternatives, however the analysis of the cost may indicate that there is an alternative. In researching this proposal I reviewed a broad range of mining proposals with the Environmental Protection Agency (EPA) most of which included an indication as to the supply of water. The general increase in mining activity has resulted in a relatively large number of applications to the EPA and while costing analysis was not supplied it was relatively easy to get a reasonable cost structure.

I have created a theoretical model based on these and costed a relatively basic mid-range water supply mechanism with the following assumptions:

- 25 bores times 20,000 ML (20 GL) per annum bore field with a spread of 5 km either side of a central collection route. Bore field located 85 km from the mine site.
- No major geographical features between the bore field and mine site.
- Water table at 200 meters with 100 meter addition depth
- Bores to have a yield rate of 2 ML per day
- Mine to be 45 Mt Fe per annum with a 20 year life of mine.
- Water predominately for camp use, dust suppression and desanding. Additional water would be available through de-watering and surface collection however this has not been costed
- No mine dewatering required.

The cost of the bore field, power generation, supply of electricity to bore field, collection and pumping infrastructure and associated engineering would be in the order of $285 million to $310 million. The annual operating costs to generate the electricity, repair and maintain the infrastructure and to operate it generally would be roughly $1.99 per kl supplied into the mine site. No accounting has been made for depreciating the assets over their life and it assumes that all capital costs last the life of the mine.

If 20,000 Individual Water Rights are purchased the cost to the mining operation would be $490 million with no cost to supply so the effective break-even point would be 5.2 years. An added benefit could be that the individual water rights can be traded for the unused portion which (assuming) no increase in the value of water over the 20 years and or no investor's premium would be $311 million meaning that water for the site cost an effective 45 cents per kl against a self-sourced cost of $2.74 per kl. Equally any unused portion of the annual Individual Water Rights could be sold prior to their lapsing.

A similar analysis can be undertaken for all of the regions highlighted in this proposal.

(Imaginary project)

Basic Assumptions made on the Project

Total Water required / extracted	20.00 GL	Life of project	20 years
	20,000 ML	Project Mining	45 Mt - Fe -- pa

CAPITAL COST		
Bores	$168,750,000.0025 bores to 300 meters @ $22,500 per meter	
Pumps	$6,250,000.00 - Assumes one pump per bore (installed) @ $250,000 per pump	
Piping	$19,125,000.00 - Assumes 85 km lead from field to mine site @ $225,000 per km with 2 ML daily capacity.	$225.00per meter
Bore field piping	$10,450,000.00 - Assumes 110 km collection pipe net work @ $95,000 per km	$95.00per meter
Land Access	$1,500,000.00 - Assumes licencing, access and the like for 20 years	$75,000.00 per year
Electricity - Power plant	$22,500,000.00 - Assumes 15 MW @ $1,500,000 per MW	
Power supply to bore field site	$32,725,000.00 - Assumes 85 km lead from field to mine site at $385,000 per km	
Power supply reticulation to bore sites	$10,200,000.00 - Assumes 120 km UG three phase supply	$85,000.00 per km
Other	$12,000,000.00 - Contingency cost	
TOTAL CAPITAL COST	**$283,500,000.00**	
	$14.18 $ per annual kl supplied.	Over 20 years represents $0.70 per kl water supplied
RUNNING /OPERATIONAL COSTS	Cents per kl - H_2O extracted	
Power / Fuel (cost to generate electricity to run pumps)	$0.72 - Assumes extraction and pumping cost to mine site is 85 km	$14,400,000
Repair and Maintenance		
Pumps	$0.25 - Assumes extraction pumps and supply pumping	$5,000,000
Piping (main access and bore field)	$0.32 - Assumes 550 to 650 high pressure main supply and 350 to 450 med pressure in bore field	$6,400,000
Power supply (incl. line access and R & M)	$0.42 - Assumes a high voltage above ground feed and a buried feed with transformers in bore field	$8,400,000
Other (access to bores etc.)	$0.05	$900,000
Labour	$0.10 - Mostly access road access / serviceability and fire fighting etc.	$1,900,000
Other - general	$0.10	$1,900,000
Total	$1.95	$38,900,000
Grand Total	**$38,900,000**	
	$778,000,000 Gross direct cost of Water - non de-watering over life of mine (20 years)	
Individual Water Right Analysis	$490,000,000 - Initial cost of 20,000 Individual Water Rights	
	$178,181,818 - Value of water used (20 year project life)	
	$19,200,000 - Value of t CO_2^{-e} (2 x t CO_2^{-e} per Individual Water Right @ $24.00 each, over 20 years)	
	$311,818,182 - Remaining Value (assuming no increase in the value of Water)	
	$584,659,091 (Estimated) - Remaining Value of Individual Water Rights after 20 years of a 55 year life - Assuming that appreciation of the value of water as a cost of production is roughly 2.5% pa i.e. remaining life (100%-36.36% of Individual Water Right times 2.5% for remaining life (35 years)	

Analyis of the comparison of providing self sourced water and purchasing purchasing 20,000 Individual Water Rights, using these for 20 years and trading out the residue after 20 years for their remaining 35 years of life.

$425,677,273 Effective profit from the purchase, use and re-sale of Individual Water Right after 20 years.

Table 2: Break Even of a Self Sourced Bore Field Water Project.

Sustainable Water Supply

Sustainable water sources are rare. Natural rainfall would appear to be the only truly sustainable water source, and as the Snowy River diversion and irrigation scheme illustrates this is not always the case. Possibly the longest studied and or identified underground water source in Australia is the Great Artesian Basin (GAB) that covers approximately one-fifth of the Australian Continent[15], and stores an estimated 64,900 million megalitres of water, (64,900,000 GL). The GAB was discovered 1878 and by 1915 over 1,500 flowing bores had been drilled.

It is estimated[16] that annual recharge from predominately the western edge of the Great Dividing Range in Queensland is 1040 Ml per day. The same source indicates that daily outflow is about 1,500 Ml per day. There is some debate as to this level of recharge with some sources suggesting lower levels however these sources tended to have vested interests so the Queensland Department's estimate will be used. Over the past 104 years, since 1908 to 2012 when average output has been in the range 1,500 Ml per day and recharge has been reasonably constant at 1040 Ml per day there has been a net loss to the system (GAB) of around .04% of its volume.

The GAB was considered to be a never ending source of stock water and yet 35 years later the source is possibly beyond repair and operating in survival mode

Prior to a concerted campaign to manage the GAB appropriately there were over 1,650 flowing bores tapping the basin. The average depth is 500 meters however some bores are up to 2,000 meters in depth. This relatively small loss (0.4% of net total volume) over the past 100 years appears to have resulted in the loss of most of the flowing artesian bores within the GAB. In 1915 bores were measured with daily flows of 10 to 12 Ml per day and a pressure of 1,300 kilopascals (roughly 130 meters head). The same bore today has a flow of .6 Ml per day and roughly a 9.5 meter head.

The majority of the bores that now tap the aquifer are not flowing and require pumping to extract water. The GAB was considered to be a never ending source of stock water and yet 135 years later the source is possibly beyond repair and operating in survival mode. Water from the GAB is unsuited for irrigation of crops which was possibly a savor for the resource in some respects.

The overall output from the system exceeds the total recharge rate and the effect of depleting the system by over .04% (four tenths of one percent) in the past 135 years is an indication of why underground water may not be a longer term solution. The WA aquifers are equally fragile and very much smaller with a less reliable recharge capacity. The relatively significant impact from a relatively minor change to the equilibrium of the (GAB) system should be an indication as to the sensitivity of the various systems.

A good deal of work has been done on the Perth based aquifers from which the Water Corporation and a range of other users extract water. With the Gnangara Mound there is constant debate as to what is being extracted, what should be extracted, what could be extracted and what controls should be in place to police the process. The various bodies that monitor the Gnangara Mound have determined that extractions are well in excess of double what they initially expected mostly through unregister bores and extractions in excess of licensed allocations. The Economic Review Board has estimated in the past that unregistered bores in the Pilbara potentially number in the hundreds and in the Mid-West a similar number. The problem is not as significant in the Mid-West as most bores are for livestock watering which tend to be lower use extractions.

However the experience that comes from the GAB is that relatively small changes may have a significant impact on the system generally. While the system exists we need to utilize the resource however there should be investigations into other alternatives that provide a similar result. In my view the Officer Aquifer and the Pilbara Aquifer are both reasonably stable systems however they are both relatively small and the volumes being demanded are likely to cause long term damage over a relatively short period. The GAB system is approximately 5 times the size of the Pilbara system and the GAB is having difficulty sustaining extractions of 547.5 GL per year. This would tend to suggest that the Pilbara system should be supporting extraction rates in the range 250 to 300 GL. Obviously annual extraction levels are double this and therefore, potentially, unsustainable over the longer term.

While the various underground aquifers have been essential in developing the mineral and agricultural bases of most of WA's remote north I predict that:

1. In the next 5 to 15 years the Pilbara aquifer will commence the process of deteriorating. The process has possibly commenced however the overall deterioration will become apparent over the next 5 to 15 years. This will manifest itself in bore fields failing to recharge between both pumping and failing to recharge to past levels between seasons. This may lead to normally reliable supplying bores and or bore fields failing to produce at required levels.
2. Projects in the Mid-West will be delayed, stop or not gain government approval to proceed due to water constraints
3. Similar issues will apply in the Gold Fields, however the most noticeable issue will be water quality generally

Unfortunately the various submissions to the EPA for bore field approvals could be merged for their similarity to one another. Based on comments included in these applications / submissions it is highly unlikely that there will be any visible signs on the surface that indicates that the aquifer is under stress. This will not help the process as there will be a period of denial before a solution is sought and that could be detrimental to the sector generally due to the lead time that any long term solution will require.

In addition to this, once an environmental problem is established a whole level of government appears to be created to manage it with the cost being carried by industry in some way. This was illustrated with both the Great Artesian Basin Coordinating Committee and the Murray-Darling Irrigation Board. There are about three semi government bodies all attempting to resolve the Murray-Darling River systems' problems which create a level of regulation that is difficult and expensive to work with for industry.

While the Western Australian mining sector is strong, the fact is that in between five to ten years' time it will have run out of water from its normal sources.

Industry Group/Sector	Industry type Sample Group		Economic yield per kl water ($ pa)	Potential Economic yield per Individual Water Right ($ pa)	Potential Net Yield per Individual Water Right ($ pa)
Manufacture	Urban Use (general manufacture/industry)	Business sectors with the potential to benefit from the purchase of water	185.25	185,250.00	184,800.00
Manufacture	Steel Making		155.00	155,000.00	154,550.00
Manufacture	Power Generation (Gas fired)		145.00	145,000.00	144,550.00
Manufacture	Power Generation (Coal fired)		135.50	135,500.00	135,050.00
Manufacture	Milk Manufacturing Plant		119.75	119,750.00	119,300.00
Mining	Oil and Gas		81.50	81,500.00	81,050.00
Mining	Base Metal Mining		75.88	75,880.00	75,430.00
Mining	Iron Ore Mining		45.72	45,720.00	45,270.00
Agricultural	Cattle Feed Lot		3.25	3,250.00	2,800.00
Agricultural	Dry Land Sheep Husbandry		2.45	2,450.00	2,000.00
Agricultural	Poultry Meat		2.36	2,360.00	1,910.00
Agricultural	Plant Nurseries	Marginal at the cost of an Individual Water Right	2.15	2,150.00	1,700.00
Agricultural	Horses		2.15	2,150.00	1,700.00
Agricultural	Olive Growing & Processing		2.05	2,050.00	1,600.00
Agricultural	Sheep-beef (not supplementary pasture)		1.95	1,950.00	1,500.00
Agricultural	Poultry Eggs		1.56	1,560.00	1,110.00
Manufacture	Wine Making/Manufacture		1.45	1,450.00	1,000.00
Agricultural	Cut Flowers		1.34	1,340.00	890.00
Agricultural	Deer		1.29	1,290.00	840.00
Agricultural	Grain Growing (Wheat/Stock feed)		1.25	1,250.00	800.00
Agricultural	Livestock Sundry Types		1.25	1,250.00	800.00
Agricultural	Hard Wood Plantations		1.21	1,210.00	760.00
Agricultural	Beef (not supplementary pasture)		1.05	1,045.00	595.00
Agricultural	Piggery (Intensive large scale)		1.03	1,030.00	580.00
Agricultural	Grape Growing	Business Enterprises with very limited capacity to gain economic benefit from water at the cost of an Individual Water Right	0.55	550.00	100.00
Agricultural	Kiwi Fruit		0.55	550.00	100.00
Agricultural	Dairy Farming		0.47	470.00	20.00
Agricultural	Grain Sheep/Grain Beef (combined operations)		0.45	450.00	0.00
Agricultural	Apple and Pear Orchards		0.36	360.00	-90.00
Agricultural	Cotton		0.35	350.00	-100.00
Agricultural	Stone Fruit		0.32	320.00	-130.00
Agricultural	Rice Growing		0.25	250.00	-200.00
Agricultural	Vegetable Growing		0.24	240.00	-210.00
Agricultural	Sugar cane		0.19	190.00	-260.00
Agricultural	Pasture		0.12	120.00	-330.00

Source; Adapted from ABS Data for 2003, 2004, 2005,2006, 2008, and 2009.

Publication "Agricultural Production and Costs for Australia and States"

NOTES

These estimates have been developed using ABS, ABARE and other basic data. The expected error due to data source and method is about 12.5% (+/-)

Many agricultural operations are marginal with regards to water due to supply issues. Reglar supply is assumed in developing this table.

The target market of industry sectors should be relatively obvious.

Water application and usage rates as are common or appropriate within the industry or sector, ie drip irrigation on wine or table grapes, spray or flood on pasture, flood on rice etc.

Many assumptions on price, costs of production and yields needed to be made in compiling this data set. For this reason the figures may not be totally applicable for comparison with the industry and or industry sector now. This could mean that some marginal sectors may be negative in particular years based on economic seasonal issues.

Graph 3: Economic Returns from Water in Selected Sectors

The Table above has been developed from ABS data and illustrates what economic yield is derived per kl of water used within a range of industry sectors. The value illustrates the economic yield from each kiloliter of water used within that sector. As can be seen the economic yields from water require that it is provided relatively cheaply to allow its use to result in an economic profit to the user. On the

Ord irrigation it takes roughly 500 liters of water (not including natural rainfall) to produce a kilogram of harvested pasture. This is in line with the recently (September 2012) Rio Tinto pasture irrigation from de-watering Marandoo mine of 20 GL annually.

In the past, proposals to supply water from the Ord and or the North-West into the Perth market have required a supply cost in the order of $4.00 to $8.00 dollars per kl. This was clearly un-stainable for the majority of industry sectors operating within the economy. For the industry sectors that could utilize the water that would have been supplied economically the volumes capable of being supplied would have been insufficient and or the locations would have been in appropriate.

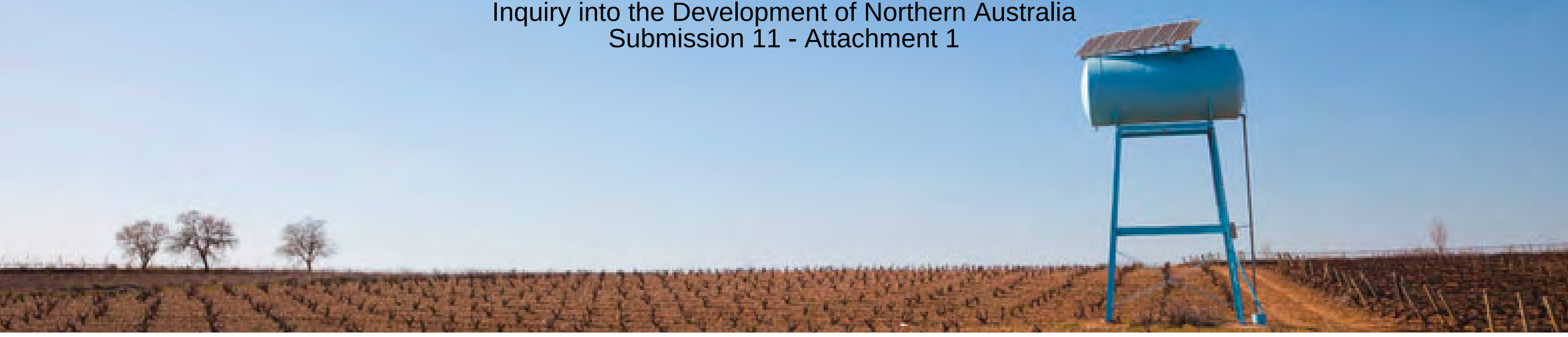
This effectively means that for all those sectors shaded in green in Table 3, water supplied at a constant 45 cents per kl will be sustainable, blue will be marginally sustainable and red are un-sustainable. The unfortunate fact is that for most agricultural ventures – the traditional market for water – will be unsustainable over both the short and longer term. Therefore, the marketing of any water supply project must be focused on those sectors that are able to utilize the water effectively. The project should be capable of supplying water at both a price that is sustainable, economic and in volumes suitable to the venture.

In developing this table I was able to research 3 Pilbara operations, 4 Goldfields operations and 5 Mid-West operations to determine a weighted average cost of water. This cost is the raw cost of obtaining the water and does not include the capital cost of developing the infrastructure. Within Iron Ore operations approximately a kiloliter (kl) of water is used per tonne of iron ore mined and shipped[17]. Use is defined as both required water operation (de-sanding, dust suppression, etc.) and dewatering that effectively takes from the water table.

	GL	$/kl	%	$
Pilbara	**125**	**2.85**	**28.28%**	**$0.81**
	81	**3.02**	**18.33%**	**$0.55**
	37	**2.85**	**8.37%**	**$0.24**
Gold Fields	**12**	**3.12**	**2.71%**	**$0.08**
	22	**3.09**	**4.98%**	**$0.15**
	18	**3.41**	**4.07%**	**$0.14**
	19	**3.05**	**4.30%**	**$0.13**
	31	**3.04**	**7.01%**	**$0.21**
Mid-West	**91**	**1.85**	**2.04%**	**$0.04**
	15	**1.95**	**3.39%**	**$0.07**
	22	**1.45**	**4.98%**	**$0.07**
	11	**1.66**	**2.49%**	**$0.04**
	18	**1.82**	**4.07%**	**$0.07**
	22	**1.92**	**4.98%**	**$0.10**
		Weighted Cost of Self Sourced Water		**$2.71**

Table 1: Weighted Cost of Self Sourced Water in Three WA Regions.
(repeated from page 9)

As the cost of water under the Individual Water Right concept is significantly less than the weighted cost of self-sourcing water then the assumption could reasonably be made that the economic cost of water to users is economically sustainable over the longer term. The water delivered under the Individual Water Rights structure has an economic competitive advantage over most self-sourced options. This means that operations are able to profit from altering their water sourcing options within their operations and to maintain a low cost base to the supply of water into their operations.



Sustainability of Water Supply in the Selected Areas

The major issue with water supply in the Pilbara and the Mid-West regions is that the aquifers are not capable of providing extraction rates at the levels required to support the level of mining production currently being developed. The Pilbara underground aquifer is a fractured rock aquifer and it has a sustainable extraction rate of approximately 250 to 410 GL per year. Current levels of extraction from the Pilbara Aquifer are estimated to be in the vicinity of 560 GL. The Mid-West has a fragmented "patchy" underground aquifer that does not have a developed extraction base.

There is some serious debate over the levels of extraction that will be sustainable over the longer terms in both of these regions. It is highly doubtful if these two systems will allow ongoing extraction at the levels to be able to support a billion tonne per year iron ore industry and a significant gold and base minerals sector.

Based on ABARE research, the WA mining sector within the Pilbara, Gold Fields and the Mid-West will require an annual supply of water in the order of 1,652 GL of water based on the processing of ore within the three regions by 2016/2017. The fairly obvious fact is that this will exceed the capacity of the current supply. The problem is that at this level of extraction water will still flow, water will not shut off simply as it has exceeded a sustainable extraction rates, meaning that any resulting problem will take time to be noticed and or accepted.

Basically, the current supply/extraction is un-sustainable over the longer term and will start to demonstrate this within the next five to fifteen years. Comments made by strategic planners for a number of operations in the Pilbara have confirmed that extraction rates, particularly in the Pilbara, are unsustainable.
A comment was made that "bore hole depths (base water level depths) are dropping by a meter a year and not recovering in the wet season". This comment was researched using initial mining lease applications and it was determined that on average water in bores was being encountered at between 105 to 165 meters. This was for applications for permits made in the late 1960's and early 1970's. Follow up research suggested that the same bores had water at around the 200 meter mark. This research was relatively difficult as it was hard to get accurate information on various sites for which I had opening depth values.

Pilbara water extraction is difficult to define. However if different methods are used, they all point to an extraction rate in excess of sustainable rates.

1. In 2010 iron ore processing in the Pilbara was around 650 million tonnes. If the measure of one GL per million tonnes is applied then extraction rates of the order of 650GL would apply - given that the majority of water used is sourced from underground sources.
2. Applying the comment that bores are dropping one meter per year – if the surface area of the Pilbara is 550,000 km^2 and the meter drop is applied this represents a total extraction of roughly 560 GL. Obviously this is net of recharge and allowing for formation saturation in the aquifer.
3. There are approximately 550 bores in the Pilbara.(18 individual bore fields with an average 25 bores each and extraction rates of 2.5 ML and 75 individual bores). The majority of these are 250mm to 300 mm bores pumping 2.5 ML per day. Extraction capacity from these is a little over 510 GL per annum.
4. In some cases dewatering of mine sites also is an extraction of significant amounts of water. In many cases this water is of a very low quality and is unsuited to normal mine operations however is an extraction on underground water.

This very brief analysis is based largely on 2010 estimates and figures and does not include additional water used for various expansion programs and or new mining operations coming on stream and or new permits being applied for. The aim of this analysis is to highlight that there may be a potential problem and not cast a blame on the current water users in the Pilbara. The current water users have done all of their water extraction with the approval of the relevant authority. The major issue is that in many cases the authorities are not pro-active enough to monitor the situation as these develop.

The Gold Fields Region sits on top of the Officer underground aquifer system that has a sustainable extraction rate well in excess of current use; however the water is relatively deep and highly salty. The depth and salinity adds to the cost of extracting and using the water for these operations. It also means that the water has little capacity to be used for other non-mining applications, is an expensive commodity to remove from the environment, and often requires equipment modifications to allow for its utilization.

Long Term Demand for Water

Demand for water in the three targeted areas is mainly from mining companies. Townships have relatively low demand and agricultural use is currently minimal however demand for agricultural water could increase for specific high value crops. Mining demand for water is currently satisfied from surface water supplies, de-watering operations within the mines and from accessing underground water sources. A range of sources[18] have indicated that for iron ore mining water requirements are approximately one GL per million tonnes mined and shipped and for base metals and gold mining approximately one ML per tonne of concentrate processed.

											Estimates					
	1995	GL	1998	GL	2000	GL	2002	GL	2006	GL	2013	GL	2020	GL	% Change	GL Change
Gold	**49.8%**	**181.5**	**49.8%**	**182.1**	**49.4%**	**212.8**	**50.0%**	**268.0**	**45.2%**	**272.5**	**39.0%**	**349.4**	**38.5%**	**492.4**	**-22.6%**	310.9
Iron Ore	16.1%	58.7	15.2%	55.7	15.7%	67.6	16.0%	85.8	21.3%	**128.4**	23.9%	214.1	24.5%	313.3	52.2%	254.6
Nickle	**12.6%**	**45.8**	**11.8%**	**43.2**	**11.9%**	**51.3**	**12.0%**	**64.3**	**11.1%**	**66.9**	**11.7%**	**104.8**	**10.7%**	**136.8**	**-14.7%**	91.1
Manganise	7.5%	27.4	7.8%	28.6	7.8%	33.6	8.0%	42.9	7.5%	**45.2**	8.0%	71.7	8.0%	102.3	6.7%	75.0
Heavy Mineral Sands	**6.0%**	**21.9**	**6.1%**	**22.3**	**5.8%**	**25.0**	**6.0%**	**32.2**	**6.1%**	**36.8**	**6.1%**	**54.7**	**6.2%**	**79.3**	**3.3%**	57.4
Alumina	2.1%	7.7	2.1%	7.7	2.2%	9.5	2.1%	11.3	2.2%	**13.3**	2.1%	18.8	2.1%	26.9	0.0%	19.2
Coal	**2.0%**	**7.3**	**2.1%**	**7.7**	**2.0%**	**8.6**	**1.9%**	**10.2**	**2.0%**	**12.1**	**2.2%**	**19.7**	**2.1%**	**26.9**	**5.0%**	19.6
Base Metals	2.1%	7.7	2.5%	9.2	3.0%	12.9	2.0%	10.7	2.7%	**16.3**	3.5%	31.4	3.2%	40.9	52.4%	33.3
Dimonds	**1.1%**	**4.0**	**1.3%**	**4.6**	**1.1%**	**4.7**	**1.0%**	**5.4**	**0.9%**	**5.4**	**1.0%**	**9.0**	**1.1%**	**14.1**	**0.0%**	**10.1**
Other	0.8%	2.9	1.4%	5.1	1.1%	4.7	1.0%	5.4	1.0%	**6.0**	2.5%	22.4	3.6%	**46.0**	**350.0%**	**43.1**
	100.0%	364.8	100.0%	366.1	100.0%	430.8	**100.0%**	536.0	100.0%	602.8	100.0%	896.0	100.0%	1,278.9		914.1

Notes

The major potential markets are effectively highlighted in this table.

Gold fields will see demand rise by 310 GL . Un-recorded Self sourced water is a significant factor in the Gold Fields.

Gold production is rising and as such demand for water for processing is rising

Iron Ore is the significant mover. Total demand of 313 GL of which 240 GL will be sourced external to surface water

Other mineral groups are bassically too small to creat specific markets for.

Estimates for water uses vary considerabily from source to source, even within government departments.
The decision was taken to use Water and Rivers Commission as the figures were conservative and developed under a constant structure. Although now defunct (Merged into DEC) the commission maintained a reasonable record base.

Sources; Various sources, ABS, ABARE, State Government, and Water Commission, corrilated with Water and Rivers Commission.

Table 4: Water Use in WA Mining Based on Current Land Allocations (Source [19 20])

The table illustrates the current and estimated future total demand for water in the three remote areas. The Chamber of Minerals and Energy[21] indicated that a significant number of bores are un-metered then the presented figures are highly likely to be understated to actual. The level of under-statement can be as high as 30% to 45%. Some research was conducted using Google Earth® maps to identify apparent bore sites that appear not to be registered, that registered significant vehicle traffic and appeared to be connected to mine workings.

Mining development requirements for water have been developed based on existing industry KPIs for varying types of mining activities. ABARE provide an annual up date of mineral development projects so developing future water requirements is not a difficult task.

Research by the Environmental Protection Authority, Economic Review Authority and State Water have all determined that water extraction from aquifers in the Pilbara and the Mid-West are all exceeding, or approaching a level of over extraction; i.e. exceeding sustainable extraction. Chamber of Minerals and Energy research suggests that mining organisations have a current investment of over one billion dollars in water supply and pay annually $850 million in extraction costs; (2006 cost estimate). The calculated average weighted cost of extraction for all water from all sources for the mining sector is approximately $1.83 per kl[22]. At an Individual Water Right price of around 45 cents per kl means that is there is an economic rational to purchasing Individual Water Rights.

Water Uses for Selected Regions. (All sources of Water in GL)					
	2005	**2008**	**2012**	**2016**	**2018**
Pilbara			Est	Est	Est
Pilbara Mining	385	442	553	685	765
Pilbara Agriculture (est)	19	21	35	40	43
Towns and Communities	11	12	14	16	22
Pilbara Total	**415**	**475**	**602**	**741**	**830**
Goldfields					
Goldfields Mining	225	232	248	259	285
Goldfields Agriculture (est)	15	17	22	25	27
Towns and Communities	18	20	22	23	26
Goldfields Total	**258**	**269**	**292**	**307**	**338**
Gascogne					
Gascogne Mining	112	135	173	192	225
Gascogne Agriculture (est)	92	99	103	105	112
Towns and Communities	35	37	41	42	51
Gascogne Total	**239**	**271**	**317**	**339**	**388**
Totals	**912**	**1015**	**1211**	**1387**	**1556**
Estimated potential market for water supplied				**739**	**992**
Estimated % of water seen as a market				**53.25%**	**63.75%**
Mining Developments					
Pilbara Mining Developments	332	285	312	245	245
Goldfields Mining Developments	74	81	64	71	71
Gascogne Mining Developments	23	88	152	185	185
Total Developments	**429**	**454**	**528**	**501**	**501**

Table 5: Water use in Selected Regions

											Estimates					
	1995	**GL**	**1998**	**GL**	**2000**	**GL**	**2002**	**GL**	**2006**	**GL**	**2014**	**GL**	**2020**	**GL**	**% Change**	**GL % Change**	**GL Change**
Irrigated Agriculture	**40.5%**	**642.33**	**40.0%**	**623.2**	**40.0%**	**718**	**39.0%**	**774.15**	**36.9%**	**780.4**	**35.7%**	**969.3**	**35.1%**	**1,282.6**	**-13.3%**	**99.67%**	640.2
Mining	23.0%	364.78	23.5%	366.13	24.0%	430.8	27.0%	535.95	28.5%	**602.8**	33.0%	896.0	35.0%	1,278.9	52.2%	**250.59%**	914.1
Industry	**4.0%**	**63.44**	**4.0%**	**62.32**	**4.0%**	**71.8**	**4.0%**	**79.4**	**4.1%**	**86.7**	**4.3%**	**115.4**	**4.2%**	**153.5**	**5.0%**	**141.91%**	90.0
Services	6.8%	107.055	7.0%	109.06	7.0%	125.65	7.0%	138.95	7.1%	**150.2**	7.2%	195.5	7.1%	259.4	5.2%	**142.34%**	152.4
Parks & Gardens	**3.2%**	**50.752**	**4.0%**	**62.32**	**4.0%**	**71.8**	**3.5%**	**69.475**	**3.9%**	**82.5**	**3.3%**	**89.6**	**3.1%**	**113.3**	**-3.1%**	**123.19%**	62.5
Housholds	14.5%	229.97	14.0%	218.12	13.0%	233.35	13.0%	258.05	14.1%	**298.2**	11.0%	298.7	10.5%	383.7	-27.6%	**66.83%**	153.7
Garden Bores	**6.0%**	**95.16**	**5.0%**	**77.9**	**5.0%**	**89.75**	**4.0%**	**79.4**	**2.8%**	**58.2**	**2.5%**	**67.9**	**2.0%**	**73.1**	**-66.7%**	**-23.20%**	-22.1
Stock Water	2.0%	31.72	2.5%	38.95	3.0%	53.85	2.5%	49.625	3.0%	**63.5**	3.0%	81.5	3.0%	109.6	50.0%	**245.59%**	77.9
	100%	1,586.0	100%	1,558.0	100%	1,795.0	100%	1,985.0	100%	2,115.0	100%	2,715.0	100%	3,654.0			

Notes

Source State Government (Water and Rivers Commission), ABS Data and ABARE Data
The lack of metering on Bores has meant a potential to underestimate usage from these sources
Declinging Household usage is the combined effects of:
- Rising water charges (micro economic effect)
- The continuing use of partial (winter) water rationing
- The effect of more careful metering of bores

The Desalination Operations will focus on the Domestic growth in demand (150 GL) at the expense of other users
Stock Water is nearly all privately sourced and as a result likely to be under declared in all state government figures
Estimates for water uses vary considerabily from source to source, even within government departments.
The decision was taken to use Water and Rivers Commission as the figures were conservative and developed under a constant structure/statistical method
Estimates are based on initial regression analysis followed by a review of anticipated variances from a range of sources - ABARE and ABS predominately.

Table 6: Historical and Projected WA Water Use 1995 to 2020

Sector	WA	SA	Victoria	NSW	Queesland	Other	Total	% of Total
Agriculture	512,510	625,140	3,320,151	6,521,500	2,241,581	3,401,548	16,660,381	66.89%
Electricity and Gas Supply	105,000	110,521	551,254	652,150	135,210	102,510	1,687,778	6.78%
Forestry and Fishing	2,142	3,125	6,521	8,155	3,525	3,448	26,924	0.11%
Households	170,250	195,214	674,810	725,480	235,080	85,420	2,181,447	8.76%
Manaufacturing	112,540	131,500	182,510	323,521	120,150	85,621	866,061	3.48%
Mining	310,050	10,520	26,224	21,520	25,950	6,552	400,622	1.61%
Other uses nec.	25,050	44,512	65,212	101,512	921,120	45,150	1,291,493	5.18%
Water Supply (Metro non household)	85,210	109,850	489,540	651,254	225,050	98,540	1,793,953	7.20%
	1,322,752	1,230,382	5,316,222	9,005,092	3,907,666	3,828,789	24,908,659	100.00%
Source	ABS Publications suppoted by reports from irrigation schemes and the like. House hold and domestic supply is the only really accurate measure of water use. As water supply becomes more critical the structure and reporting has improved sigtnificantly.							

Table 7: National Water Use by Sector - 2008

Total Annual Supply	1,250,000 ML				
	1,250 GL				
	cost/kl/pa	life in Years	Individual Water Right -- Marketed	Individual Water Right cost	Total Raised
	$0.45	55	1,000,000	$24,750	$24,750,000,000
Pipe Infrastructure	estimated Distance (Km)	Per KM ($)	$	% of total cost	cost per kl (pa)
1,250 GL Capacity	1,250	$2,700,000	$3,375,000,000		
500 GL Capacity	1,200	$1,550,000	$1,860,000,000		
Final Distribution	2,400	$722,000	$1,732,800,000		
		Sub-Total	$6,967,800,000	28.2%	$0.13
Pumping and Power Generation					
Pumping Infrastructure	Pumping Stations	Value per Station			
	15	$65,000,000.00	$975,000,000	3.9%	$0.02
Power Generation (3,200 MW (Wind / Solar)	Power Stations	$ per MW			
	15	$1,950,000.00	$6,240,000,000	25.3%	$0.11
CO_2 Tree Farm (uses 250 GL of water not marketed as Individual Water Rights)			$3,000,000,000	12.1%	$0.05
Waste Re-Cycling			$1,250,000,000	5.1%	$0.02
Royalities and Water Purchase	**Price per kl**	**term in years**	**for 1250 GL**		
Local Owners of Water	$0.015	55	$1,031,250,000	4.2%	
State Govrnment	$0.015	55	$1,031,250,000	4.2%	
Access Rights Cents / ML Km	$0.003		$350,000,000	1.4%	
		Sub-Total	$2,412,500,000	9.8%	$0.04
Finance Cost / Servicing (Construction Life of Project)			$1,350,000,000	5.5%	$0.02
Contingency Cost/s (Construction Life of Project)			$2,500,000,000	10.1%	$0.05
Total Cost			$24,695,300,000	100.0%	$0.45
Short fall / Surplus			$54,700,000		

Table8: Basic Cost Structure for Water Delivery System

Suggested phases in furthering this project

Over the past 6 years I have researched and developed a concept that will allow for the structured implementation of this project to transport water from the North-West to the identified markets that can utilize the product with on-going sustainability, has a need for the product and can deliver the product at a price lower than the current cost structure.

The thrust of this work has been in identifying as many projects as possible from around the world and analyzing these in as much depth as possible to attempt to better understand the costs, and cost structures that affected these projects. This concept has been supported by a very significant body of research by a range of organisations that have suggested that:

- The cost structure of self-sourced water in the geographic areas being targeted is high
- The fact that the aquifers are being managed at above sustainable rates of extraction
- The fact that mining operations are expanding production which will require additional water
- The fact that some mining operations have be prevented from commencing operations due to water accessibility, and the like

The WA State government effectively supported this approach by conducting a very in-depth analysis into five water supply projects proposed to bring water from a similar source to supply Perth. The Water Corporation of WA, Water Commissions of WA, the Economic Review Board of WA, the CSIRO, ABARE, and a range of other organisations have undertaken research on water supply, usage and costs.

In my view this form of investigation can only go so far in developing this project to some level of conclusion. The project now requires the injection of some funds to carry out a dedicated “desk top” review of “all” of the relevant data to determine if the project has the capacity to move forward. This will require an injection of roughly $5,000,000 to be utilized to conduct a detailed review of the data at a level that an individual is unable to achieve with the objective of developing a definitive answer to the question - “is the project viable to progress to a further level?”. Essentially, an in-depth and comprehensive literature review of previous projects with conclusions drawn by individuals with both training and current expertise in the specific areas.

To that end, a detailed review of the following areas needs to be conducted:

1. Engineering viability
    - Civil engineering
    - Hydro engineering
    - Electrical engineering
2 Economic/marketing viability
3. Environmental potential impacts
4. Land rights and land access implications
5. Political implications
6. Mining Strategic position
7. Sustainable Development Potential

The aim is to undertake a detailed examination of available research and to investigate that impact on the project. The concept of transporting water from the North-West to other areas of WA have existed for the past 50 years and a significant number of projects have been suggested. Each of these projects has comprised some level of research.

In my opinion, the time is now appropriate to examine all of the available research with a view to confirming the most economical, sustainable, environmental and logical approach to the concept.

The proposal I have formulated is more of closed sustainable system that has a significantly different proposed market and pricing structure than any of the concepts proposed in the past. This will add a layer of complexity to the investigations. The following questions need to be addressed in this initial investigation and can be answered with an analysis of currently available information, research and or mathematical / business modeling.

To supply the required water over a given period will require roughly 3,500 ML to be supplied on any one day. The channel proposal suggested some time ago was designed to deliver less than a third of this volume. The design effectively came down to a range of controlled or controllable variables that the promoters of the concept felt were acceptable and addressed the required out comes. The Individual Water Right concept is no different, in that a set of conditions is defined and the requirement is to initially determine a systematic search to determine the best fit solution. The following are the constant factors that cannot be altered:

- 3,500 ML of water capacity (per day) to be delivered at any of multiple points along the designed delivery system
- Water to be valued at no more than 45 cents per kl as a 55 year Individual Water Right.
- Individual Water Right value cannot be exceeded in the construction process
- One individual water right will equal one ML of water and 1 x tCO_2^{-e}.

It then becomes a case of testing models to match a best fit scenario to the above set of constraints. The groupings below are suggestions as to how this process could be structured. Much of the work is basic working with basic research to confirm relatively basic structures. For example, if we return to the channel proposal the route proposed was approximately 3,500 km in length and was essentially gravity fed. This resulted in a low energy requirement (for pumping) however also resulted in a slow travel time with an outcome that it was estimated that on arrival the water would require very extensive treatment to be suitable for human consumption as it was proposed to supply the Perth water market.

Speed of flow will be dependent on pipe size, size and power of pumping infrastructure, power available for pumping, required delivery schedules, length of delivery system, route taken etc. The other dependent variables will have additional independent variables and the initial program is aimed at determine what these are and how they contribute and or detract from the project. The list here is not exhaustive, more representative.

1. Engineering viability

Civil Engineering

- Potential issues - geography
- Three potential routes and why. Distance of each and logistics issues of each.
- Form of transport (high pressure pipe, low pressure pipe, other options and why)
- Preferred distance for option delivery, i.e. time in transit.
- Potential life of project (i.e. length of time before major repair or infrastructure replacement, probability that infrastructure will last individual water right period)
- Construction issues - land form, geography etc. and how can these be engineered for.
- Type of construction material (options)

Hydro engineering

- Energy required to transport volume water on each of three potential routes
- Capacity to meet potential / required delivery schedules
- Capacity to handle peek volumes
- Best fit model (volume, distance, speed)
- Best fit pumping stations (location and capacity) on each route and why

Electrical engineering

- Power generation options (Solar, Wind, Gas, Diesel, etc.)
- Are these options viable? (sufficient wind, sunlight, electricity usage profiles, etc.)
- Potential power generation location points and why.

- Do potential power generation sites suit the best fit route option?
- tCO_2^{-e} produced from a variety of generation methods

2. Economic/Marketing viability

- Define the true market for water in the proposed segment
- Define the current cost and usage of water in the market sector
- Define the ongoing sustainability of both supply and the market for water

3. Environmental Impacts

- Review other EPA applications for mining projects in relation to water allocation - Review of those that have water as a key issue
- What are the current rules and regulations on transporting water
- Current Ord Dam releases (net annual inflow; allocations and implications)
- Species impacted on route
- Species impacted in Kimberley
- Potential Impact of reduced water extraction in Pilbara
- Historical data on Pilbara Aquifer (current data regarding water access, availability, usage, registered bores, etc.)

4. Land rights and Access

- Investigation of Kimberley land council Price Point agreement
- Who will be affected by the Individual Water Right water proposal? (traditional owners, leaseholders and freehold land owners and the extent of that impact)
- Land owner impact for the three proposed routes
- Easement and easement regulation (gas line, rail line water access)
- Construction access in the past for projects (such as gas pipe lines, private rail etc.)

5. Political implications

- Potential reaction/s to the concept
- Ownership issues (initial and ongoing; who owns what assets)
- Review of the work on the legal licensing / extracting of water in the Pilbara

6. Mining Strategic Position

- What does mining sector see as its water supply options over the next 50 to 60 years, and are these seen as viable/valid options?
- What are the current costs associated with both the supply of water to mine sites and of maintaining this infrastructure?

These topics are only a basic guide and will be expanded. It is almost certain that topics can be, and will be added, into all sections however the list provides a starting point. The aim is to keep the project on a “previously researched” basis. Investigate and correlate what others have done in the past and not attempt to either reinvent the wheel, or attempt to invent a better model. An opportunity also exists to develop a relatively competent project team that can both provide the individual levels of expertise and also be the basis for a broader based group should the recommendation be made to move the project to the next phase.

As indicated, most of the research and planning work has been conducted in the past and is on the public record through various structures. I beleive that the need is to seek an experts option in each area based on a relatively focused and specific brief and to use these expert options to both allow a definite option to be drawn on the project generally, to build a base of information that will allow the project to extend into Phase II and to assist in developing a core of people to move the project forward should this be the decision.

Funding the Project

Phase I

Review of current data on the following with a view to determining if the conclusions already made are accurate, and determine if it is viable to proceed further with the project as described.

i. Sustainable development overall
ii. Land rights and access, including water supply issues iii. Environmental impacts
iv. Economic viability, both short term and long term.
v. Accounting issues; i.e. accounting for the asset in business vi. Mining (largest customer) potential strategic position
vii. Engineering viability
viii. Political implications

I believe that the budget indicated ($5,000,000) and a 12 to 18 month time frame would be adequate and at the end of that period provide a number of significant pieces of information:

- Define if the project is feasible based on detailed "desk top" assessments, and based on this allow the investors to proceed if there is sufficient interest in furthering the project,
- Provide a sophisticated and researched base of information on which a decision to proceed can be made
- The information could be either sold off as a business concept or the information used to attract other interested partners to progress the project through to a detailed bankable feasibility study.

The aim is to establish a low cost yet competent project team that will compile a detailed understanding of all of the known aspects of the project. This aspect of the project needs to be relatively lean and mean. The outcome will report on the viability to proceed and based on this recommendation the decision will be made to either move on to Phase II or abandon the project.

This proposal is currently seeking seed funding for Phase I. Seed capital investors would be entitled to a 1:5 allocation on IPO while equity investors to Phase II would be entitled to an allocation on IPO of 1:2.5. Phase I could be structured as a partly paid equity raising that would carry through to the IPO allocation and is so doing maximize the capacity to benefit from the script allocation on IPO. I am seeking one to three initial investors for Phase I otherwise management becomes an issue, or can become an issue.

Benefits to an Investor in the project at Phase One

Should an investor become involved and should the project advance fully (i.e. Phase 1 to Phase 4) in basically the method outlined then I believe the following would apply:

- Phase I — Investment of $5,000,000 as described.
- Phase II — Investment of up to $45,000,000 on the assumption that the investors fully fund the Bankable Feasibility Study.
- Phase III — IPO for project, and market the Individual Water Rights (1.25% deposit). The number of shares and their value will be developed in Phase II. Allocation of shares in the entity to the initial investor in line with capital contributed and the desire to have either a controlling interest or a minority interest in the final structure. The aim would be to reward initial investors of seed capital to a ratio of 1:5 with a share allocation on IPO and for bankable feasibility investors of 1:2.5 with a share allocation on IPO.
- Phase IV — Sale of the Individual Water Rights to raise the construction cost. On completion my valuation of the infrastructure project would be in the order of between $24 and $26 billion. Depending on how the overall shareholding is structured on completion the value could be significant for any individual investor.

  In Phase IV the sale of the Individual Water Right will be to water users and on a basis that will allow them to profit from owning the right. They will also have to fund the purchase meaning that the project does not have the requirement of seeking a funding structure to raise the construction cost. Potentially this is a benefit.

This is a potentially a fairly good out come on a relatively small initial investment. I personally would like to retain a 2.5 % to 3.5% interest in the project to be funded by work already done.

Expense Group	Expense Detail		Estimated Expense (pa)	Per Month	Total Cost (18 months)	Actual Annual Salary Paid
Budget		Total Projected Cost	$5,000,000			
		Total Projected Time	18	months		
1	Project Management	CEO / Project Manager	$220,000	$18,333	$330,000	$190,000
2		Company Sec / FC & Acc's / Office Admin	$200,000	$16,667	$300,000	$170,000
3	ALL Salary costs are Gross -- include all	PA - Administration Support	$80,000	$6,667	$120,000	$70,000
4	Super annation	Basic Reception / Relief / Support / Other	$50,000	$4,167	$75,000	$40,000
	Leave --(Sick and Annual)	Research Support				
5	Pay Roll Tax -- if applicable	Environment / Economic	$75,000	$6,250	$112,500	$60,000
6	Work Cover	Sustainability	$75,000	$6,250	$112,500	$60,000
7	Other wage fringe costs	Mining	$75,000	$6,250	$112,500	$60,000
8		General / Marketing	$75,000	$6,250	$112,500	$60,000
				$70,833		$1,275,000
Administration and Occupancy						
	Office Accommodation	Approx 225 Sq M @ $1,000 per Sq M	$250,000	$20,833	$375,000	
	Telephone services	12 Mobiles on $125 per month contracts, Leased Land Lines and syetem set up	$55,000	$4,583	$82,500	
	Computer Services	20 ($3500) lap tops with $750 programming and $850 support each	$95,000	$7,917	$95,000	
	Office Furniture -- fit out cost	Basic set up for 20 people	$35,000	$2,917	$35,000	
	Sundry Office Set Up		$15,000	$1,250	$15,000	
	Printing and Copier with Consumables	Leased copier/ printer with scanner	$35,000	$2,917	$52,500	
	Graphic Art		$15,000	$1,250	$22,500	
	Travel and Accommodation.	Contigency Cost	$30,000	$2,500	$45,000	
	Presentations	Room hire and other costs	$15,000	$1,250	$22,500	
				$45,417		$745,000
Expert Opinion Reports -- inhouse and or external						
	Engineering Viability					
9	Civil Engineering	Contracted Report / Internal	$275,000	$22,917	$412,500	
10	Hydro Engineering	Contracted Report / Internal	$275,000	$22,917	$412,500	
11	Electrical Engineering	Contracted Report / Internal	$275,000	$22,917	$412,500	$1,237,500
12	Economic/Marketing Viability	Contracted Report / Internal	$125,000	$10,417	$187,500	
13	Environmental Impacts	Contracted Report / Internal	$125,000	$10,417	$187,500	
14	Land Rights and Access	Contracted Report / Internal	$125,000	$10,417	$187,500	
15	Political implications	Contracted Report / Internal	$125,000	$10,417	$187,500	
16	Mining Strategic Position	Contracted Report / Internal	$150,000	$12,500	$225,000	
17	Sustainable Development Potential	Contracted Report / Internal	$125,000	$10,417	$187,500	$1,162,500
Sundry Costs						
	Contigency Costs and basic operational costs not specific to specific reports		$375,000	$31,250	$562,500	$562,500
						$4,982,500
	under / over					$17,500

Table 9: Proposed Proforma Phase 1 Operational Budget

Overview of Business Model

While the aim of Phase I is essentially to conduct a literature review of all relevant papers and work relating to the project the proposed business model needs to be understood. The business model will be developed further in Phase II, however a basic overflow follows

Once Individual Water Rights have been marketed the aim is to undertake the majority of the work in house with a minimum of contractors. The “in house” model has been successful in a range of companies that are very successful - BGC and Mineral Resources being two Perth based examples. The aim is to both control costs and to also allow for the development of specific Strategic Business Units (SBU) that can be marketed at the conclusion of the project. The actual construction of the project will take up to six years and cost in the order of $24 billion – funded through Individual Water Rights to water end users. The alternative funding model is an in house funding option that would be difficult to maintain an income stream to support and therefore hard to establish.

In my view, this will allow both time and capacity to develop SBUs in the following areas:

- **Power Generation SBU**. Sell and buy back provision for up to 4,500 MW predominately solar and wind generated power and extensive distribution network into Pilbara, Mid West and Goldfields. ($10.50 Billion)
- **Solar and Wind Power Generation Equipment SBU** ($2.850 Billion)
- **Transport SBU** ($0.150 Billion)
- **Recycled Plastic Products - irrigation SBU**. ($0.950 Billion)
- **Waste Management SBU** ($2.300 Billion)
- **Staff Training SBU** ($0.100 Billion)
- **Fabrication SBU** ($0.150 Billion)
- **Construction SBU** ($0.175 Billion)
- **Remote Area Support SBU** ($0.175 Billion)
- **Mine Support / HRM SBU** ($0.150 Billion)

I feel that these SBUs (and potentially others) could be developed in the development and construction phases to be marketed at the prices indicated which would raise in the order of $17.33 billion. If fully realized, this would mean that the business would have the cash reserves to:

- Support the supply of water to its customers,
- Support the capacity to develop other projects
- Support the company’s share price which allows investors to benefit from their involvement.

Following the construction phase the intention is to only have the following assets in the company:

- The actual water supply infrastructure,
- The tree farm
- The ownership of the water purchased to supply in the future
- The ownership of the tCO_2^{-e} developed and marketed.

Phase II will develop business models for each SBU that will need to be achievable to allow for the prices indicated. In most cases the business models will need to show both a management capacity and an order book capable of supporting the business into the near/midterm future. This will mean generating sales external to this project and developing the individual business plans is proposed for Phases II, III and IV. Sale of the SBU could be as a direct sale to a third party, a management buy-out, or as in independent listing of the SBU – or a combination of the three.

This very brief outline will not answer all questions, and it does not intend to. There are a broad range of potential business issues that will be developed during the Phase I research that may vary aspects of the initial plan.

In my view, this project will only work financially is with the prepaid Individual Water Right concept. To raise the construction costs from the market would be almost impossible as, in my view, it would be difficult convince to the required number of investors to invest.

The other issue would be developing a sufficiently large on-going income to support the share price (dividend income). Any increases in costs would flow on to end-users who would be constantly seeking alternative sources of supply. Ongoing sourcing water would be problematical practically with the traditional owners and the government. The strategic concept of developing SBUs to both provide services during construction phase, and be designed for an eventual sale needs to be a strategic planning focus from project conception to be successful. To attempt to package business units for sale in the last year or so of the project may not produce the desired outcome. While the need to manage a range of different business models adds to the complexity of the business the benefits can be significant.

Sustainable Development Potential

Central to this entire project is the need to put forward, and potentially develop a sustainable concept for both the mining sector, the state of WA and for the Australia economy generally. I believe that the project as a whole has a greater capacity to successfully address all potential environmental, social, economic and regulatory issues if the holistic project is as environmentally, socially and economically sustainable as possible. While I feel that there are some very serious concerns in the various definitions and descriptions of "sustainable" and "sustainability", the project does address many of the key concepts.

What follows is a brief overview of the concept of sustainability generally and how this project attempts to address key issues. The project has been specifically designed to require minimal external inputs and as much as is possible be a relatively closed system which will make it as enduring as it is possible to be.

Sustainability[23] is generally defined as the capacity to endure. For humans sustainability is the long-term maintenance of responsibility which has environmental, economic and social dimensions. The concept of sustainability appears to encompass the concept of stewardship – the responsible management of resource use. In ecology sustainability describes how biological systems remain diverse and productive over time. Healthy ecosystems and environments provide vital resources and processes.

The concept of sustainability appears to encompass the concept of stewardship - the responsible management of resource use

There are two major methods of managing human impact on ecosystem services. One approach is environmental which is based largely on information gained from educated professionals in earth science, environmental science and conservation biology. The other approach is management of consumption of resources which is based largely on information gained from educated professionals in economics, finance and business.

Human sustainability interfaces with economics through the voluntary trade consequences of economic activity. Moving towards sustainability is also a social challenge that entails among other factors international and national law, urban planning and transport, local and individual lifestyles and ethical consumerism. Ways of living more sustainably can take many forms from controlling living conditions - Eco villages, eco-municipalities, sustainable cities, to reappraising work practices – using permaculture, green building designs, sustainable agriculture or developing new technologies that reduce the consumption of resources.

A universally accepted definition of sustainability remains elusive because it is often linked with other concepts such as "sustainable development" or "sustainable agriculture". On the one hand it needs to be factual and scientific, a clear statement of a specific "destination" on the other hand it appears to be required to illustrate a goal for society – or a part of it. The simple (or simplistic) definition "sustainability is improving the quality of human life while living within the carrying capacity of supporting eco-systems"[24] though vague conveys the idea of sustainability having quantifiable limits. But sustainability is also a call to action, a task in progress or work in progress and is therefore a political process and as such some definitions set out common goals and values. The Earth Charter[25] speaks of "a sustainable global society founded on respect for nature, universal human rights, economic justice and a culture of peace".

To add to the overall complication of a simple definition the word sustainability is applied not only to human sustainability on Earth but to many situations and contexts over many scales of space and time, form small local ones to the global balance of production and consumption. It can also refer to future intention - “sustainable agriculture” is not necessary a current situation but a goal for the future, a prediction. For all these reasons sustainability is perceived at one extreme as nothing more than a feel good buzzword with little real meaning or substance but at the other end as an important but un-focused concepts like “freedom”, “liberty”, “justice”, and “equality. It has also been described as an “a dialogue of values that defies consensual definition”.

In this somewhat confused and or confusing environment, the mining sector is required to generate a sustainable mining production model. The mining sector will supply various international markets while there is an economic competitive advantage to do so. While the price paid for the commodity covers all costs, including environmental costs then the project; by definition is sustainable, it will endure over time. This water project offers the industry an opportunity to retain a competitive advantage by retaining a ready supply of water, and in so doing potentially retain a completive advantage in supply and potentially endure for longer.

The significance for the mining sector to drive one of the most significant truly sustainable supply projects in history should not be lost. The mining sector drove the Goldfields water supply project that was completed in 1903. This project was the sustainable supply of water that was essential for the sector to survive. Its sustainability is evidenced in the fact that it still functions in the method originally devised. Whether or not it is now “propped up” with desalinated water could be a contentious and vexed question left to nobler minds.

In the 1880s and 1890s when the Goldfields water supply project was devised water was being railed in at a cost of three pounds per thousand gallons[26] and following the completion of the project water was freely available for three shillings six pence per thousand gallons.[27] In current costing and volumes this compares to $19.85 per kl for carted water compared to $1.17 per kl for pumped water.[28] While self-sourced water is not yet at the $19.00 per kl level (1890’s equivalent) the capacity of the price of water to rise exponentially due to reduced supply is highly probable. Due to ever increasing demand for water the mining sector is again finding itself in a position when something will need to be done.

It is interesting to note that the current drought (2012 Northern summer) gripping North America is having a big impact on the current corn (maize) harvest. The USA had embraced the production of ethanol as a sustainable fuel alternative. 114 million tonnes of corn (maize) had been earmarked for ethanol production, more than the total production of Argentinian, Brazil and Ukraine combined. The drought has so decreased overall production that the (US) Environmental Protection Agency has been lobbied to decrease the allocation to be processed to ethanol. Which tends to suggest that sustainability is only as deep as the next environmental, political or global drama.

In my view, It is unlikely to find a definition of sustainability that is not heavily skewed with self-interest. The whole “science” of sustainability is a conjured science were in truth nothing in modern manufacture will ever be “sustainable” based on the current definitions due to the required inputs into modern manufacture and the various “leakages” from the system. The aim therefor is to develop a ‘best fit” model that appears that it may pass the various tests leveled at it. Possibly the most sustainable industry or sector in the economy, though much maligned, is the agricultural sector. The least sustainable sector in the economy, in my view, is the public sector. The rest fit in between.

An Integrated Sustainable Project

The Water Supply

This project offers a unique opportunity to create a truly integrated sustainable resource support infrastructure mechanism. The project being developed functions around the concept of the Individual Water Right and the Individual Water Right incorporates the following:

- One ML of water supplied annually for a period of 55 years (on current planning)
- One tonne of Carbon Dioxide credits (tCO_2^{-e}) supplied to for a similar period
- Under current planning not charge for delivery.

To be in a position to be able to achieve this for the full license period the project must have the capacity to source both the water and the tCO_2^{-e} and to achieve this requires specialized elements of planning. Each element should supply a component yet be integrated into the whole and at the same time develop an income to support itself financially.

The Water is sourced in the North West from a sustainable source and transported south for use in markets that, need the resource, are able to afford the supply, and the supply is at a cost to supply not an inflated cost to supply that is not long term sustainable. The integration of the project is more about the support components that the water delivery.

The Power Supply

As was constantly indicated to me during researching this project water is extremely expensive to transport. The calculated power requirement for transporting this volume of water is between 2,750 and 3,700 MW which is similar to the current (2012) base load generation capacity for Perth. The options for generation are basically:

- Onsite gas and or Diesel generation
- Off site with transmission gas and or diesel generation
- Onsite solar and or wind generation.
- Other – hot rock etc.

Two mechanisms where used to make an estimate of electrical power required for pumping of water. Initially as many projects as could be found in which large amounts of water were moved and power usage numbers were quoted. These were reduced to a lower common base, I.e. kl per transported meter per unit of power or energy, and these were then extrapolated to the project's parameters. The second method was to calculate energy on a flat surface to move one cubic meter of water one meter in joules. This amount was then extrapolated over the proposed distance for the proposed volumes to develop a total energy requirement. This energy component was then converted to a power estimate.

Nether method is without significant shortcomings due to

1. The number of assumptions that need to be made on geography/gradients, flow rates and pipe configurations, and the like,
2. "Joules" is a measure of energy while "watts" is a measure of power and while it takes 3.60×10^{12} joules of energy to produce a MW of power the conversion should not be seen as a direct conversion.

The end result was a calculation that developed an estimated power requirement in the range 2,750 to 3,700 MW. The table below summarizes the joules to watts calculation.

3.44E+12	**Tonnes (kl) over distance (km) 1250 GL over 2750 km**
3.44E+15	**Meter Tonnes Total distance converted to meters**
3.85E+00	**Joules per tonne meter transported**
1.32E+16	**Total joules**
3.60E+12	**Joules of energy required to produce each MW of electrical power.**
3.68E+03	**total MWs required**
3,676	**MW in non-scientific notation**

Table 14: Basis for the development of the Power Requirements for Pumping in the Project.

**NOTE:* There are a significant number of assumptions that need to be made in developing this estimate. The measure is cross correlated with actual projects (smaller) to validate that the measure is within a reasonable scope. I believe that it is an over estimation to actual but until a more detailed study (Phase I) this measure will suffice.

The options for generation are basically:

- Onsite gas and or Diesel generation
- Off site with transmission gas and or diesel generation
- Onsite solar and or wind generation.
- Other – hot rock etc.

Each option has pros and cons that need to be investigated. My research has focused on onsite solar panel and wind turbines as being a viable option. Solar heat concentrator technology while more effective and efficient (24 hr supply) the need to have fully staffed isolated generating capacity makes the ongoing operating cost significantly higher than all other models.

Supply feeds of both gas and fuel make the cost of the other options very high. The tCO_2^{-e} cost of both gas and diesel options is high which potentially has flow on effects to the cost and or the number of carbon offset credits that could be marketed as in income source. The current planning is that power supply will be a combination of solar and wind generation with bulk storage (electricity) to provide 24 hour supply.

The recently announced (February 2013) Alinta Energy 178 MW capacity Newman (WA) gas powered power plant, the BHP counter announcement (August 2012) of a 190MW on mine gas fired generation capacity demonstrates the potential power needs into the Pilbara.

The water project potentially offers the economics of scale to address this need in an economic and sustainable method. The water project will require approximately 3,250 to 3,700 MW of capacity for pumping requirements. A review of power generation capacity sought from a range of Pilbara Iron Ore projects suggest that between 1.25 MtFe and 1.67 MtFe require 1 MW generation capacity. The ore bodies in the Mid- West appear to require slightly higher capacity at approximately 1 MW per 1.1 MtFe. While antidotal this would suggest that in the Pilbara raw electricity requirements are in the range 600 MW currently, potentially rising to 750 – 800 MW in the next four years as expansion projects and new operations come on stream. Logically a base load Pilbara capacity of around 1,000 MW should be being planned for 2020.

The water project delivery infrastructure (system) will provide the economics of scale, the initial capital capacity and the delivery capacity to develop and deliver power into all mine sites to which it delivers water. The BHP announcement of a 190 MW capacity gas fired power station for $573 million values a MW of capacity at $3.14 million which is about double the cost of a similar MW of capacity on the coast in a populated area. It is also well within the range at which intergraded solar/wind is viable.

Add to this the fact that antidotal evidence would tend to suggest that the FTE staffing per MW capacity is .48 with gas fired power plants then the lower maintenance of integrated solar/wind generation has some perceived benefits in cost and supply. Base level business planning would tend to suggest that an integrated solar (PV Panel) with wind turbine generation, through an integrating control center with energy storage capacity will cost roughly $2.15 million per MW. As the entire power system will require in excess of 17.5 million individual 200 watt PV solar panels and roughly 400 x 3.5 MW wind turbines then there is potential to reduce the per MW cost through economics of scale and or self-manufacture with off-setting third party product sales. There is significant commercial interest in supplying infrastructure into the mining sectors of the state and as such there is an opportunity.

The Tree Farm

Each Individual Water Right provides 1 x tCO_2^{-e}[29] which needs to be provided through some mechanism and in this case the strategic plan is to do it via a purpose developed tree farm. The cost of developing the tree farm is included in the cost of the Individual Water Rights. Located in the Mid-West a 125,000 ha tree farm of native trees will be established that will have access to limited irrigation and have the physical capacity to develop the required CO_2 offsets.

Research to date would suggest that *Callitris preissii* (Rottnest Island Pine) is native to the area, is hardy, has both moderate salt and lime tolerance and is reported to have relatively high tolerance to termite infestation. *C. preissii* is described as a tree or shrub (conifer), 1 – 9 meters high to 4 – 6 meters wide and would produce biomass growth of around 25 to 35 kg MAI (Mean Annual Increase)[30] with limited irrigation support. The tree species has an extensive WA native range with specimens reported as far north as Wiluna, and from the coast through to the WA/SA border. *C. preissii* were first recorded on Rottnest Island in 1846 hence the common name.

In a small trial that I conducted in Perth with *C. preissii* growth rates of over 45 MAI were achieved with limited applications of water, however this could be less (MAI) in the rainfall equivalent in the suggested location. The trial did however demonstrate that the species was reasonably quick growing, (slow initially, then growth sped up) hardy to the local conditions and would readily tolerate transplanting. Plantings of *C. preissii* could be relatively dense (4 x 1 meters or 2,500 stems per ha) to minimize irrigation cost while maximizing effect. At a density of 2,500 stems per ha and 35 MAI the annual tCO_2^{-e} developed would be 5.67 million tCO_2^{-e} for the entire tree farm. This would allow for 1 x tCO_2^{-e} per Individual Water Right and a further 4.5 million tCO_2^{-e} that could be sold annually to support the operation of the tree farm generally.

The Table (page 38) indicates a progressive 55 year estimate of biomass developed. The price of carbon credits have fallen from an initial $24.00 to a level of $4.00 (per tonne – April 2013 pricing) so this would need to recover significantly. Alternatively three or four tCO_2^{-e} could be linked to each Individual Water Right and the price be higher.

I have only undertaken reviews of a small number of tree species that would be suitable due to the constraints of time, space and resources. Significant work has been done in the Kalgoolie area on cultivation of native species for tCO_2^{-e} sequestration and these studies need to be reviewed in more depth. It is my belief that the EPA (government) is unlikely to accept anything other than a non-invasive native species to the area which requires minimal irrigation as a farmed tree species.

With *C. preissii* there is little apparent value form the timber produced however this may change with a volume resource. Other tree species reviewed had relatively slow growth rates and those with faster growth rates were either not specifically native to the area and or likely to be classed as invasive if introduced in a farmed nature. Non-native traditional plantation trees were not reviewed as most would not survive in the area without significant husbandry and irrigation support. Blue Gum (*E. Globulas*) would have produced annual yields in 350 – 400 mm rainfall ranges of less than 15 MAI (bio mass yield) which on a similar density to C. preissii would mean a yield just sufficient to support the Individual Water Right CO_2 requirements leaving none as an income source.

My conclusions here based heavily on work carried out for Perth and Mt Barker based Softwood Logging Pty Ltd were I did extensive experimental work into valuing both the cost of biomass sequestration in timber (plantation) and the cost of commercially harvesting biomass from established plantations. I undertook work in both softwood (Conifer) and hardwood (Blue Gum) plantations through-out the Great Southern region and Perth, Bumbury, Margaret River and Bridgetown areas.

C. preissii will not have a significant final value in 55 to 60 years as a timber species. There are samples around of 50 year old trees that would have some timber capacity however this has not been investigated, i.e. potential timber yield in 55 to 60 year old trees. *C. preissii* produces a multi trunked growth and as such on 55 year old stock individual stems are 2 meter by 150 mm and as such they have limited sawn timber potential. The envisaged final end use is as a biodiesel resource. Modeling would tend to suggest that at the end of the growing period a total of over 720 million tCO_2^{-e} will have been generated.

As a resource for biofuel conversion, the trees are ideally suited and would convert to approximately 325 million tonnes of biodiesel (325 billion liters). This has a significant revenue potential, or will have a significant revenue potential in 55 to 60 years' time when fuel stocks will be depleting and potentially the price per liter will be higher than 2012 prices. The growing resource of biodiesel can be periodically valued to provide a capital backing for share value which can be used to provide capital gains on shares that will have limited capacity to pay regular dividends.

life (year) of Individual Water Right	Rotness Island Pine C. preissii Biomass weight (kg/tree)	Stem Weight (kg)	Ha Harvest @ 2,500 stems per ha (tonnes / Ha) (4 x 1 m spacing)	Biomass MAI (kg)	Harvested Stem MAI (kg per stem)	Annual Biomass available for sale --Tonnes pa	Tonnes per ha biomass	Total Biomass (Tonnes) (125,000 ha tree farm)
1	0.51	NA	NA				1.3	159,375.0
2	0.98	NA	NA				2.5	306,250.0
3	***2.65***	NA	NA				6.6	828,125.0
4	***9.12***	NA	NA				22.8	2,850,000.0
5	***15.92***	NA	NA				39.8	4,975,000.0
6	***44.85***	NA	NA				112.1	14,015,625.0
7	***65.12***	NA	NA				162.8	20,350,000.0
8	***98.12***	NA	NA				245.3	30,662,500.0
9	***151.25***	NA	NA				378.1	47,265,625.0
10	***198.50***	NA	NA				496.3	62,031,250.0
11	***235.33***	65.89	164.73	14.98	5.99	4,679,857.95	588.3	73,540,625.0
12	***277.58***	77.72	194.31	16.19	6.48	5,060,052.08	694.0	86,743,750.0
13	***319.83***	89.55	223.88	17.22	6.89	5,381,754.81	799.6	99,946,875.0
14	***362.08***	101.38	253.46	18.10	7.24	5,657,500.00	905.2	113,150,000.0
15	***404.33***	113.21	283.03	18.87	7.55	5,896,479.17	1,010.8	126,353,125.0
16	***446.58***	125.04	312.61	19.54	7.82	6,105,585.94	1,116.5	139,556,250.0
17	***488.83***	136.87	342.18	20.13	8.05	6,290,091.91	1,222.1	152,759,375.0
18	***531.08***	148.70	371.76	20.65	8.26	6,454,097.22	1,327.7	165,962,500.0
19	***573.33***	160.53	401.33	21.12	8.45	6,600,838.82	1,433.3	179,165,625.0
20	***615.58***	172.36	430.91	21.55	8.62	6,732,906.25	1,539.0	192,368,750.0
21	***657.83***	184.19	460.48	21.93	8.77	6,852,395.83	1,644.6	205,571,875.0
22	***700.08***	196.02	490.06	22.28	8.91	6,961,022.73	1,750.2	218,775,000.0
23	***742.33***	207.85	519.63	22.59	9.04	7,060,203.80	1,855.8	231,978,125.0
24	***784.58***	219.68	549.21	22.88	9.15	7,151,119.79	1,961.5	245,181,250.0
25	***826.83***	231.51	578.78	23.15	9.26	7,234,762.50	2,067.1	258,384,375.0
26	***869.08***	243.34	608.36	23.40	9.36	7,311,971.15	2,172.7	271,587,500.0
27	***911.33***	255.17	637.93	23.63	9.45	7,383,460.65	2,278.3	284,790,625.0
28	***953.58***	267.00	667.51	23.84	9.54	7,449,843.75	2,384.0	297,993,750.0
29	***995.83***	278.83	697.08	24.04	9.61	7,511,648.71	2,489.6	311,196,875.0
30	***1,038.08***	290.66	726.66	24.22	9.69	7,569,333.33	2,595.2	324,400,000.0
31	***1,080.33***	302.49	756.23	24.39	9.76	7,623,296.37	2,700.8	337,603,125.0
32	***1,122.58***	314.32	785.81	24.56	9.82	7,673,886.72	2,806.5	350,806,250.0
33	***1,164.83***	326.15	815.38	24.71	9.88	7,721,410.98	2,912.1	364,009,375.0
34	***1,207.08***	337.98	844.96	24.85	9.94	7,766,139.71	3,017.7	377,212,500.0
35	***1,249.33***	349.81	874.53	24.99	9.99	7,808,312.50	3,123.3	390,415,625.0
36	***1,291.58***	361.64	904.11	25.11	10.05	7,848,142.36	3,229.0	403,618,750.0
37	***1,333.83***	373.47	933.68	25.23	10.09	7,885,819.26	3,334.6	416,821,875.0
38	***1,376.08***	385.30	963.26	25.35	10.14	7,921,513.16	3,440.2	430,025,000.0
39	***1,418.33***	397.13	992.83	25.46	10.18	7,955,376.60	3,545.8	443,228,125.0
40	***1,460.58***	408.96	1,022.41	25.56	10.22	7,987,546.88	3,651.5	456,431,250.0
41	***1,502.83***	420.79	1,051.98	25.66	10.26	8,018,147.87	3,757.1	469,634,375.0
42	***1,545.08***	432.62	1,081.56	25.75	10.30	8,047,291.67	3,862.7	482,837,500.0
43	***1,587.33***	444.45	1,111.13	25.84	10.34	8,075,079.94	3,968.3	496,040,625.0
44	***1,629.58***	456.28	1,140.71	25.93	10.37	8,101,605.11	4,074.0	509,243,750.0
45	***1,671.83***	468.11	1,170.28	26.01	10.40	8,126,951.39	4,179.6	522,446,875.0
46	***1,714.08***	479.94	1,199.86	26.08	10.43	8,151,195.65	4,285.2	535,650,000.0
47	***1,756.33***	491.77	1,229.43	26.16	10.46	8,174,408.24	4,390.8	548,853,125.0
48	***1,798.58***	503.60	1,259.01	26.23	10.49	8,196,653.65	4,496.5	562,056,250.0
49	***1,840.83***	515.43	1,288.58	26.30	10.52	8,217,991.07	4,602.1	575,259,375.0
50	***1,883.08***	527.26	1,318.16	26.36	10.55	8,238,475.00	4,707.7	588,462,500.0
51	***1,925.33***	539.09	1,347.73	26.43	10.57	8,258,155.64	4,813.3	601,665,625.0
52	***1,967.58***	550.92	1,377.31	26.49	10.59	8,277,079.33	4,919.0	614,868,750.0
53	***2,009.83***	562.75	1,406.88	26.54	10.62	8,295,288.92	5,024.6	628,071,875.0
54	***2,052.08***	574.58	1,436.46	26.60	10.64	8,312,824.07	5,130.2	641,275,000.0
55	***2,094.33***	***586.41***	***1,466.03***	***26.66***	***10.66***	***8,329,721.59***	5,235.8	654,478,125.0
56	***2,136.58***	598.24	1,495.61	26.71	10.68	8,346,015.63	5,341.5	667,681,250.0
57	***2,178.83***	610.07	1,525.18	26.76	10.70	8,361,737.94	5,447.1	680,884,375.0
58	***2,221.08***	621.90	1,554.76	26.81	10.72	8,376,918.10	5,552.7	694,087,500.0
59	***2,263.33***	633.73	1,584.33	26.85	10.74	8,391,583.69	5,658.3	707,290,625.0
60	***2,305.58***	*645.56*	*1,613.91*	*26.90*	*10.76*	*8,405,760.42*	5,764.0	720,493,750.0

Average Biomass	**7,484,785**	**Tonnes pa**
Total available Biomass at 60 years	**720,493,750**	**Tonnes**
Estimated Value of Bio Diesel from Biomass	**$1,178,907,898,438**	
Estimated price in 2080 **at $3.50 per litre**		

Table 10: Annual Biomass development both per stem and for plantation of *C. preissi* (Rotness Island Pine) in a tree farming configeration under low level of direct irrigation.

Waste Treatment Plant / Process

Incorporated into the cost of the Individual Water Rights is the cost of developing a Waste Processing plant for Perth's general waste. From this project's stand point organic waste has much value. Through one of a range of processes it can be converted to both electrical power and compost. Waste and waste management is seen as integral aspect of this project for the following reasons:

- From waste a compost / soil improver can be derived which can be utilized to improve outcomes on the tree farm, increase tCO_2^{-e} outcomes
- An integrated all of Perth waste management infrastructure will stand well with the EPA on making an overall decision on this project
- The waste management infrastructure will be developed to be sold off as a Strategic Business Unit. With income stream, capital cost, and economic barriers of entry a SBU value of around $2.75 billion is viable.
- From waste an income stream can be derived to support the project generally

Compost developed from waste and used in the tree farm has the capacity to improve the utilization of water used in limited irrigation by a factor of three to four when measured against biomass tCO_2^{-e} outcomes.

Waste Management in Western Australia

Western Australia generally handles waste management extremely poorly. Waste management is handled by a range of local governments with a varying range of expertise/competence in overall management. Local government has no capacity to achieve the economies of scale that would allow economic management of waste. State government is not sure just how to tackle the issue as it invariably means impeding on the perceived "powers" of local government.

In all of this confusion and general incompetence an opportunity exists that

- Allows for the development of an attractive SBU that can be developed and marketed to add value to the core project
- Allows for the development of a by-product that can be incorporated into other aspects of the concept's potential success
- Provides a potential attractive addition to progressing the core project past State and Federal regulators and the EPA approval process.

Manser and Keeling[31] define waste as a material or mixtures of materials that have been deliberately discarded by consumers who no longer have a use for them or it. It therefore follows that for waste to become a product, it must have been substantially changed in some way such that it's original characteristics on longer exist, and such that it assumes a value to an independent consumer.

During the period 2006/07 Western Australia generated 5,247,000 tonnes of waste of which 3,539,000 tonnes was disposed (land fill) and 1,708,000 tonnes were recycled. This equated to a diversion rate of 33% which was the lowest for all mainland Australian states. South Australia diverted 68% to recycling, and Victoria had a recycling rate of 63%. Hyder Consulting[32] stated that across Western Australia the average rate of waste generation in 2004 - 05 was calculated at 2,707 kilograms (2.707 tonnes) per head of population. This is in the order of 35% more than NSW and Victoria. In addition in the same year total per capita recycling was 839.17 kilograms (per capita) which also is well below the eastern states average generally. Put another way, West Australians generate more waste per capita and divert less from land fill compared to other mainland states.

This means that waste management becomes essentially a population issue and specifically a population growth issue. Australian Bureau of Statistics[33] published a population up-date that Western Australia's population is currently 2.351 million (June 2011). Interestingly in the 2008 ABS Australian Year Book the forecast population of WA at 2,498,400 in 2021 in a mid-range scenario. Obviously Western Australia is growing its population far more rapidly that estimated as the state should achieve the 2021 estimate by 2015 to mid-2016 and is in line with a 3 million population in 2021. From a waste management viewpoint, an additional 1.75 million tonnes of annual waste being produced to make the state total around the 7.1

million tonnes annually.

Due to abundance of land and few alternatives in Western Australia, the majority of waste is disposed of in land fill. Waste that is disposed to land fill has major environmental effects, not just limited to the land immediate to the land fill, (i.e. while the land fill site has that use). Land stabilization post landfill closure takes approximately 30 years. During this time depending on various management techniques, liquid contaminates leave the landfill and enter the ground water.

In Perth, due to the relatively permeable nature of the soil there is a reasonable possibility that heavy metals and other contaminants can be leached into the ground water and affect drinking water. New land fill sites are lined to collect and remove leachate however old unlined sites are still potentially leaking into the underlying soil. In addition, as landfill breaks down in an anaerobic environment methane is produced and emitted from the landfill. This gas can contaminate new houses as occurred in a new housing estate in Cranbourne east of Melbourne that had been established on land reclaimed from a decommissioned tip – actually adjacent to a decommissioned land fill/tip site.

In the mid 1970s there were 28 sanitary land fill (tip) sites run by local government in the Perth metropolitan area. A series of initiatives by various governments during the 1980s and 1990s to generally clean up the sector has seen the majority of these closed. There are currently (2011) seven landfill sites licensed to accept putrescible waste in the Perth metropolitan area – waste material that includes organics and mixed waste. According to published advice by the Waste Authority the Perth area has between 10 to 15 years of land fill remaining at current rates of disposal. With population growth and the resulting increase in waste requiring disposal there will be very low capacity by at least 2015 – 2017.

Due to the approval process being implemented by the EPA for new land fill sites, the potential for new sites with an annual capacity of around 600,000 tonnes putrescible waste and 3,500,000 tonnes of other waste is unlikely and therefore represents an opportunity.

The Table below is a breakdown of the sources of waste and an approximate break-up of the types of waste. The break-up is relatively subjective as the overall proportion of waste recycled leads to a relatively low level of data on type and the recycling market is relatively fragmented.

	Municipal Waste	Commercial & Industrial	Construction & Demolition	TOTAL
Generated Waste (Tonnes)	1,434,000	1,476,000	2,348,000	5,258,000
Disposed -- Land fill etc (Tonnes)	1,013,000	585,000	1,939,000	3,537,000
Recycled (Tonnes)	421,000	891,000	409,000	1,721,000
% of TOTAL -- All Waste Tonnes	27.3%	28.1%	44.7%	100%
% Recycled of total collected	29.4%	60.4%	17.4%	33%
% of TOTAL Recycled	8.0%	16.9%	7.8%	33%

Break Down			per capita	Est Population	
Organic Waste		**Estimated tonnes of waste based on a poulation of :-**		**3,150,000.00**	Estimated Greater Perth Population -- 2020
		Tonnes	**Proportion**		
Putrescible Waste		1,276,671	14.26%	Energy Conversion -- then composted	
Garden Waste		604,315	6.75%	Energy Conversion -- then composted	
Timber Waste		281,118	3.14%	Energy Conversion -- then composted	
Other Organic Matter (NUC)		25,963	0.29%	Energy Conversion -- then composted	
Total Organic Waste		**2,188,067**		Initially processed for Gas then Compost	
Plastic and Plastic Products		213,077	2.38%	Recovered for Recycling	
Iron and Steel Products		936,464	10.46%	Recovered for Recycling	
Aluminium Products		145,036	1.62%	Recovered for Recycling	
Other Metals		105,643	1.18%	Recovered for Recycling	
Glass and Glass Products		147,721	1.65%	Recovered for Recycling	
Paper and paper products		147,721	1.65%	Recovered for Recycling	
Sand/Gravel/Cocrete rubble		3,670,652	41.00%	Crushed -- Reo bar and rod removed and crushed to size	
					Road Base -- 75%
					Compost -- 25%
Brick Rubble		800,000	15.12%	Crushed for Clay component -- Compost	
Other		21,500	0.50%		
Total tonnes Waster for a population of	3,150,000	8,375,882	100.00%		

Table 11: Waste - Generation, Disposal and Recycling of Waste

In Western Australia the primary legislation dealing with metropolitan waste management is the Waste Avoidance and Recovery Act 2007. Currently the local government sector of government has accepted (basically by default) the task of collecting and managing waste management. There is no statement within the Act that local government will have any legislative requirement to undertake waste management, and there-in is lies the next opportunity.

The desire of the State Government is to proceed towards a "zero waste" position by roughly 2020. A zero waste position is one in which all waste is effectively diverted from landfill in some way or other. In 2020 it is estimated that Perth will have a population of about 3 million and a requirement to process over 7 million tonnes of waste.

Local government does not have the capacity in any respect to be able to match this challenge. To develop an integrated system to process all waste by local government would require more than their capacity to fund. Based on other similar sized whole of city operations then the cost would be in the order of $750 million to $1.25 billion. The waste management sector is currently a $250 million sector most of which is paid by home owners for the collection of waste. The low levels of re-cycling means that there is relatively small monetary benefit from this for Local Government. The unfortunate fact is that as 70% of waste is dumped in land fill roughly $1.25 to $1.8 billion (pa) of potential income is forgone and the value of the industry / sector is really a cost of "collection to dump". A WA report on local government amalgamation recently released in October 2012 recommended a single waste management structure. However, under current planning (even with some amalgamation) is unlikely to be developed by local government due to the cost structures involved. In local government the development of regional council structure has allowed some development to economics of scale within the sector however the volumes are still too low to allow for meaningful economics of scale within individual operations.

Due to the general fragmentation of local government none enjoys the economy of scale that would allow an economic operation in waste management. On the other hand the project being presented here:

- Has the capacity to incorporate the waste management system into its overall planning process
- The project can utilize the entire output of soil improver that will result in an improved yield from the planned tree farm

- The incorporated waste management has the potential to allow the State Government to achieve its "zero waste" objective by 2020
- The integrated waste management solution has the potential to generate an income of around $950 to $1,450 million annually – mostly the sale of "green" base load power and recycled yield,
- The integrated waste management system is a useful bargaining tool with the EPA for approval of other aspects of the project
- The integrated waste management system potentially develops a stand-alone SBU that could be sold in the future.

Alternative Methods of Managing Waste Treatment Methods

Traditional waste treatment technologies currently include; composting, incineration, landfill, recycling, and windrow composting. The major types of biological conversion technologies that are either developed or are being developed include: *(listed alphabetical order, not of use/importance)*

- Aerobic digestion
- Anaerobic digestion
- Alcohol / ethanol production
- Bioconversion of biomass to mixed alcohol fuels (pilot scale development only)
- Bio-drying
- Gasification
- Gas-Plasma (commercial test scale)
- In-vessel composting

- Mechanical heat treatment
- Plasma arc waste disposal (commercial demonstration scale)
- Pyrolysis
- Sewage treatment
- Tunnel composting
- Waste autoclave
- Vermicomposting – (commercial demonstration scale)

Biological treatments generally are classified as either, aerobic composting, anaerobic digestion or vermicomposting.

Aerobic compositing is waste that is processed in the presence of oxygen. This includes open windrowing of waste where the waste is left out in the open to decompose. Enclosed aerobic compositing is the same process however the waste is enclosed in chambers to control aspects of decomposition through the use of drums, boxes, silos, or vessels to hold, rotate and generally control aspects of the process. The Bedminster system used at the Canning Vale RRRC is an example of this process. The domestic Bunning's® compost bin is another example admittedly one of lesser complexity. The process generally is not suited to suburbia due to the space required and the odor issues.

The process encourages the development of colonies of bacteria, and is characterized by the generation of heat. Emissions from the process are usually carbon dioxide, water vapour and traces of methane, some sulphur and traces of ammonia. Residues are relatively dry, dark brown, and friable. The residue is the only saleable outcome from the process as a soil improver. Sales are not great as currently the Canning Vale plant has to pay contractors to remove the residue as it cannot be sold successfully. This is due to glass contamination in the compost which limits its use in domestic home use and the product not being economically viable in general agricultural application, as it costs too much to transport and spread. Bedminster aerobic compositing plants operating in other parts of the country are more successful due in part to a more robust market for the by product which then underpins the commercial operation.

Anaerobic digestion is a process where bacteria are added to biodegradable organic waste to convert the organic matter. This is done in the absence of oxygen (anaerobic) by mixing the waste with water with an end product of a gas containing methane and carbon dioxide. The process is used as part of a process to treat biodegradable waste and sewage sludge. As part of an integrated waste management system, anaerobic digestion reduces the emissions of land fill gas into the atmosphere. Anaerobic digestion is widely used as a source of renewable energy. The process ($C_6H_{12}O_6 \rightarrow 3CO_2 + 3CH_4$) yields carbon dioxide, methane, water and some contaminate gasses in an exothermic reaction. This biogas can be used directly as cooking fuel, in combined heat and power gas engines or up-graded to natural gas quality bio methane. Anaerobic digesters can also be feed with purpose-grown energy, such as maize, canola, wheat and or barley to drastically increase the power yield from the process.

The technology to do this process is relatively well known and has been around for some time. In the mid 70's I was working on village improvement methane digesters for the United Nations and the World Bank in then termed "underdeveloped countries". The efficiency of the systems is however now vastly superior, more complex and designed for larger applications. Perth firm GRD Minproc has developed and build a digester in Lancashire (England) which will receive 750,000 tonnes per year in organic waste and produces over 44 Gigi watt hours (GWh) of electrical energy via a gas fired powerplant.

A digester capable of handling all Perth's suitable waste (1,500,000 tonnes pa) would result in potentially a 450 MW power plant. This could be increased to over 650 MW capacity if the entire city (Perth) sewerage sludge is added to the waste. Approximately 25% to 33% of power generated would be utilized in the operation of the plant generally allowing for the sale of roughly 350 and 400 MW annually - base load operation.

An additional output would be over 950,000 dry tonnes of nutrient-rich digestate that would (could) be combined with sand, silt, and clay (from the recycling of demolition and construction waste) to form 2,500,000 tonnes of a balanced soil enhancing top soil/ soil conditioner. This could be used on the tree farm to increase overall growth rates and or be sold as a stand-alone product. Either way its value would be roughly $100 to $150 million annually (between $40 and $50 per tonne). This product would have value due to its properties as a soil conditioner / top soil and not a ground cover mulch. Coupled with the power output the net income generating capacity of the digester operation would be in the order of $450 to $655 million annually, (2012 values; Net operational Income before Depreciation, Interest and Tax)

It should be stressed here that the difference between a soil conditioner containing digestate, silt, sand and clay, and a rough ground cover mulch is very significant. A soil conditioner when added to natural soil will add to the soils ability to retain water mostly due to the number, size and resulting surface area of the particles within the resulting soil. Mulch has limited capacity to do this however will reduce water loses in exposed soils if the cover is thick enough. Mulch will also allow for the development of natural soil micro-fauna by moderating the temperature extremes. Soil conditioners have a significantly greater economic cost benefit than raw mulches.

Thermal Processing of Waste

Municipal solid organic waste has an average calorific value of about 11mega-joules (MJ) per tonne, and recovery of this energy can be achieved to produce heat and electricity. The solid organic waste is fed through a furnace, burnt and the heat generated is used to generate electrical power.

Incineration is the most common method where organic waste is simply burnt. Tends to be a relatively dirty process with significant air pollution and waste products being produced, the others used are outlined below.

Pyrolysis involves the heating of waste, in an anaerobic (blocked to oxygen) environment to breakdown the waste at temperatures of 350 to 850 ^{O} C. The lack of oxygen results in a reduction in energy and greenhouse gases produced. The process produces a hydrocarbon rich gas mixture leaving an inert residue containing carbon, ash, glass and non-oxidised metals. If this gas is allowed to cool a hydrocarbon rich liquid will form. This liquid can be used as a synthetic fuel oil with some further processing. The pyrolysis process produces a charred substance rather than an ash from the combustion process which requires additional processing to allow this to be disposed of.

Gasification involves the heating of waste to even higher temperatures than pyrolysis. Waste material is converted into combustible gases under extreme heat of around 1,000°C. The combustible gas consists of hydrogen, methane and carbon dioxide. Gasification, when integrated with electricity production provides to be economical and environmentally attractive. It produces less toxic gas than all other processes with the inert slag able to be utilized in the construction industry (as bricks). The process has the potential to generate 500 – 600 kWh per tonne of waste with a lower cost that mass burn incineration.

Chemical processing of waste uses a method of esterification to convert waste to biodiesel. It is used to process feedstock from forest harvesting, excess grain and other agricultural waste into a liquid fuel source. The WA Forrest Products Commission reviewed the cost of harvesting biomass from conifer (P pinaster and P radiata) and hardwood (E. globulas) forests for biofuel however the cost of the harvesting and transport of the product for processing was uneconomical[34]. In part this is due to the nature of mature stands in each of the tree types listed as the trees are so large that the cost of extracting the below ground proportion and moving this to a loading station is too costly in both time and energy.

If *C. preissii* is utilized in the proposed tree farm this will not be a significant problem due to its tight dense growth nature and they are a relatively small tree. At the conclusion of the 55 year Individual Water Right period the tree farm will have produced around 750 million tonnes of harvestable biomass which would have the potential to be chemically processed to over 332 million tonnes of biodiesel through a chemical processing plant. At estimated 2080 prices (around $4.50 per liter for diesel) this would represent an economic gross yield of approximately $1,780 billion. This is a reasonable secondary return on the investments primary function. The supply will become available at a point in the future when the general availability of fuel will be becoming scare and therefore diesel prices will potentially be higher. The biodiesel is an additional environmental factor.

However the initial aim is to develop a base to collect organic waste, convert this to electrical power through an anaerobic digestion process, as a source of operational income and then compost the organic residue with all crushed brick and building rubble to produce a soil enhancer that when applied to the tree farm trees will lift production an estimated 25% (from 25 MAI to 32 MAI), or 1.5 million tCO_2 $^{-e}$ per annum (or $40 million potential revenue per year). It also develops a business (Strategic Business Unit) that in the future can be sold off to offset operating costs generally.

Complexity of a Sustainability Project

A truly integrated sustainable project will increase the overall complexity of the project however there is a real argument to be made that it may be time to try. I feel that there are elements proposed within this project that will add to our collective knowledge of sustainability while at the same time provide a platform to develop a project that is designed to be a sustainable service provider within the scope of the current definition of sustainable.

While there have been some disparaging statements made on sustainable development I feel that there is a need to embrace it in the planning phase. In part, the benefit of a sustainable planning phase, or making sustainability a part the planning phase is that it broadens the scope of providing a sustainable outcome for communities beyond individual specific mining projects, and even mining itself. Potentially, there is a greater capacity for the community and society generally to benefit from the mining process.

Ownership of the Infrastructure as a Base to a Solid Share Price for Investors

At the conclusion of the 55 year Water Right period the water delivery (infrastructure) system would remain with the developer however; the Individual Water Rights would all need to be renegotiated. This could be a major economic benefit given the general economic barriers of entry to a competitor.

In the year 2080 the estimated weighted cost of water using multi variant regression analysis will be in the order of $20.00 (per kl) (roughly 40 times the 2012 proposed Individual Water Rights rate of 45 cents per kl.) This would theoretically value a renegotiated infrastructure project at roughly a trillion dollars. There is no way that any firm commitment on a replacement cost of the project could be made. I personally feel that as the economics of an increasing water price takes effect demand will fall and as such the price in 2080 will not be achieved. The aim is to provide an effective “floor” to the share price which provides a basis to asking for an initial investment in the project.

For a shareholder (initial investor) the following are the proposed support structures to the share price, both to provide underlying value and to allow a meaningful capacity to trade in the shares to realize the value.

- The cash on hand if all developed SBU’s are structured and sold as indicated
- The income generated from the sale of un-used water, tCO_2^{-e} not linked to Individual Water Rights, income from cash reserves, and income from agricultural production linked to the tree farm
- The capital value of the infrastructure project and its potential value as a replacement project
- The potential income that could be developed from marketing the timber for another purpose (i.e. as a biodiesel)
- The replacement value of the tree farm as a tree farm.

My planning is for an initial IPO share price of around $3.50 and following construction based on construction, replacement and water trading income valuation alone the target share price should be in the range $22.00 to $26.00. If the sale of SBU’s occurs as planned the target share price should be an additional $10.00 to $18.00. Roughly 10 years into the project life with the capacity to fully verify tree growth rates a valuation and projection of carbon capacity should place the share target price at between $95.00 and $110.00. The capacity to convert biomass in the tree farm to biodiesel is the major economic driver of this valuation. Growth from that point will be more modest and be based on the increasing potential value of biodiesel, and of re-marketing the Individual Water Rights in the future.

This should allow for a meaningful economic yield to all investors. There will be limited capacity to pay a significant dividend and as such share value appreciation will be the only capacity to allow a benefit from ownership of the shares. To offset the lack of a dividend then annual appreciation of 15% to 16% should be planned for initially, settling back to roughly 11.5% annually from about the 6^{th} year following commissioning of the project.

Stakeholders

This Project will involve a range of Stakeholders. These include the State and Federal Government, Indigenous Australians, conservation groups, mining companies, farming operations and farming communities, to name the key members. The initial investment is to be used, in part, to determine their views and to move forward with these views and values included within the final commercial solution.

In Phase II planning the nature of the IPO will be fully developed, however initial planning would see the following stakeholders made an allocation of shares.

- WA Future Fund
- Australian Future Fund
- The Kimberly Land Council
- The traditional owners of the Water - Lake Argyle Traditional Owners

If the share values following the predictions made above then the benefits to each of the groups could be significant. These allocations are planned as I feel that there will be some negativity to a national infrastructure project being in private hands and these allocations will go some way to undermining that negativity.

In early planning, the aim would be to make each of the listed groups an allocation of approximately 35 million shares each (2.3% of total issue). If the value of the shares appreciates as planned then this allocation may be of a strategic benefit in future negotiations.

Perceived Benefits to Stakeholders

The benefits that are felt to be available to the stakeholders at this point are highlighted here as these represent the key marketing points in selling the concept into the government and community.

- Water is being drawn in un-sustainable amounts from aquifers to service mining operations. In most cases no alternatives exist to this and it is unviable for individual mining companies to develop a solution in isolation. The concept being investigated will provide a viable alternative to ground water extraction for mining companies and other water users.
- Natural greenhouse “storage” in the form of tree farms or preserved wood lands.
  This proposal has costed stored tCO_2^{-e} (tonnes CO_2 equivalent) at approximately \$24.00.35 This makes this a competitive alternative to the proposed tax/permit/license structure being proposed and developed in the current ETS / Carbon Tax concept, or whatever eventuates from government[36].
- Proposed tree farms for carbon will have the economic capacity to provide effective fencing to preclude feral and introduced species to allow for the re- establishment of native species. This is a side benefit.
- The movement of water from the Kimberly region will allow for an agricultural use in a more economically viable location, closer to markets and distanced from a significantly environmentally sensitive area.
- The project will provide very significant employment opportunities for indigenous Australians in areas in which they live, both during construction and on-going.
- The concept will provide on-going funding for all land owners on the pipe route (Royalties)[37]. This will include traditional land owners and the traditional owners of the water source in the Kimberly who will be paid royalties for their water as a single initial payment. A payment to traditional land owners similar to the James Price Point agreement is envisaged
- The plan also provides a payment be paid to the State government for the purchase of water equal to that paid to the land holders (water owners). This potentially will allow relatively open discussions with the state government especially as the payment will be in excess of \$1 billion.
- Develop common good infrastructure in three remote and arid regions of the state, which will provide ongoing benefits to the State’s economy.
- For the developer of the project an asset with an effective replacement value of approximately \$35 billion.
- For the developer a significant level of control of the mining industry and general infrastructure development through the overall control of the supply of water from non-underground sources.
- By instigating a 55 to 60 year life of the individual water rights the traditional owners have the opportunity to reassert their title to the ownership in the future.

SWOT Analysis

**NOTE*: in addition to the SWOT points identified here, many others will evolve in the evaluation of the project (Phase I), as well as further developing solutions to those identified here. This SWOT Analysis is therefore a key to further discussion rather than an end result.

Strengths

- 95% of WA Residents feel that Kimberly water should be used either in Perth or between Perth and Lake Argyle.
- Significant ongoing naturally sustainable source of supply
- Sustainable natural supply well in excess of regular/ongoing demand
- Pre-Paid privately funded infrastructure project, i.e. no need for significant government funding

Weaknesses

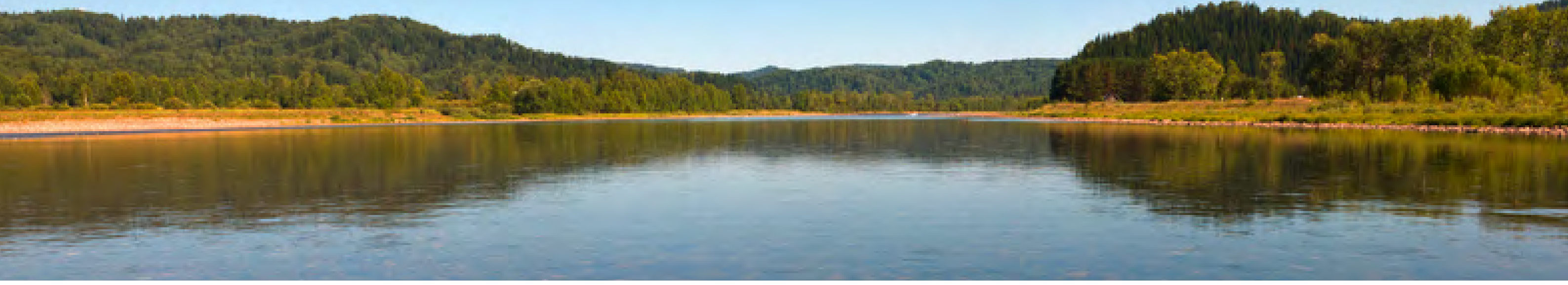
- Mining firms feel that they are accessing a sustainable supply in their underground water supply
- Significant construction project being considered at a time of fiscal contraction
- Project has a finite life span – 55 to 60 years,

Opportunities

- Water to be supplied would be at roughly one-sixth of current water costs in target market areas
- Capacity to experiment with a range of sustainable construction techniques and or energy supply sources in a major construction project
- Capacity to export the knowledge gained in the management of the project to other countries or into other projects
- Capacity to make the Greater Perth area into a self-supporting sustainable recycled waste closed system. For general waste, industrial waste and water waste.
- Capacity to provide water for development en-route that could make isolated communities more self-sufficient and or provide these communities with more employment opportunities
- Whoever effectively controls the supply of water into the various mining areas will have a significant level of control within the mining sector.

Threats

- Failure of the government to agree to supply water into the project
- Failure of the government to develop and pass suitable enabling legislation for the route and for trading in either water and or carbon.



Other Projects Presented to use Ord River Water in the South of the State

Ever since the Ord Dam was developed in the 1970's there have been proposals presented to transport this water to various markets in the southern part of Western Australia. The range of both concepts and methods is really quite significant. Some of these proposals had significant research and development input, while others were sketchy to say the least.

Professor Reg Appleyard[38] chaired an inquiry that investigated four methods of bringing water from the Kimberley to Perth. A table summarizing the findings of each method - open channel, pipe, by ship and by water bladder is attached. At the same time that the committee was investigating these options, the WA state government had commenced the development of two desalination plants and as a result all options were shown to be more expensive than desalination. It is my understanding that there were over 200 submissions to be included in the inquiry which tends to confirm that there were a significant number of concepts advanced enough in their planning to transport water south.

The relative comparison costs for the Individual Water Rights option are included in Table 12 (page 49) for reference.[39, 40]

Comparison of six options to transport water:

- **Tenix Australian.**[41]Open channel gravity fed 200 GL supply to Perth.
  Supported by Colin Barnnet; then opposition leader in WA Government. Not supported by then WA State Government, the Appleyard inquiry terms of reference virtually made it impossible to be viable. Did require significant contractual commitment to take most of the water to under-right the capital and operational costs. Initial cost as presented by Tenix was $2.5 billion for full construction. In my view, some problems with this plan were:
  - Flooding / wash away due to cyclone activity.
  - Channel damage due to wild camels, donkeys, horses, and native animals.
  - Transfer route for introduced and native pest species, i.e. cane toad and crocodile.
  - Water quality issues after a 100 day transport in open channel.
- **Watering Australia Foundation.** A pipe to supply 200 GL to Perth.
  As an ex-labour Minister for Water has been promoting the concept for some considerable time. Required a 100% underwriting from the state either in a contractual purchase agreement and/or constructional and operational costs.[42]
- **Water Bags.** To ship 50 GL of water from the Kimberly in 500,000 kl water bags.
  This concept had benefits in its capacity to be flexible in demand however had basically un-tried technology at this scale.
- **Shipping Water.** Shipping water (200 GL) in 500,000 kL super tankers.

  Effectively tried technology however the size of the ships and draft (30 to 35 meters) created difficulties and expenses at both loading and off-loading. Had great capacity for flexibility. Required to be underwritten by state government.

  500,000 kl is 500,000 tonnes which in shipping terms means VLCC or VLOC (Very Large and Ultra Large Crude and Ore Carriers) of 150,000 to 320,000 dead weight tonne and 320,000 and 500,000 dwt capacity respectively. Currently, Fremantle harbor will accept ships with dead weight capacity of around 60,000 to 80,000 tonnes.

Comparative Issue		Mr E. Bridges Pipeline Option to Perth	Open Channel Option	Ocean Tanker / Barge	.05 GL Water Bag	De-salination	Individual Water Rights Option
Quanity of Water supplied GL		**200**	**200**	**200**	**200**	**90**	**1,000**
Design Certainty		High	Uncertain	High	Un-known	High	High
Reliability of Supply		Acceptable	Acceptable	Good	Good	Excellent	Good
Source		Fitzroy River	Fitzroy River	Ord River	Ord River	Sea	Ord River/dam
Length of Delivery Chain		1,900 km	3,700 km	3,000 km	3,000 km	nil	3,250
Water Quality Issues (delivered)		Managed	Variable	Managed	Managed	Managed	Managed
Number of Vessels required		N/A	N/A	14	35	N/A	N/A
Time in Transit (days)		17	93	14	32	N/A	21
Energy Consumption (kWhr/kL delivered)		4.32	3.7	10.5	8.6	4.5	3.75
Total Greenhouse gas produced (t CO_2 $^{-e}$ per year)		612,540	512,500	1,998,521	1,601,520	413,400	1,758,000
Total t CO_2 $^{-e}$ offsets generated (t CO2 -e per year)		Nil	Nil	Nil	Nil	188,520	4,462,500
Effective greehouse generation (kg CO_2 -e per kL)		3.1	2.6	10.0	8.0	2.5	-2.7
Capital Cost ($)		11,900,000,000	14,500,000,000	6,200,000,000	5,300,000,000	2,250,000,000	24,500,000,000
Operational Cost ($)		250,000,000	110,500,000	325,000,000	158,000,000	102,500,000	125,000,000
Total Cost ($)		12,150,000,000	14,610,500,000	6,525,000,000	5,458,000,000	2,352,500,000	24,625,000,000
Operational Cost per kl pa		$1.25	$0.55	$1.63	$0.79	$1.14	$0.13
Unit Value of water deliverd $/kL		$5.10	$6.50	$5.00	$5.00	$1.35	$0.45
Annual Revenue based on Constant Unit Cost of Water		1,020,000,000	1,300,000,000	1,000,000,000	1,000,000,000	121,500,000	450,000,000
Planed operational life of the infrastructure (years)		30	20	on-going	on-going	30	55
Pay Back Period in Years at constant unit cost.		12	11	6	5	19	54

Based on the Conclusions developed in the Proffesional Appleyard Investigation into the transport of Water from the North West to Perth.

Table 12: Key Comparison of Six Options Investigated to Transport Water to Perth

- **Desalination.** Initially 45 GL with another 45 GL desalination facility to come on line 2012.

  The production of both these plants is contractually sold to the water corporation to cover return on investment and operational costs. The project was developed by the WA state government to provide security of supply for domestic Perth Water and to reduce pressure on underground sources in the Perth metro area. Effectively underwritten by government.

Inquiry/study indicates that all models are technically and financially possible and provides a very useful tool establishing a range of technical benchmarks for the various methods proposed to transport large quantities of water from various Kimberly sources to Perth.

United Utilities. Another project not considered as a part of the Appleyard inquiry was the United Utilities project to supply the Gold fields and Perth with up to 33 GL of water from a desalination plant at Esperance. This project required the Water Corporation to contractually purchase the majority of the water supplied. The United Utilities proposal priced current usage at $1.15 per kl with additional water supplied at $4.65 per kl[43] This plan was not pursued as the State government failed to effectively underwrite the purchase of all water supplied and to effectively cut off the Perth – Goldfields supply.

In discussions with some of the affected miners they felt that

- That the weighted cost of water supplied was likely to be in the order of $2.50 per kl; (2009 prices) which was on a par or higher than their current cost for water sourced from the Officer Aquifer
- That the amount being supplied was insufficient to supply all their needs and once demand increased price increases would follow

The mining sector were essential to the concept's success, yet they were being asked to pay significantly more than the economic cost to supply, as they were seen as having the greatest capacity to pay. This project was abandoned once the State Government failed to under-write production.

Overseas projects investigated were the **Californian Aqueduct** and the **Libyan Man Made River**. These are the only truly large scale water transport systems that I can locate. Not saying that there are no others about just that there was no research data available on them if they do exist.

... the mass and long distance transport of water is possible and is largely economic, or can be made to be economic in the context of individual country's political ideologies.

Californian Aqueduct. this is a series of canals, tunnels and pipelines that transports 370 m² per second 1,130 km from the Sierra Nevada Mountains in to Southern California. The canal is concrete lined roughly 34 meters by 12 meters. Pipes and tunnels are utilized to allow for geography features and the requirements for pumping.

As reported in Wikipedia, the capacity is 370 m² per second which gives an annual capacity of some 11,500 GL. The canal capacity utilizing a 34 m x 12 m canal would allow this volume. Pumping capacity and or method is not reported. The total volume of water is the largest volume moved by any water transport system in the world. This is equal to the total volume of Lake Argyle on an annual basis.

No (user) costs are provided however a significant amount of the water is used for irrigation so the cost is either subsidized or the output is used in high value cropping.

Libyan Man Made River. In Libya a network of 4 meter diameter high pressure concrete pipes transports 3.68 GL per day of water from the south of the country to Tripoli, Benghazi, and Sirte on the coast.[44] Water is drawn from an aquifer approximately 500 meters below the surface transported 2,800 km, and is used for both domestic supply and agriculture. The British BBC did a program on the system and indicated that (their calculations) the effective cost of the water (2010) to be 35 cents per kl (Australian) compared to aAUD$4.12 cost (per kl) to desalinate the same volume of water.

It is difficult to justify these costs as extracting nearly 3,000 GL of water from 500 meters underground would cost nearly that in fuel alone, and then pumping the water over 2,800 km would significantly increase the cost however their (Libyan) fuel cost may be less that the Australian equivalent.

These two examples demonstrate that the mass and long distance transport of water is possible and is largely economic, or can be made to be economic in the context of individual country's political ideologies.

It is interesting to note that in all of the projects reviewed for this project (with the possible exception on the United Utilities concept), each of these projects were conceptual projects in which much of the specifics had not been fully researched. The two project concepts to ship water from the Kimberley coast to Perth in either Super tanker and or bladders had not been tested and were pure theory in concept and practice.

The bladder concept has never been done anywhere in the world at the level proposed, and as such it was pure speculation as to how the process would actually work. The bladder concept is remarkable – just the size is difficult to comprehend – a half GL bladder would need to be roughly 25 meters by 25 meters by 1,000 meters to be able to hold that volume of water. How they would work in practice needs to be further researched and tested.

In part this is the case with my Individual Water Rights concept. The Individual Water Rights water transport project, as presented, needs to be more fully tested and analyised to determine just where it may stand and the aim of Phase I is to undertake this study. Phase 1 will not provide all of the answers, however it will provide definitive substantiation if the overall project is potentially viable and really what needs to be established in a feasibility study of the project. It will offer a clear direction.

Based on these projects, the Individual Water Right proposal that I have developed has attempted to address many of the issues raised as concerns by a range of organizations and inquiries into transporting water from the North West to Perth. The Individual Water Right concept is:

- Not dependent on Government contractual purchase of water supplied. The Western Australian Treasury Corporation makes the comment that "… a project of this nature and size, that is dependent on assured revenue stream over a period of 50 years, would not be bankable without a high degree of certainty over its income stream"[45] The Individual Water Right concept to fund this proposal will develop all of the required funding for construction without the need to contractually market water to the state to assure an income stream.
- The weighted cost of water supplied will be roughly one-sixth of the current cost of water to the major potential market. At this price (45 cents per kL pa) the supply is economically viable to the potential market. For the mining sector they must be seen as paying an economic cost to supply and not an inflated price to subsidize other, less economically viable commercial or social operations.
- The Individual Water Right concept does not specifically supply the Perth market which means that it does not impact on the State Government's water supply infrastructure. The supply of 200 GL into the Perth market represents roughly 75% of total demand and this would impact significantly on the Water Corporation's economic viability. For this reason the Water Corporation is more conceptually inclined to be supportive, especially now that they are contractually bound to purchase 90GL annually from desalination of a scheme that does not directly supply the Perth market. The State Government through the strategic planning of the Water Corporation has underwritten the supply of water into Perth even if natural rainfall continues to decrease over the next decade as is predicted.
- The State Government, again through the Water Corporation has an obligation to supply water through-out the state and it is this aspect of the supply of water that the Water Corporation would like to distance itself from. In 2007 the water corporation made overturns to a range of businesses particularly infrastructure suppliers to tender for the supply of water to some WA towns. There was very limited interest and the Global Financial Crisis stopped the tendering process. However, it confirms that there is an element within government that wants to distance itself from supply of water in these remote areas.
- The capacity to trade in Individual Water Rights will mean that an economic market is in place to allow water customers to move into and out of water positions as mining and operational demand dictates. In addition the trading market will allow for a supply and demand price regulation model that is independent of the costs associated with operating the infrastructure.
- That the project will develop a negative trend in the customer's greenhouse gas emissions position

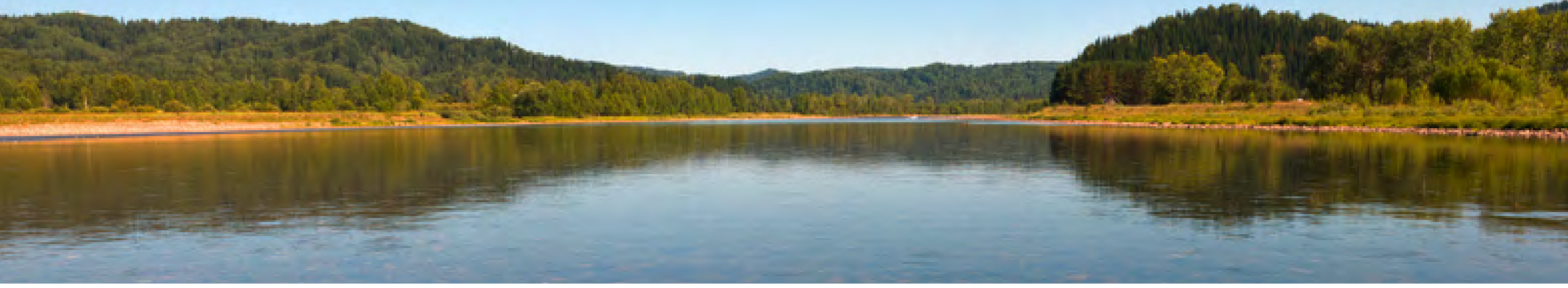
(i.e. the supply of water will reduce generally greenhouse gas emissions.)[46]

- The concept has sufficient economics of scale to potentially supply all water demanded from the principle customers so that they are in a logistical position to decommission their self-sourcing options with the confidence that supply will meet future demand for water.
- The concept has a trading structure that will allow towns en-route to purchase water on a need basis that will allow the state government to reduce or mitigate its cost to supply these towns with a state sponsored water supply. Currently this cost is over $450 million annually and represents a significant marketing opportunity.

Why now is the Time to Act?

There are a range of issues that make now the time to act on this issue. In summary these include:

- Generally the region is currently experiencing a reducing water resource. This trend is predicted to continue.
- Mining operations are expanding production and as such demand for water will increase in proportion to this increase. Currently mining operations are being denied EPA approval to commence operations based on water. Sino Pacific's decision to build a 55 GL desalination plant for its mid-west proposed operation is good evidence of this trend.
- The Pilbara mines are supplied with water predominately from a fractured rock aquifer. In the 1970s it was calculated that sustainable extraction rates from this resource was roughly 250 GL per annum. The Chamber of Minerals and Energy estimate in 2005 that extraction from this resource was in excess of 350GL. I estimate that extortion and/or dewatering extraction is around 380 to 410 G. (Obviously in excess of sustainable extraction rates.)
- It was indicated[47] that bore levels in the Pilbara were dropping by up to a meter per year and not recovering over time. The average drop in bore level over the past 40 years is 37 meters.48 This would tend to suggest that extraction is in excess of sustainable levels for this aquifer.
- The resource in the Ord Dam will never be fully utilized in agriculture. To fully utilize the water resource. Based on current usage rates for irrigation it would require over 95,000 ha be developed for agriculture in the Kimberly. With current land availability this is effectively impossible. This means that the state government will be seeking alternative uses for the resource, or should be.
- As water sources within the mining regions dry up, as has happened in the Queensland Great Artesian Basin, this will place very significant pressures on the mining sector, both economic and social to produce environmentally appropriate alternatives.
- Based on the Interim Performa Budget developed the State Government will be offered the full value of the water to be taken over the 55 life of the individual water rights at two cents per kl which will yield over $1.3 billion which will strengthen their budget bottom line.
- The project offers the developer the capacity to be at the fore-front of the green sustainable economic revolution.
- The project has some very significant commercial benefits.
- There is real social support for the concept of an environmentally sustainable solution to aspects of the mining's industry's environmental signature.
- Economically, politically and socially it will become harder and harder to implement a proposal as time passes and as such if this opportunity is forgone then it really will be up to government to develop a solution and this may have significant economic, managerial and environmental consequences on industry in the State.



References

1 The costs have been developed based on the research conducted for the WA Department of the Premier "*Options for Bringing Water to Perth from the Kimberly—An independent Review*" chaired by Prof R Appleyard 2006.

2 The discussion paper for discussion was released November 2012 which tended to focus on water required for the coastal Pilbara towns and cities and water for port processing of ore. The discussion paper focused on the extractions from De Grey, Yule, Lower Robe and West Canning underground water sources. The Pilbara fractured rock source was not cited overly and as a result overall extraction was significantly understated.

3 G Lowe, an engineer that worked for the Water Corporation in private conversation. Due to this research, the Water Corporation has been very reluctant to revisit the transport proposal at later dates, however this may change as the water position changes over time.

4 *ABARE: Guide to Australian Irrigation Infrastructures, locations, capacity*. December 2004

5 *CSIRO: Ord River Irrigation Study, Water Loses in Transport*. June 1999

6 *Ord River Co-Operative: Tabulated Data*, 2005 (Internet)

7 The report "*Options for Bringing Water to Perth from the Kimberly—An independent Review*" chaired by Prof R Appleyard 2006 has a relatively detailed description of the current status of the } allocations of water currently in storage from the Ord River.

8 Ord River Authority publicity brochure. There is some dispute as to the level of evaporation from the water body. CSIRO research on evaporation from the irrigation system suggests a figure much lower than 15% of volume. If the loss is 15% of volume then seepage may be a bigger factor than evaporation.

9 Bureau of Meteorology, Rain fall data for Kununurra 1970 to 2005

10 Policy and Economic Unit, CSIRO (Land and Water), Water for a Healthy Country, May 2006

11 International Monetary Fund and World Bank web sites – Accessed September 2012

12 Written initially in Mid 2012.

13 OECD – Paper – "*Looking to 2020; A Global Vision of Long-Term Growth*" November 2012.

14 Fuel for water pumping will be a very low user after vehicle use and power generation so much of it is likely to be absorbed into general mine use – conversely repair and maintenance issues with pumping infrastructure.

15 Queensland State Government – Department of Environment and Resource Management, February 2011 Ref W68.

16 Op Cit

17 This research was undertaken based on discussions with contractors to determine water table depths and bore diameters – estimates of pumping costs from these depths for the estimated water usage. The measures are therefore calculated estimates. They have been tested in conversations with mining operators who have suggested that they are possibly conservative.

18 Chamber of Minerals and Energy, ABARE, State Rivers, Applications to EPA for mining approvals and the like.
To the best of my knowledge no specific study linking specific water use to production across a broad base of operational conditions has ever been conducted.

19 Chamber of Minerals and Energy; Private Research Paper on Water sources and Uses by Member Organizations'. Author; Economic Research and Solutions, Perth, April 2004

20 State Water and Rivers, Bore Water Allocations 2006/7

21 David Parker, Director of the Chamber of Minerals and Energy in private conversation. Supported in conversations with D Gibson, General Manager Water Resources, Rio Tinto Limited, January 2008

22 Norm Daffin Infrastructure consultant with Yilgarn and now with Sino Pacific has suggested that the Weighted cost of water (all sources) is significantly higher—in the range $2.60 to $3.20 per kL. (However, I have not seen his proofs.)

23 Much of the notes on sustainability have been drawn from Wikipedia (the free encyclopedia) 2012. Other references tended to be similar in tone however there were significant clouded issues once linked socio, political and economic issues where included. Retrieved 2012

24 IUCN/UNEP/WWF (1991) "*Caring for the Earth – A Strategy for Sustainable living*" Quoted Op cit

25 *The Earth Charter Initiative* (2000) Op cit

26 *Goldfields Water Supply Scheme* – Wikipedia

27 Op Cit

28 This assumes a constant CPI of 2.5%, a 110 year lapsed period and £3 would equal $6.00 and three shillings six pence would be 35 cents.

29 Tonnes Carbon Dioxide equivalents. Greenhouse gases take a range of forms and the general convention is to express these in Carbon Dioxide equivalents.

30 I have utilised the research of P. Ritson and S. Sochacki's 23, March 2002 done on accounting for greenhouse gases to estimate the below ground (stump and root) biomass.

31 A.G.R Manser and A.A. Keeling, *Practical Handbook of Processing and Recycling Municipal Waste*, CRC Lewis Publishers, New York, 1996, p 334.

32 Hyder Consulting, *Waste and Recycling in Australia – Final Report*, prepared for Department of Environment, Heritage and Arts, Melbourne, November 2008, p 17.

33 www.abs.gov.au/ausstats/abs@.nsf/Previousproducts/3218.0Main%20Features82010

34 In 2006 I conducted harvesting and transport trials on both conifer species in 10 year, 15 year and mature stands to enable Softwood Logging to tender for a biomass harvesting contract.

35 Australian Government. Carbon Pollution Reduction Scheme: Australia's Pollution Future. White Pater Volume 1 December 2008

36 At the time of preparing this report (2012) there had been two fundamental variations to the Carbon Tax concept with significant variations made to accommodate critics to the Carbon Tax. What eventually results may or may not resemble what has been planned for here.

37 Lt Col Jeffries, Special Commissioner for Indigenous Affairs in WA. Report on Employment in indigenous and remote communities. The comment was made that many communities require a purpose to generate an income and or a "real position with a real purpose"

38 Prof R Appleyard, *Options for Bringing Water to Perth from the Kimberley—An independent Report*. WA Office of the Premier, 2006

39 There are aspects of the development of the cost base of the three options that are difficult to justify, such as the unit cost of water. At this point I have not attempted to research how the panel developed their cost base and as such their unit cost.

[40] Op cit. The Appleyard report received over 25 individual responses to the proposal of transporting water to Perth from the Kimberly. From these the four were selected.

[41] Mr Phiroze Devitre from Tenix provided significant input into the Tenix proposal; Mr Devitre has now left Tenix.

[42] Mr Ernie Bridges the CEO of the Foundation was interviewed in relation to this project in 2006

[43] 2005 prices. These will be up 25% to 35% now due to increase in all costs associated with the concept which has now been abandoned.

[44] Wikipedia – the free encyclopedia

[45] Prof R Appleyard, *Options for Bringing Water to Perth from the Kimberley—an independent Report*. Appendix 10. WA Office of the Premier, 2006

[46] Prof P Newman, Professor of Sustainable Development at Murdoch University and a member of the Federal Government's Infrastructure Review Board, has reviewed the concept and indicated that of all of the proposals he has reviewed the Individual Water Right concept is the most sustainable from the view point of CO_2 emissions generally.

[47] A Rio Tinto Water Strategy Manager in private conversation.

[48] Op Cit

THE WATER PROJECT

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