

INTRODUCTION

The Gascoyne region stretches 600km along the Indian Ocean Coast in the north-west of Western Australia and inland through dramatic desert country beyond Mount Augustus and the Burringurrah Aboriginal community and is rich in resource and investment potential.

Shires contained in the Gascoyne include Carnarvon, Exmouth, Shark Bay and Upper Gascoyne. There is a diverse, balanced economy with the major industries being tourism, fishing, mining, horticulture and pastoralism.

The Resource Infrastructure Review has been prepared by the Gascoyne Development Commission as an industry focused report and does not include community infrastructure projects. Opportunities for projects listed in this Review are those assessed by the GDC as worthy of consideration. They do not constitute the only available or conceivable opportunities.

The Review consists of chapters divided into the categories of airports, communications, energy, flood mitigation, harbours, horticulture, industrial land, mining, roads, sewerage, and water. These categories are then divided into the main population areas including Carnarvon, Coral Bay, Denham, Exmouth and Gascoyne Junction.

The Gascoyne Regional Infrastructure Review is a living document located on the Gascoyne Development Commission's web-site and will be updated annually.

The document is the property of Gascoyne Development Commission (GDC). The GDC cannot guarantee accuracy and status of any infrastructure described within this report. Information contained within this review may be used by any party on condition that the GDC is acknowledged as the source of that information.

The information contained herein is a snapshot representation of the infrastructure of the Gascoyne Region; however parties wishing to use this information should seek their own advice on the current state of particular items and projects.

How to Use This Document

During the initial deliberations on the layout and format of this Infrastructure Review, it was decided that the most useful layout would be to construct separate sections by Infrastructure and then deal with each town in the Region under those section headings.

As an example: if you wanted to look at information pertaining to Carnarvon Small Boat Harbour, you would first go to Section 9 Harbours and then to the Sub-Section 9.1 Carnarvon.

Existing projects and opportunities for projects are contained in each section. A listing of all projects both existing and opportunities can be found under the reference section for convenience.

Acknowledgements

In gathering the information contained in this document, many agencies and individuals were consulted. The Gascoyne Development Commission extends their sincere appreciation to those who gave of their time, knowledge and experience in providing information, suggestions for improvements and feedback on corrections and editing.

***Note:** Care has been taken to ensure the accuracy of information contained within this document by reference to Government Departments, Local Governments, Businesses, Web sites, library documents and files held by the GDC. It is entirely possible that some inaccuracies exist. However the document is intended to be a 'living' reference work and as such will need input and feedback from all stakeholders to ensure accurate, up-to-date information on project progress, proposals and infrastructure changes across the region if it is to remain a useful resource.*

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2. OVERVIEW OF THE GASCOYNE

The Gascoyne region covers an area of 138,000 km² or some six percent of the State of Western Australia. There are four local government areas within the Region, centred on the towns of Carnarvon (Shire of Carnarvon), Exmouth (Shire of Exmouth), Denham (Shire of Shark Bay) and Gascoyne Junction (Shire of Upper Gascoyne) with two Indigenous communities at Burringurrah within the Shire of Upper Gascoyne and Mungullah in Carnarvon.

Total population of the local government areas is: Carnarvon - 6,166; Exmouth – 2,424; Shark Bay – 962 and Upper Gascoyne – 313 for a Region total of 9,865 as at 2009. The average distance between towns is 300km which can cause particular issues for the development of the Region.

The Region supports a diverse range of industries: fishing, aquaculture, horticulture, tourism, mining, agriculture and pastoral industries which all contribute to an economy that has the potential to grow with vision and direction from all sectors of the communities comprising the Region.

Climate

The Gascoyne has a moderate arid tropical climate, the intense heat of the northern wet season or the cold winters of the south are not felt in coastal parts. Inland these extremes are felt. The Region has around 320 days of sunshine each year.

Table 1. Monthly, annual & extreme temperature at representative stations (c⁰)

	J	F	M	A	M	J	J	A	S	O	N	D	Yr
Carnarvon													
Mean Max	31.3	32.4	31.2	28.9	25.9	23.2	22.1	22.7	24.3	25.7	27.2	29.0	27.0
Mean Min	22.4	23.2	22.0	19.1	14.9	12.5	11.1	11.6	13.9	16.3	18.5	20.4	17.1
High Max	47.7	46.9	45.3	41.1	36.9	31.8	30.7	31.6	38.4	42.4	43.4	45.4	na
Low Max	24.2	23.9	22.2	21.1	17.1	15.0	15.3	15.3	17.6	18.9	21.0	22.2	na
Gascoyne Junction													
Mean Max	40.8	39.8	37.4	32.7	27.3	23.4	22.7	24.2	28.1	32.0	35.0	38.5	31.8
Mean Min	23.4	23.9	22.1	18.2	13.4	10.3	9.1	9.8	11.5	15.0	17.6	20.6	16.2
High Max	47.0	48.8	46.1	44.2	38.5	30.8	31.0	32.9	38.4	42.5	44.4	45.8	na
Low Max	26.1	25.1	23.9	21.1	15.6	14.4	15.5	15.3	20.7	20.6	20.3	21.1	na
Learmonth													
Mean Max	37.9	37.7	26.4	33.2	28.4	24.7	24.0	26.0	29.3	32.1	34.2	36.8	na
Mean Min	23.0	24.3	23.1	20.6	16.1	13.4	11.4	12.5	14.0	16.2	18.3	20.6	na
High Max	45.9	47.7	45.5	41.4	37.3	30.5	31.1	32.2	38.9	42.6	44.2	45.6	na
Low Max	28.0	23.8	27.5	23.4	20.2	18.3	17.8	19.3	20.4	23.2	24.9	28.4	na
Shark Bay (Nanga)													
Mean Max	31.7	33.5	32.2	29.5	25.9	22.8	21.5	22.6	25.1	26.4	27.5	28.5	27.3
Mean Min	20.9	22.4	21.3	18.7	14.7	12.0	10.5	11.4	13.5	15.4	17.9	19.0	16.5
High Max	47.0	47.1	44.4	41.0	35.8	30.0	27.6	32.3	37.0	38.4	41.8	42.4	na
Low Max	25.1	24.2	24.4	22.2	19.9	16.4	16.3	16.9	18.4	20.0	21.9	24.6	na

Note: Figures averaged over 46 years (Carnarvon); 20 years (Gascoyne Junction); 17 years (Learmonth); six years (Shark Bay). Source: Bureau of Meteorology

Rainfall in the Gascoyne is low, highly variable and averages about 200 millimetres per year. The majority of the Region's rainfall occurs as a result of cyclonic activity and consequently, the amount varies widely due to the unpredictable nature of where and when a cyclone may occur.

The area is influenced by the belt of South East Trade Winds which generate southerly winds for most of the year.

Cyclones are experienced across the Region, mainly in coastal areas. They can and have caused major damage to homes, infrastructure and crops. Building and engineering works require the highest construction standards in Australia.

Table 2. Average monthly and annual rainfall at representative stations (mm)

Reporting Station		J	F	M	A	M	J	J	A	S	O	N	D
Carnarvon	12	20	14	12	37	49	42	19	5.9	5.8	4.7	0.8	225.8
Errabiddy	26	28	28	19	25	29	18	8.2	2.8	2.3	4.0	11.3	204.4
Gascoyne Junction	10	29	17	17	35	34	36	16	3.7	6.2	8.3	3.1	215.9
Learmonth	41	44	40	18	47	40	24	14	3.0	3.0	1.0	3.0	278.0
Shark Bay	35	62	38	15	38	38	26	13	1.4	4.8	4.8	6.2	282.4

Note: Figures averaged over 48 years (Carnarvon); 70 years (Errabiddy); 83 years (Gascoyne Junction); 37 years (Learmonth); six years (Shark Bay). Source: Bureau of Meteorology

Geomorphology

Shark Bay, a vast shallow bay of about 13,000 square kilometres, is broken into a series of gulfs, inlets and basins by north-trending dune ridges and seagrass banks.

Seagrass covers over 4,000 square kilometres of the Bay, with the 1,030 square kilometres Wooramel Seagrass Bank being the largest structure of its type in the world.

To the north is Lake MacLeod, a large salt lake whose surface lies beneath sea level for most of the time. Lake MacLeod, 30 kilometres north of Carnarvon, covers 300,000 hectares of mostly dry salt lake.

The rugged marine cliffs north of Carnarvon are unprotected by reefs or offshore islands and waves from the deep ocean waters crash onto the coastline. Sheer cliffs at Cape Cuvier rise approximately 100m above the ocean.

The coastline of Exmouth Gulf has many bays, the largest of which are the Bay of Rest, Giraliala Bay and Gales Bay. Very extensive tidal flats, extending in places up to 15 kilometres landward of the shoreline, occur along the eastern shore of the Gulf.

An anticline called Cape Range is the major feature of the North West Cape peninsula. The range, part of which is a National Park has a maximum elevation of approximately 300 metres. The West Coast of North West Cape is part of the Ningaloo Reef Marine Park. This park contains Australia's longest fringing coral reef which is 260 kilometres long.

Inland, the Gascoyne region is dominated by wide alluvial valleys, the drainage basins of the Wooramel, Gascoyne, Lyons, Minilya, Lyndon and Ashburton Rivers. This area contains vast alluvial plains and red dune belts interspersed between low sedimentary ranges, such as Kennedy Range.

Mount Augustus National Park derives its name from Australia's largest isolated rock, Mount Augustus, which rises 858 metres above the surrounding landscape.

Vegetation

Land within the Gascoyne region is mostly low lying, and is almost entirely semi arid scrub with little or no tree cover. The natural vegetation has not been cleared over much of the area however, extensive grazing by sheep, cattle and goats has affected the soil and some plant species.

Terrestrial Fauna

Red and Euro Kangaroos are common in the Region. Smaller marsupials and bats, including rare and endangered species, are found often in the less accessible parts of the mainland and on offshore islands.

A wide diversity of birds, both resident and migratory, inhabits the Gascoyne. Large flocks of corellas and galahs are the most easily visible as well as emus, parrots and numerous smaller birds.

Lake MacLeod is home to diverse bird species and an important resting spot for trans-equatorial migratory waders. It has been nominated in part, for Ramsar listing.

Dingoes and feral animals such as goats, foxes, cats and rabbits have had a significant effect on the vegetation and fauna of the Region.

Marine Fauna

The marine fauna of the Gascoyne is diverse and plentiful. The single, most profound effect on this fauna is the Leeuwin Current. Green and hawksbill turtles, dugong, humpback whale and the whale shark are common to the Region.

At the southern end of the Region is the World Heritage listed area of Shark Bay. Shark Bay has one tenth of the world's dugong population (approximately 10,000 animals) and significant loggerhead turtle rookeries. The Bay contains breeding grounds for prawns, scallops and commercial finfish as well as habitats for endangered green turtles.

Monkey Mia is home to a large wild dolphin pod of about 300 animals. Several of these bottle nose dolphins are regular visitors to the beach.

Hamelin Pool contains the most diverse and abundant examples of stromatolite forms in the world, comparable to fossils in ancient rocks.

Shell Beach, a stretch of coastline about 60 kilometres long, has been formed by the shells of the tiny coquina bivalve that are constantly deposited onto the shore. The shell build up is between 25 to 30 feet deep.

Ningaloo Reef, which was nominated by the State and Commonwealth Governments for World Heritage Listing in early 2010, is a 260km long fringing coral reef that stretches from Red Bluff located on Quobba Station to the tip of the North West Cape north of Exmouth. The reef supports an abundance of marine life including 500 fish species, 300 species of coral, 600 species of molluscs, and large amounts of marine invertebrate species. The reef is also known worldwide for its seasonal feeding concentrations of whale sharks.

A unique subterranean fauna has been recently discovered in Cape Range and has created worldwide scientific interest because it provides evidence of continental drift and the evolution of specific species. The fauna, known as troglobites are small, live in limestone rock caves and are blind due to adaptation to a life in darkness.

Land Use

The predominant land use, by area, in the Gascoyne is pastoral. In 2006, there were 66 leases mainly in the Shark Bay, Carnarvon and Upper Gascoyne Shires.

The horticulture industry in Carnarvon utilises approximately 1,000 hectares of the 2,000 hectares zoned. Mining activity is mainly salt and gypsum production in the Shires of Carnarvon and Shark Bay.

Shark Bay became a World Heritage listed area in 1991 and is one of only 11 places on the World Heritage List to satisfy all four natural criteria for listing. The Shark Bay World Heritage Area extends over 2,320,000 hectares and overlaps the Shark Bay Marine Park which encompasses 748,735 hectares. Within the Marine Park, the Hamelin Pool Nature Reserve covers 132,000 hectares.

Cape Range National Park covers 50,581 hectares and Ningaloo Marine Park 224,000 hectares, some of which overlaps Cape Range.

The Kennedy Range National Park encompasses 141,660 hectares with the Ranges extending 195 km long and up to 30 km wide.

The Mount Augustus National Park covers 9,168 hectares and includes the world's largest monoclinal.

Francois Peron National Park stretches over about 40,000 hectares of undulating sandy plains interspersed by gypsum clay pans.

3. WATER

3.1 CARNARVON

SUMMARY

Carnarvon obtains water supplies for both domestic consumption and for the irrigation industry from a series of bores along the Gascoyne River between the Brickhouse homestead and Rocky Pool (Basins B-L). Current entitlement licence for Town Water Supply is 1.8GL. Current irrigation entitlement licence is 5.0GL licensed by Water Corporation.

Owners of horticultural properties along the north and south banks of the Gascoyne River between the east end of McGlades Road and west of Chinamans Pool (Basin A) are also licensed to take water from private bores located in property 'prolongations' totalling 5.8 GL for Basin A, subject to a review of the sustainable limit. This abstraction is tightly controlled in terms of abstraction rates/month as the extent of fresh water available in Basin A is 5.8 GL, which is less than in Basins B-L with 12.2GL. Salinity is monitored on a regular basis.



Gascoyne River flowing Feb 2009

Whilst many studies have been carried out over the years, the capacity of sustainable yields, total storage and recharge processes in the underground aquifers is still not fully understood and quantified.

There are concerns by the Department of Water that Basin A has been over-allocated for some years which was highlighted in 2004. The Department of Water have been implementing a strategy to address this issue under the terms of the Lower Gascoyne Management Strategy Plan. The sustainable yield and individual allocations will be reviewed as part of the new allocation plan. The Strategy Plan was issued in 2004 and covers the period until 31 December 2010.



Gascoyne River in its normal dry state

Basins B-L are less affected by salinity as these basins, being further inland, are elevated above sea level and are better recharged by river flow events. Current entitlements for town water supply purposes are 1.8GL. Irrigation water is supplied to growers as raw (untreated) water while the same raw water is chlorinated before reticulation to the town consumers.

Most irrigation properties do not have access to treated Town Water Supply and either use untreated water from the irrigation scheme or from their private bores in the river. The Department of Water and Gascoyne Water Cooperative advise irrigation properties that the water supplied by the irrigation scheme is unsuitable for drinking water purposes.

Current Status of Water Infrastructure

The water infrastructure in Carnarvon can be split into three groups including headworks, town water supply, and irrigation distribution:

Headworks

Headworks include assets comprising of bores, collector pipelines, electrical installations, SCADA (Supervisory Control and Data Acquisition), access tracks and flood protection.

Construction of the Carnarvon Bore field was commenced in the 1960s. Many of the bores drilled and equipped over the years have now either been abandoned or redrilled using more modern technology and materials.

The electrical controls for bore pumps are well maintained. In the late 80s, SCADA was introduced to allow for remote control of the water supply from bores. Recent refurbishment of bores and SCADA controls has improved reliability of the bores and water supply capacity of the overall system.

The collector main's pipes, (some 40 km ranging in size from 375mm to 600mm) are the sole source of water supply to the irrigation cooperative and to the residents of the town.

Town Water Supply

Town water supply infrastructure includes disinfection treatment, pump stations, distribution mains and reticulation including meters and consumer services.

The Town Water Supply system is constructed of a variety of materials from Cast Iron (CI), lead jointed pipes to Asbestos Cement (AC), Un-plasticised Poly-Vinyl Chloride (UPVC), Medium Density Poly-Ethylene (MDPE) and other materials. This reflects the changing



This tee piece is used to fill poison tanks for spraying. It rises from the same pipe work that leads to the house tank.



Remote controlled electrical switchboard for four bores in bore field.
Note: the platform is 1m above flood level

technology and available materials over the history of the Town Water Supply needs and growth. Recently the chlorination system, used to disinfect the Town Water Supply, was relocated from Brown Range to the Brickhouse Storage Complex. This improved the security and safety of the installation as previously it was located within 50m of residential housing and was considered to be a safety risk from potential gas leakage.

The major storage tanks located at Brown Range are concrete and both the low level (LL) and high level (HL) tanks have a capacity of 4,500KL. The pumps used to transfer water from the LL tank to the HL tank are reasonably modern and well maintained. There is also a small HL tank and transfer pump located at the HL tank site to provide adequate pressure for the houses on Brown Range. This tank and stand was recently refurbished.

With varying materials and ages, maintenance needs vary considerably, with older sections of town generally requiring the most attention. Meter replacement programs ensure accuracy of metering and the use of copper for service installations has kept the condition of consumer service assets at a reasonable level of compliance.

In general, the Town Water Supply system is in good condition.

Irrigation Distribution

Irrigation distribution infrastructure includes the pump stations, distribution mains, off-takes and meters.

The irrigation distribution system was constructed in the late 1960s and early 70s. The majority of the total 30km of pipes are constructed of A Class AC pipe (with the exception of McGlades Rd which is for the most part 600mm C Class AC), ranging in size from 100mm to 600mm.

Failure rates on the joints have reached an unacceptable level from a customer service reliability perspective and the low pressure rating of the pipe materials makes improvements in demand management and delivery pressures impossible. These pipes were designed to supply a gravity fed flooded furrow irrigation system. They are considered to be no longer fit for purpose in an environment where flood irrigation is no longer practiced. This method has been replaced by drip and micro sprinkler irrigation and fertigation systems which operate at a nominal pressure.

A full replacement of the irrigation system was agreed to in October 2009, with an announcement that the State Government would provide \$7.4m out of Royalties for Regions funds, with additional contributions from the Commonwealth Government and the Industry to meet the project cost of \$19.9m.

EXISTING PROJECTS

Carnarvon Artesian Basin Rehabilitation Project

Birdrong Sandstone is the main aquifer in the Carnarvon Artesian Basin and covers an area of some 25,000 km². Artesian bores are found from south of Shark bay to Exmouth and up to 70 km inland.

The depth to the artesian aquifer ranges from 120 m in the south to over 1500 m in the north. Most artesian bores are 300-400 m deep.

The basin is recharged through areas of outcrop along the eastern extent of the basin. The aquifer is estimated to recharge at a rate of $17 \times 10^6 \text{ m}^3$ per annum.

It is estimated that the total storage of the aquifer is approximately $25\,000 \times 10^6 \text{ m}^3$.

Flow rates from bores tapping the Birdrong Sandstone may be as high as 5000 m³/day with the majority of pastoral bores flowing between 100-500 m³/day.

It is estimated that $22 \times 10^6 \text{ m}^3$ per year is lost from the aquifer due to uncontrolled and corroded bores coupled with in-efficient bore drain systems.

The Carnarvon Artesian Basin Rehabilitation Project involves re-drilling and capping a series of artesian bores in the area that represent the only reliable water source for local pastoral properties, industry and coastal settlements.

Phase two of the project will remove about 28 bores which are free flowing from the Basin and re-drill 10 bores in their place.

The initiative follows the first phase of a three year, \$3.5m project to rehabilitate uncontrolled artesian flows in the Basin. This allowed local pastoral properties to diversify into horticulture, aquaculture and other industries.

The initiative also saw 57 uncontrolled bores removed, which represented significant water savings of more than 8 GL per annum at the surface, with up to 60 GL saved from sub-surface loss. It is expected that the second phase will result in similar water savings.

In association with phase two of the project, the Department of Water has contracted URS to develop an Aquifer Model for the Basin. The model will prove a valuable tool in Department of Water's management of the Basin which is also under increasing pressure from the resource and industry sectors.

Carnarvon Water Futures

The Shire of Carnarvon is committed to working with the Department of Water and the Water Corporation on the Carnarvon Integrated Water Supply Project, utilising bore, recycled and surface water from the Gascoyne River during flows as part of the water

vision for Carnarvon. The water will be used for the watering of sports facilities and parks and gardens. This will lessen the stress on the scheme water supply that is currently used for public facilities. Initially, the process will be to create a scope of works for an audit that will develop a plan of the Shire's water requirements and how they can be linked in to the project. Funding sources are currently being investigated.

OPPORTUNITIES FOR PROJECTS

Carnarvon Artesian Basin Diversification

Carnarvon Artesian Basin Advisory Group is currently overseeing rehabilitation in the basin and has been expanded to investigate the development potential of the artesian water on pastoral stations. The project identified there may be up to 20GL available for sustainable abstraction from the artesian basin each year which could be used to develop new horticulture, fodder production or aquaculture in the Region.

Gascoyne River Surface Water Flow Loss Study

None of the surface water of the Gascoyne river is currently captured for industry or community benefit. A plan to capture such flows to enable a long term and sustained aquifer replenishment should be considered.

Water Integration – Implementation

Project includes alliances with key State Government agencies and local government to develop innovative programs to integrate additional water supplies from alternative water resources with current supplies.

Development of Water Supplies Upstream from Rocky Pool

In the late 1990's, it was estimated that there may be an additional 8GL of sustainable water upstream of the disconnect located at Rocky Pool.

It was further considered that it would be more practical to develop land at Rocky Pool rather than transport the water into the existing horticultural area. Since those early days, the Water Corporation has extended its bore field to within two or three kilometres of Rocky Pool and Horizon Power has extended the 22kv high voltage power lines to the same distance.



Rocky Pool is a permanent water hole 50km east of Carnarvon on the Gascoyne River.

It may well be feasible to duplicate existing pipes for part of the distance (the last extension was constructed in 375mm and 300mm pipe while the major of the pipeline is 600mm) and with power within a couple of kilometres, even if a step up to 33kv is required, costs could possibly be less than originally anticipated. It is also worth noting that most construction in the past has been fully funded by government (long term recovery is via rates and charges). There may be an opportunity for revenue raising from land release and sales of water entitlements to recover investment costs.

Assessment of Sustainable Yield of Gascoyne River Aquifers

In the late 1990's, a Hydro-Geologist, Mr Wade Dodson, was engaged to create a model of the aquifers in the Lower Gascoyne River (Basins A-L). The model was constructed, but a major failing was that so much data had to be extrapolated from the relatively few monitoring points that could supply reliable, empirical data. Over many years, drilling of monitoring bores had been suspended as maintenance funds for existing bores was reduced. It is estimated that some 50 percent of existing monitoring bores have failed, been damaged or disappeared, and funding for replacements, let alone expansion of the system has been unavailable for some years. The Department of Water drilled 10 new monitoring bores in Basin A in 2008; these included new bores to expand the monitoring network as well as re-drilling on non-operational bores. The Water Corporation advise that all monitoring bores within the borefield area have been refurbished or redrilled.

Department of Water has engaged consultants to revise the modelling work completed by Wade Dodson, incorporating data collected over the past 5-10 years. In review of the management strategy, sustainable limits will be considered.

The Department of Water applies the cautionary principle to estimating sustainable yields and from that the total allowable entitlements. However, to assess whether or not the horticultural industry is to grow, reliable data on existing aquifers and potential new sources need to be studied and understood. It is considered that this project would be beneficial for the Gascoyne region as a whole.

Construction of Dedicated Drinking Water Supply Reticulation for Plantation Area

The growers of Carnarvon are major contributors to the economy of the Region, yet they provide their own water supply for drinking purposes. With the associated risks of contaminated water from backflow or cross-connection to other systems, the irrigation area of Carnarvon carries a very high incident risk.

A dedicated Town Water Supply for growers would remove the highest risk potential on the scheme. Attention would still need to be paid to backflow protection on the irrigation scheme to prevent cross contamination from poisons and fertigation systems from farm to farm.

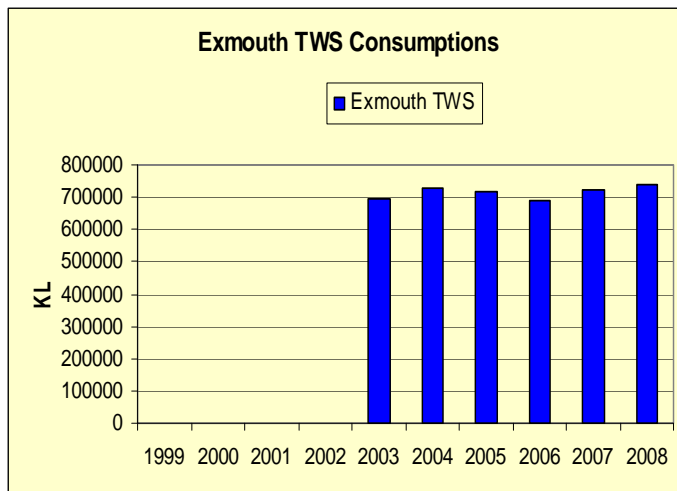
Significant savings on the cost of construction for the scheme could be realised if laying of pipe for a Town Water Supply was undertaken at the same time as the replacement of the irrigation distribution system.

If a potable supply were to be operated by an entity other than the Water Corporation, they would be required to apply for approval of a separate Operating Area and an Operating Licence from the Economic Regulation Authority.

3.2 EXMOUTH

SUMMARY

Exmouth obtains water supplies through bores located in Cape Range Limestone Aquifer to the west of the town. Water from these bores is chlorinated and fluoridated before being reticulated to domestic and business consumers.



Note: Blank years indicate no data available.

Sustainable yields from the Exmouth water reserves are governed by rainfall, and the movement of water from the Range toward the sea. Maximum draws per km of flow are set and this determines the maximum number of bores allowed across the range. Recent and future extensions of the bore field will need to spread towards the south of the existing bore field to reduce the total interception of the cross flows.

CURRENT STATUS OF INFRASTRUCTURE

Much of the water supply headworks were replaced after Cyclone Vance in 1999 and following bushfires in 2000. New storage tanks, Supervisory Control and Data Acquisition (SCADA) and new distribution mains systems have seen a complete overhaul of the water supply system in Exmouth.

Water is treated with chlorine for disinfection purposes and dosed with fluosilic acid (fluoridation) to raise the level of fluoride in the Town Water Supply as required by the Department of Health.

The Town Water Supply reticulation system is maintained by permanent Water Corporation staff located in Exmouth with specialist maintenance personnel visiting from Carnarvon as required.

The expansion of residential and lifestyle blocks in Exmouth is continuing and will eventually add to the demand on the capacity of water sources. To compensate for the loss of capacity in the northern bore field, new bores were drilled and equipped in the southern bore field to meet existing and future demand growth.

EXISTING PROJECTS

Upgrade of High Voltage (HV) Power Lines to Southern Legs

Project to upgrade the HV lines to the southern bore field is in process. This will provide reliable power to the southern legs, including legs 7 and 8.

Legs 7 and 8 Bores

Drilling and testing of new bores in southern legs 7 and 8 is proceeding and up to four additional bores should be available for emergency use (using generators sets and manual controls). This will help cater for increasing demand in the short term.

Southern Water Treatment Plant Decommissioning

The southern chlorination and fluoridation plant located in the Exmouth bore field has been out of operation for some years and is not required under future planning. A project has been funded to decommission and remove this plant from the area. This will improve the visual amenity considerably.

Exmouth Demand Management Project

In response to indications of increasing water use in Exmouth, the Water Corporation Mid West Region Office implemented a demand management program in late 2007 with the objective of reducing domestic consumption.

Per capita consumption in Exmouth has been recorded at 224 KL/person/per year as a five-year average from 2002-2007. In early 2008 a consumption reduction target of 15 percent for the 2008 calendar year was set using average figures from the past three years. Initiatives introduced as part of the program have included a fortnightly newsletter to residents detailing actual consumption figures compared to the 15 percent consumption target.

The demand management program will continue to be developed. Stakeholders and major consumers were visited in August and November 2008 with particular focus given to encouraging water efficiency among tourist accommodation providers. Water consumption in Exmouth has reduced from 775,541KL in the 2006/2007 reading year to 702,642KL in 2007/2008– a saving of 72,899 KL.

Demand management initiatives already in place include:

- Meetings with major stakeholders to discuss water efficiency initiatives and seek support for the demand management program;
- Water audits have been carried out on high consumers and as a result several accommodation providers have made changes, including refitting showerheads and toilets, investigating grey water systems and changing reticulation habits;
- Education and awareness programs including the delivery of fortnightly consumption graphs to residents, promotion of the Permanent Water Efficiency Measures on the town's notice board and the local school being recognised as a Water Wise School;
- Signage installed in tourist accommodation to educate visitors of the need to save water in Exmouth;
- Water Wise information packs delivered to local real estate agents for distribution to tenants and new home owners;
- Water Efficiency Monitoring officer regularly visiting Exmouth and liaising with business and residential consumers.

Source: Water Corporation – Gascoyne District Manager.

OPPORTUNITIES FOR PROJECTS

Desalination Plant Using Waste Heat, Solar or Wind Energy

The location of Exmouth lends itself to both wind and solar power generation. Coupled with a growing demand for water, which may soon outstrip the capacity of the aquifers to deliver, an opportunity to provide desalinated sea water using renewable energy or waste heat presents itself.

Potential sites for such a facility could include the area near the naval jetty or areas to the south of the town along Murat Road. Considering the main attraction to tourists in the area is eco-tourism, a solar or wind powered desalination facility could become another tourist attraction in its own right. A Waste Heat Recovery Evaporator system would need to be situated adjacent to the power station and would be environmentally friendly in that it would be using energy from burned fuel that would otherwise be lost to the atmosphere.

Planning has commenced with regard to the provision of a desalination plant should it be required in the future. The plant was designed with due consideration to the use of renewable (green) energy.

The Water Corporation advise that the need for a desalination plant is likely to be more than 10 years away unless there is a significant increase in growth. Planning will include consideration of green energy.

3.3 CORAL BAY

SUMMARY

Coral Bay obtains water supplies from an artesian bore and desalinated water is produced through a reverse osmosis (RO) process and is chlorinated for drinking, food preparation, showers and laundry purposes. All other water requirements are met from privately operated artesian bores.



Coral Bay Water Treatment Plant

Water is sourced from the Carnarvon Artesian Basin and is managed on an impact management basis by Department of Water (DoW).

Data for water consumption is not available as the Water Corporation did not take responsibility for metering and supply until November 2008.

CURRENT STATUS OF INFRASTRUCTURE

The reticulated water supply infrastructure is new and in good condition. Problems regarding the use of saline artesian water for watering public spaces should not arise here as the very sandy soils allow for flushing of salts compared to the build up that occurs in clay/silt soils.

OPPORTUNITIES FOR PROJECTS

Options for Desalinated Water

Coral Bay currently has a state of the art desalination facility and energy which is supplied by gas powered generators (Verve Energy) augmented by wind generators, and there are no planned projects for improvement projects related to water infrastructure.

The Water Corporation advise they investigated the option of utilising waste energy, but in this case it was found not to be viable.



Coral Bay Water Treatment Plant

3.4 DENHAM

SUMMARY

Most properties in Denham have dual water supply services, a desalinated service and a brackish service. There are two production bores that are used to supply the town, Bores 1/79 (a stand by bore) and 1/97 (the main production bore). Groundwater is drawn from around 500 metres (m) depth.

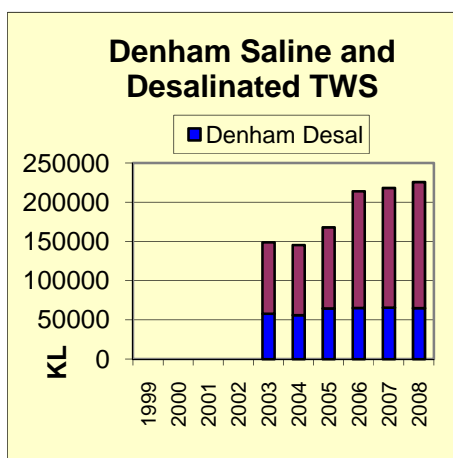
CURRENT STATUS OF INFRASTRUCTURE

Most properties have dual water supply services, a desalinated service and a brackish service. There are two production bores that are used to supply the town, Bores 1/79 (a stand by bore) and 1/97 (the main production bore). The groundwater is drawn from around 500 metres (m) depth.

The aquifer is considered to be confined and with its depth of 500 m, it is not considered vulnerable to contamination from surrounding land uses. Currently, Denham has two water reserves D7-2 and D7-7 (Denham South which contains bore 1/79). The Department of Water proposes to de-proclaim D7-2 and proclaim a Denham North Water Reserve on which bore 1/97 is located. The boundaries and priority classification have been determined to provide an appropriate level of protection for Denham's drinking water source (refer to: *Denham Water Source Protection Plan, Report No. 68 - Dept of Water*).

Developments in the area of Denham located on the upper escarpment (referred to as the High Level Area) have increased the demand for water supplied by the HL Storage at the Water Treatment Plant Storage Complex and consideration of increased capacity may need to be given to upgrading the storage capacity for future demand.

The lift pumps used to fill these tanks are single duty pumps (meaning there is no redundancy). This set up is used due to the corrosive nature of the environment and water. Spare pumps are retained in storage on site. The spares must be installed after the Water Corporation is notified of a break down and lack of supply to the High Level area.



It is normal practice in such installations to install duty/standby pumps to improve reliability, particularly in areas where trained technical staff are located outside of the town (in this case Carnarvon), but this is not a practical solution in the case of Denham.

Monkey Mia Resort, approximately 25kms east of Denham is privately owned and operated. However the time may come when delivery of water and sewerage services could be normalised for environmental, operational and regulatory compliance reasons.

EXISTING PROJECTS

Desalinated Water Storage

A new 1,000kl desalinated water tank has been commissioned to vastly improve the security of drinking water supplies.

Valve Replacement Program

A Valve Replacement Program is nearing completion with some 200 valves in the reticulation area being replaced. This project has improved flow rates and pressures within the reticulated area.

Duplication of Treatment System

The Reverse Osmosis Plant has been duplicated giving security of desalinated water supply through a duty standby arrangement and potential coverage for increased peak demand by running both installations.

Artesian Bore – Southern Water Reserve

This Artesian Bore has recently been refurbished providing security of supply (through redundancy) of saline water for the Town Water Supply.

The Following Strategies are also recommended by the Department of Water for Implementation:

- The boundary of the Reserves at Denham need to be proclaimed and that information needs to be available to the public to help them protect their drinking water;
- The Water Reserve boundary and proposed Priority One (P1) classification need to be recognised in the Shire of Shark Bay's Town Planning Scheme and other applicable schemes and strategies;
- The management principles outlined in this plan should be incorporated into the Shire of Shark Bay's Town Planning Scheme and other applicable land use planning schemes and strategies; and
- Best management practices for existing or future bore construction in close proximity to the water reserves should be implemented.

In order to protect water quality of this groundwater source, best management practices at design, construction and operational stages is recommended for existing and future land use developments. Guidance on best management practices is available on the Department of Water's website, www.water.wa.gov.au under Water Quality.

OPPORTUNITIES FOR PROJECTS

Saline Water Pre-Treatment

The increasing demand for both saline and desalinated water in Denham is putting pressure on the pre-treatment infrastructure. It is reported that this system of cooling tower, flocculation and sand filtering is nearing its design capacity, requiring increased frequency of cleaning routines. However, it is maintaining its filtration parameters at the

current pumping rates. A new filter is planned for installation when the next bore upgrade is programmed at which time the pump rate will be increased to match demand.

Installation of Supervisory Control and Data Acquisition

There is a recognised need for the installation of Supervisory Control and Data Acquisition (SCADA) in Denham to improve the operational security, monitoring and control of the technically complex water treatment and storage complex in Denham. With dual water supplies and separate high and low level reticulation areas, Denham for its small size has a complex sourcing, treatment, storage and reticulation system that would benefit from remote control and data collection. A private company (Veolia) have SCADA fitted to the RO plant. This company is responsible for maintaining the technical aspects of the plant.

Upgrade of High Level Storage System

Increasing demand from property developments in the high level area of Denham has made this project one worthy of consideration. It is recognised that two hours storage for a manned town (i.e. a town with permanent Water Corporation staff) is usually sufficient, most manned towns also have duty/standby pump stations as a backup if needed. With less than two hours back up supplies, coupled with the need for replacement pumps to be installed, the tanks are perhaps undersized for the duty they are required to perform. The Water Corporation advises that additional storage is being considered as part of the normal planning process.

Desalination by Use of Waste Heat Recovery

The Shire of Shark Bay only has access to saline water for greening parks and gardens. To enhance the parks and gardens around Denham, an investigation into the use of waste heat from the existing power station to drive a flash evaporation desalination plant could be undertaken. Water produced could be shandied with saline water to provide suitable quantities of fit-for-purpose water.

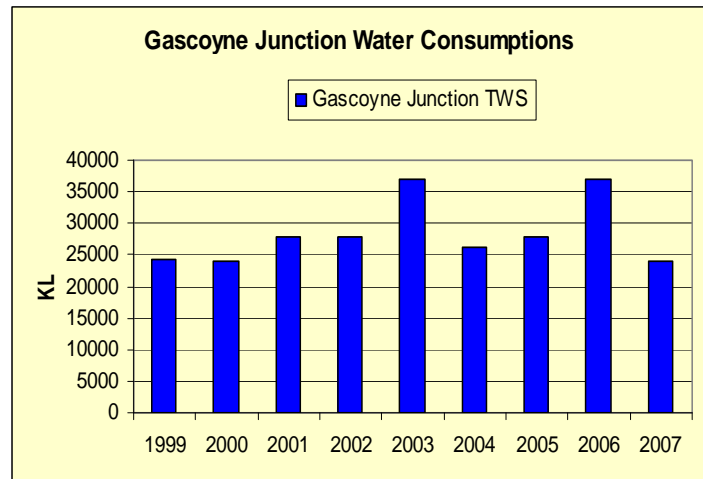
3.5 UPPER GASCOYNE

SUMMARY

The Gascoyne region is semi-arid, with most rain coming from summer thunderstorms. These storms can cause flooding of the Gascoyne River and this is when most recharge of the aquifers occurs.

The inland Gascoyne's water needs are serviced by a series of bores and pump stations. Drinking water for Gascoyne Junction is obtained from groundwater within the alluvial sands of the Gascoyne River. The water is pumped from the alluvial sands by two bores. The salinity of the groundwater can increase significantly between recharge events.

A reverse osmosis plant is transported to Gascoyne Junction when required to reduce salinity. More recently micro-filtration was introduced to treat the water supply for high turbidity following river flows with chlorine disinfection for treatment of microbial contamination.



Residents living on the north side of the river at Gascoyne Junction do not access scheme water. The Water Corporation has received interest from some property owners to extend the scheme supply however the cost to provide the potable water is considered costly by landowners. The capacity of the existing scheme supply is limited and an alternative source of supply would need to be identified and operational prior to any extension of the existing scheme system. Investigations into alternative water sources have been undertaken with little success to date. Further investigations are required to identify alternative water sources to meet any future growth. The Water Corporation is responsible for undertaking these investigations.

CURRENT STATUS OF INFRASTRUCTURE

Gascoyne Junction

Quality of groundwater is at risk of contamination from surrounding land uses. Cattle grazing within the Gascoyne Junction Water Reserve has been identified as a high contamination risk to the town water supply. Other risks include rubbish dumping, cross contamination of private and public bores, picnic sites and a river crossing for vehicles.

(Source: Dept of Water - Water Resource Protection Report No.84)

It is worth noting that the Gascoyne Junction Hotel as well as the residences on the north side of the river, extract their water from within the Water Corporation Water Reserve.

Burringurrah

Burringurrah has a system of submersible bores located in the vicinity of the community. The first bores utilised were Edney's Bore located at the western side of the community and Pink Hills Bore located to the south east of the community. In the 1980s and 1990s, new bores were drilled to the west of the Mt Augustus Rd in between the two sections of the community.

At the time these bores were drilled, it was known that there was a high level of nitrates in the water. For this reason, it was recommended that infants and mothers should drink bottled water. Anecdotal evidence from staff working at the community suggests this practice and advice is still in place today.

There is limited information available on production figures, consumption and water quality for this community. The community is self managed and no data is collected or held by agencies responsible for data in normalised towns.

EXISTING PROJECTS

Police Complex and Roadhouse/ Caravan Park

The capacity and quality of water supply at the Burringurrah community would need to be taken into account in planning for future developments such as a roadhouse, or caravan park in the community.

OPPORTUNITIES FOR PROJECTS

Expansion of Gascoyne Junction Water Supply Capacity from Alternative Sources

Demand is predicted to rise (apart from increased consumption due to reject water needs for RO Plant). If recommendations to connect northern properties to Town Water Supply are implemented, this will add to the consumptive load on the resource. No suitable additional resources have been found to date in the existing Water Reserve and it is believed that some exploration has been carried out towards the Lyons River.

Provide Town Water Supply to Gascoyne Junction Residents Located on the North Side of the River

This project would provide drinking quality water to those residents on the north side of the Gascoyne River and remove the need for private bores to be located in the water reserve in close proximity to the two Water Corporation bores. The quality of water in the river at certain times of the year becomes unsuitable for drinking.

Development of Horticulture for Community and Travellers at Burringurrah

The Community has raised the issue of them providing fresh fruit and vegetables on small commercial basis for internal use of the community and for sale to pastoralists and travellers through the community store. There is some question over the required sustainable yield of these bores if development of a horticultural business is contemplated.

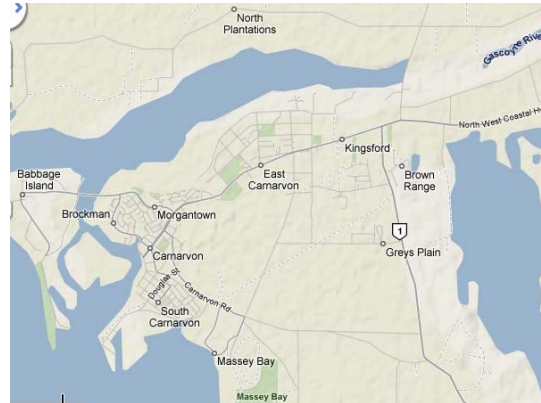
4. ROADS

4.1 CARNARVON

The major road servicing the town is North West Coastal Highway (NWCH). Access roads to the town site are via Robinson Street, Boor Street and HMAS Sydney Memorial Drive.

CURRENT STATUS OF INFRASTRUCTURE

The NWCH within the Gascoyne region south of Carnarvon is 7.4m wide or greater. There is a section south of the Wooramel River which has unsealed shoulders.



Map of Carnarvon

The Minilya to Barradale section of NWCH requires widening as the seal is only 6.2m wide. A number of passing lanes will be constructed on this section in the 2010/2011 financial year.

Local roads are generally sealed and serviceable, and are maintained by the Shire of Carnarvon. Robinson Street and NWCH are maintained by Main Roads WA (MRWA).

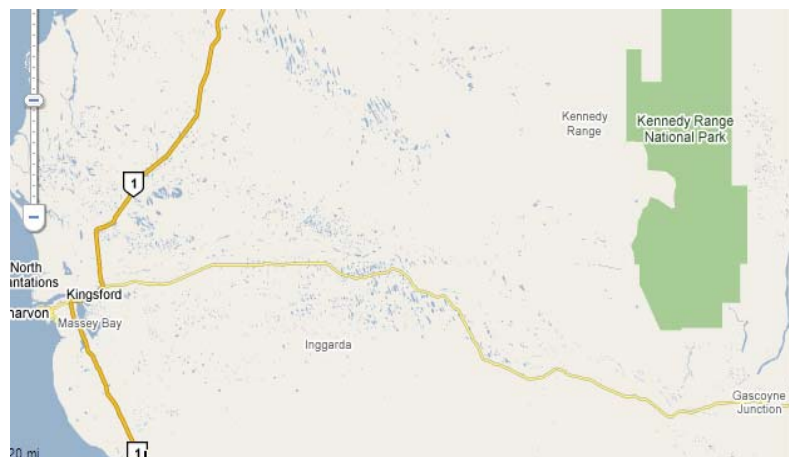
EXISTING PROJECTS

Carnarvon – Gascoyne Junction Road

The sealing of the road between Carnarvon and Gascoyne Junction is near completion.

A summary of works to complete the sealing of the Carnarvon section of Carnarvon – Mullewa Road is as follows:

- 18km remaining of unsealed section;
- Complete additional drainage works; and
- Rehabilitate gravel pits and access tracks.



Carnarvon – Gascoyne Junction Road

OPPORTUNITIES FOR PROJECTS

Extension of Dual Carriage Way to NWCH

A proposal to complete the dual carriageway of Robinson Street from Morgantown to the Perth turn-off (NWCH – Robinson Street intersection) has been considered for a number of years. This project would enhance access to the town centre, but given current traffic density figures, is unlikely to be justified in the foreseeable future.

Robinson Street Lighting

Robinson Street lighting needs relocation to be more effective on the existing single carriageway section from Morgantown to Perth turnoff.



Robinson St looking towards the intersection with NWCH. Street lighting is virtually non-existent



Dual use Pathway in background. This pathway has no effective lighting for most of its entire length along Robinson St.

Dual Use Pathway Lighting

Dual use pathway lighting will need to be addressed as relocation of street lighting will leave the dual pathway in total darkness. Bollard lighting may be appropriate for the area.

Realignment of NWCH - Robinson Street Intersection

Improvements to the intersection of North West Coastal Highway and Robinson Street were undertaken in early 2010.

Coastal Road to Gnaraloo Sealed Upgrade and Change Alignment

Coastal Road from Quobba to Gnaraloo needs to be sealed and realigned to increase safety of road users. Project will also increase tourism to the Region.



NWCH/ Robinson Street Intersection

4.2 EXMOUTH

CURRENT STATUS OF INFRASTRUCTURE

Exmouth is serviced by the Minilya – Exmouth Road and Burkett Road.

The Minilya – Exmouth Road intersects with the NWCH just north of the Minilya River 144km north of Carnarvon and runs for 218km north to Exmouth.

Burkett Road intersects with NWCH approximately 117km north of Minilya River and travels west for 78km to meet the Minilya – Exmouth Road some 87km south of Exmouth. Both of these roads are maintained by MRWA. Both roads are sealed with Burkett Rd being the most recently completed.

The Minilya - Exmouth Road has seen much greater traffic numbers than was anticipated at the time it was first sealed. This road is maintained by MRWA to the beginning of Murat Rd. Tourism is now the major industry in the town and the condition and general safety of the road, Lyndon River crossing and local flood ways continues to be closely monitored.

The majority of roads within the town boundaries are sealed and serviced by the Shire of Exmouth.

EXISTING PROJECTS

Minilya - Exmouth Road

Two passing lanes have recently been constructed north of the Airport to improve road user safety.

OPPORTUNITIES FOR PROJECTS

Construction of Bridge at Lyndon River Crossing

Investigations have been completed into the feasibility of construction of a bridge at Lyndon River crossing. If this project receives funding, there would be all weather access to Coral Bay, Learmonth and Exmouth (provided the latter has the causeways upgraded between Learmonth and Exmouth).



Two of the many creek crossings that can prevent travel between Exmouth and Learmonth Airport during rain events.



Learmonth to Exmouth Section of Minilya – Exmouth Road

There is a need to upgrade the existing crossings to enable access between Learmonth and Exmouth during significant rainfall events.



Two examples of the crossings involved

Yardie Creek Road Upgrade

Upgrade of Yardie Creek Road which accesses the Cape Range National Park and Ningaloo Marine Park. This is the only access point to these areas, which will see increased usage and focus when World Heritage Listing occurs. Road Management reports identify the need to upgrade this road.

4.3 CORAL BAY

CURRENT STATUS OF INFRASTRUCTURE

Coral Bay is located 12km west of the Minilya - Exmouth Road, 85km north of Minilya River. The Coral Bay access road is maintained by MRWA and is sealed and relatively new. Coral Bay is a small community and currently requires few roads.

Coral Bay has only four gazetted roads – Robinson Street, French Street, Banksia Drive and Sanctuary Drive.



Coral Bay Settlement

EXISTING PROJECTS

Banksia Drive Development

Extension of Banksia Drive to become the main access road into Coral Bay.

Robinson Street Development

Pedestrian Mall to be developed on Robinson Street to provide a shaded, safe, walkable environment for Coral Bay visitors and workers.

French Street Development

Install a cul-de-sac in French Street to provide a safe environment for pedestrians and passive recreation opportunities.

OPPORTUNITIES FOR PROJECTS

Workers Accommodation

The planned development of workers' accommodation will require road access to be constructed and/or upgraded.

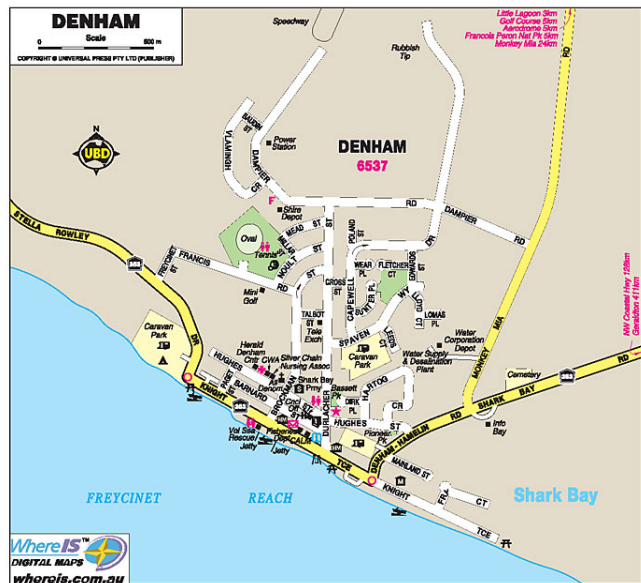
DEVELOPMENT NEED

Regional Roads Development Strategy states that Coral Bay Road safety upgrades are to include improved traffic safety by widening road and shoulders; upgrade the intersection between Minilya-Exmouth Road and Coral Bay Road; and an upgrade of the intersection of Coral Bay Road and the Rubbish Tip Road.

4.4 DENHAM

Denham is serviced by the Shark Bay Road which branches off the NWCH 200km south of Carnarvon. The Road is maintained by the Shire of Shark Bay under contract to MRWA, is sealed and runs approximately 129km to the town of Denham. The 25km long Monkey Mia Road is also maintained by the Shire of Shark Bay on contract to MRWA.

Shark Bay Salt at Useless Loop is served by a 100km gravel road branching off the sealed Shark Bay Road approximately 40 km west of NWCH. All local roads are maintained by the Shire of Shark Bay.



Denham Town Site

CURRENT STATUS OF INFRASTRUCTURE

The Shark Bay Road requires sealing of the shoulders. Traffic numbers are increasing and the road is inside the World Heritage Area. Access to local gravels for shoulder maintenance is limited and materials must be transported over longer distances. It is considered cheaper in the long run to cart the necessary resources in to seal the shoulders once. This, while being more capital intensive, would save money in the long term by reducing the frequency of maintenance works into the future.

EXISTING PROJECTS

Francois Peron National Park

Improvement of access to tourism and recreation sites in the Francois Peron National Park.

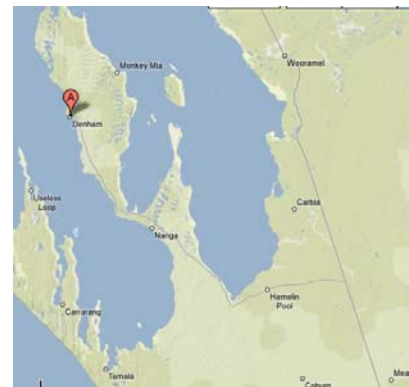
OPPORTUNITIES FOR PROJECTS

Useless Loop Road Upgrade

Access tracks to Steep Point and other recreation nodes in West Edel Land to be designed and located at levels consistent with use and protection of the area from degradation. Shark Bay Salt Mine is supportive of maintaining Useless Loop Road, with a view to progressively sealing it.

Upgrade Basic Raw Material (BRM) & Water Access

Provision of BRM and water to rural road network maintenance/ construction requirements is needed. This project is for tests to be conducted to find road building resources in the Shark Bay local government area.

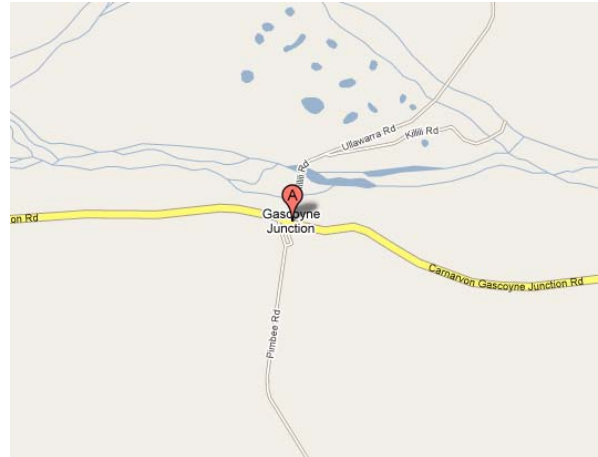


4.5 UPPER GASCOYNE

CURRENT STATUS OF INFRASTRUCTURE

Gascoyne Junction

Gascoyne Junction can be reached in a variety of ways from the north, south, east and west. Currently the only sealed road servicing the town is Carnarvon – Mullewa Road running 158km east from NWCH some 11km north of Carnarvon. This road is maintained by both Shires of Upper Gascoyne and Carnarvon. There is still approximately 18km of unsealed road midway along the road and some 3km at the western intersection with NWCH to be completed.



Gascoyne Junction

Discussion regarding the agency responsible for maintenance of this road into the future will be held between MRWA and the respective local governments.

Burringurrah

Access to Burringurrah as for Gascoyne Junction, can be made from many directions via direct or circuitous routes. From Carnarvon, The most direct route is via Gascoyne Junction and is some 500km with only the section between Carnarvon and Gascoyne Junction mostly sealed. The community can also be accessed from Meekatharra and the Great Northern Highway to the east among many alternate routes.

Mt Augustus is a growing tourist destination in the inland Gascoyne and is accessed from Carnarvon via the Carnarvon - Mullewa Rd described above. The description of access to Burringurrah is also pertinent to Mt Augustus. All roads in the vicinity are gravel.



Burringurrah Aboriginal Community

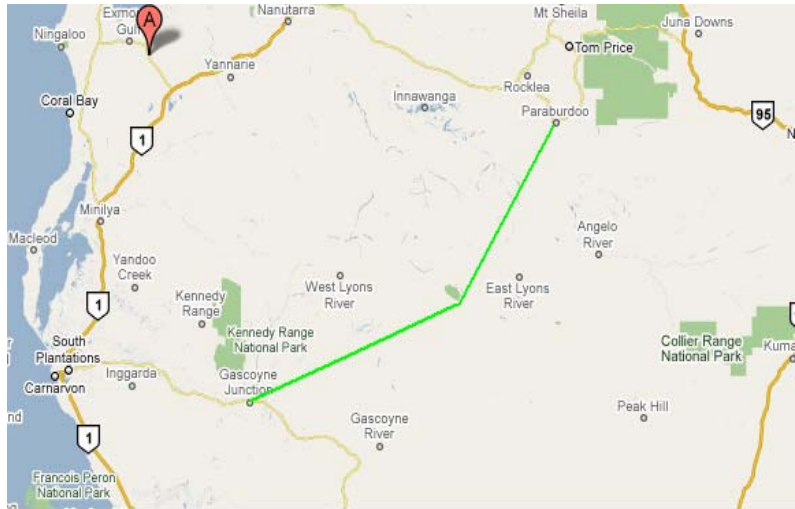
EXISTING PROJECTS

The sealing of the road between Carnarvon and Gascoyne Junction is progressing at an estimated cost of \$26m (including additional funds to complete the works).

OPPORTUNITIES FOR PROJECTS

Construction of a Suitable “Outback Road”

This project is an outcome of the Mt Augustus and Gascoyne Outback Development Committee Taskforce and proposes improvements and possible realignment of the road from Mt Augustus to Paraburdoo to enable a tourist circuit to be promoted, commencing in Carnarvon and travelling east through Gascoyne Junction, Mt Augustus and then north linking to Karijini and Paraburdoo. This would be a major draw card for “eco-tourists” who desire to see the real outback of Australia.



Proposed Direct Outback Road Linking Mt Augustus to Paraburdoo

The successful completion of such a project would require links to other infrastructure projects mentioned in this document, including the provision of upgraded airstrips suitable for RFDS day and night operations, improved accommodation (“roughing it in comfort”) and services for self drive tourists as well as group treks.

Sealing of Landor - Mt Augustus Road

Sealing of the entrance and exit roads of the Burringurrah Aboriginal community. This would greatly assist dust suppression from vehicular traffic passing the community and help with the visual amenity of the settlement.



Roadhouse

A roadhouse has been proposed at the Burringurrah Aboriginal community as a commercial venture, servicing local and tourist requirements.

This would be an advantage to the previously mentioned Outback Road.

Burringurrah Aboriginal Community

5. ENERGY

5.1 CARNARVON

CURRENT STATUS OF INFRASTRUCTURE

The main power generation in Carnarvon is managed by Horizon Power and comprises a dual fuel diesel/gas powerhouse. Diesel fuel is trucked in from Geraldton some 500km to the south and gas is delivered via a spur line off the Dampier - Bunbury gas line which runs a short distance to the east of Gascoyne Junction. The spur line roughly follows the Carnarvon – Mullewa Rd for most of that distance. Carnarvon has 2,536 customers. The area is serviced by 205 km of overhead 22 kV high voltage power lines and six feeders. Electricity demand growth is in the vicinity of four percent per annum.

Seven units are permanently installed in Power Station buildings. The summer capacity for all engines is de-rated from the winter capacity. The summer capacity with three temp sets is 13,300 kW and with six temp sets, 15,700 kW.

The maximum load recorded is 12,500 kW (summer) and minimum was 3,500 kW (winter).

Gas from the Dampier – Bunbury gas spur line is used exclusively for power generation and all other gas appliances within the town are supplied by bottled gas transported from Perth.

There is a small number of privately owned solar powered (PV) installations powering the needs of individual domestic residences as well as a small commercial system. These systems feed excess energy into the local grid when not required to provide power to the home etc. under the Renewable Energy Buyback Scheme (REBS) through Horizon Power.

The private, commercial solar power system currently feeds around 100 kW (or 0.7 percent of total capacity) into the Carnarvon grid.



Carnarvon Power Station is the only Power Station in Regional WA that can run on diesel fuel or a combination of Diesel and Gas

Renewable Energy Buyback Scheme (REBS) Capacity	
Privately Owned Solar Energy Systems in Carnarvon	
Installed	KW
Carnarvon	4.2
Carnarvon	5
Carnarvon	1.7
Carnarvon	5
Carnarvon	5
Carnarvon	5
Carnarvon	5
Carnarvon	10.08
Carnarvon	8.32
Carnarvon	5.04
Carnarvon	5
Carnarvon	5
Carnarvon	6.3
Carnarvon	6.3
Carnarvon	6.3
Carnarvon	30.24
Carnarvon	5
Carnarvon	11.61
Carnarvon	6.3
Solex Solar	46
Solex Wind	15
Pending	
Carnarvon	6.72
Carnarvon	5
Carnarvon	6.3
Carnarvon	5
Carnarvon	5
Carnarvon	5
Carnarvon	5
TOTAL	230.41

EXISTING PROJECTS

Carnarvon Power Station Project

Horizon Power is undertaking a major program involving the transition and renewal of power generation from the existing site to a new site, more suitable for the town's growth needs and future requirements, including the injection of more renewable generation.

Funds required for the project of \$69.7m are to cover the establishment of the new site, install new and existing generation assets and remediate the existing site.

OPPORTUNITIES FOR PROJECTS

Underground Power

This project is a whole of Gascoyne region project to provide underground power to Carnarvon, Exmouth and Denham. Installing underground power has many benefits and consideration will be given to replacing overhead powerlines with underground power as a situation presents itself.

Ready Power

Mungullah Community already benefit from this system with the completion of the Town Reserves Regularisation Program in January 2010. Customers who could potentially benefit from this scheme include Burringurrah Community, if normalisation proceeds. This system allows customers to pre-pay for electricity consumed.

The service based on these meters is called Ready Power, in which you pay for power as you use it, and never receive a power account.

Customers using Ready Power purchase a power card, similar to a pre-paid phone card. \$10, \$20 and \$50 power cards are available at nominated retail outlets. The single use power card is then inserted into the meter, with the monetary value of the card uploaded into the meter. This amount is reduced as power is used.

Ready Power is progressively being offered to residents of nominated Town Reserve Aboriginal communities. Historically, many Town Reserve communities receive one electricity account for all premises. With Ready Power individual meters are installed on each dwelling. This ensures that customers only pay for the electricity they use. Eligible customers can also receive energy rebates, such as the supply charge rebate, and seniors' air conditioning rebate.

5.2 EXMOUTH

CURRENT STATUS OF INFRASTRUCTURE

A new gas-fired power station commenced operations in November 2006 replacing the Horizon Power diesel fuelled power station. Compressed natural gas is transported by road to Exmouth from the Dampier-Bunbury natural gas pipeline. The transfer station is located north of Burkett Road on the NWCH. This continuous delivery train has also contributed to the increased traffic on the Minilya - Exmouth and Burkett Roads. Power from this station is augmented by three small wind turbines.



Exmouth Gas Fired Power Station

Currently there are 7 x 980 kW reciprocating engines running on NG and one x Diesel which is primarily used for a black start and back up. Number eight NG engine will be commissioned shortly and the ninth should be installed in 2010. Exmouth has experienced a peak load of 6.2 MVA this summer and with powered lots in Snapper Loop and the Marina development lots seeing construction well under way, the load could escalate quickly.

Exmouth has approximately 1,132 customers. The area is serviced by 94 km of 11 kV and 33 kV high voltage overhead power lines and six feeders. Worley Parsons owns and operates the local power station. Electricity demand growth is approximately 5-6 per cent per annum.

Three Western Australian designed and manufactured wind turbines were installed in 2002. The lightweight, transportable, tow-up 20 kW wind turbines with guyed towers were developed by Westwind Turbines of Perth and can be quickly lowered ahead of an advancing cyclone. Being tow-up wind turbines also means they are constructed on the ground prior to raising which alleviates the need for a high lift crane. This is a major advantage in remote locations.



One of three wind turbines in Exmouth

The Exmouth wind turbines are each coupled to the Exmouth electricity grid via an inverter. These inverters provide a high quality supply from the wind farm without the need for battery storage on the varying wind farm output. A refurbishment program for the wind turbines is currently being formulated by Horizon Power.

EXISTING PROJECTS

Horizon Power's project team is seeking to improve customer service through the use of mobile service centres that will provide customer contact, payment facilities, meter reading and safety and energy education.

OPPORTUNITIES FOR PROJECTS

Underground Power

This project is a whole of Gascoyne region project to provide underground power to Carnarvon, Exmouth and Denham. Installing underground power has many benefits and consideration will be given to replacing overhead powerlines with underground power as a situation presents itself.

Wind Farm on Cape Range

There is a huge potential to harvest wind energy on Cape Range in Exmouth. Discussions with Department of Environment and Conservation (DEC) and Shire of Exmouth would need to be held to consider environmental and National Park issues. However the high cost of transport of fossil fuels may well provide impetus for such a project.

Solar Power Generation Using Photo Voltaic or Solar Concentrator Systems

Considering the number of days of sun experienced in towns of the Gascoyne, potential as a site for solar concentrator generation systems is high. There may be opportunities for research and development into this type of renewable energy in conjunction with proposal for the development of an extension of University campus activities to the Exmouth area.

The Office of Sustainable Energy Development website includes a reference to a project involving a consortium led by Worley Parsons looking to develop large scale solar thermal power stations in Western Australia and other Australian jurisdictions. Potential locations in Western Australia for a 250 MW plant are near Geraldton and the north west of the state, with plans for the first plant to be operational by 2011.

5.3 CORAL BAY

CURRENT STATUS OF INFRASTRUCTURE

Coral Bay until recently was supplied by three separate private generators, but Horizon Power have installed new generating capacity and have normalised electrical supplies to the town site.



Three wind turbines - Coral Bay. Note twin bladed props.

The \$14m project has seen Horizon Power assume responsibility for power supplies in Coral Bay. The power station consists of seven 320KW low-load diesel engines, with a total capacity of 2,240KW.

Three 275KW wind turbines have also been installed at the wind farm, which is enough to generate up to 45 per cent of Coral Bay's annual electricity requirements. This is expected to save 440,000 litres of diesel each year and reduce greenhouse gas emissions by 1,160 tonnes of carbon dioxide per year.



Coral Bay Power Station

The turbines can be lowered and raised as required in extreme weather conditions.

Horizon Power has also constructed a new 22,000-volt underground power network for the distribution of the electricity in Coral Bay, using nine kilometres of cable.

Street lighting has been replaced with modern high-pressure sodium lights.

Street lighting has been replaced with modern

EXISTING PROJECTS

Major projects were recently completed and no new projects are currently being considered.

OPPORTUNITIES FOR PROJECTS

Cost Effective Use of Power Capacity

With an increased supply of employee accommodation in Coral Bay, operators and accommodation providers would be able to expand and develop businesses with the view to increasing tourism numbers, thus utilizing more of the available power supply. This would ensure that the new system operates to its full potential.



Coral Bay Power Station

5.4 DENHAM

CURRENT STATUS OF INFRASTRUCTURE

A single 230KW Enercon wind turbine was installed in Denham in 1998. Horizon Power state that following the wind turbines success with displacing diesel fuel, the Australian Greenhouse Office provided a \$1m Renewable Energy grant which enabled the system to become a world first in high wind energy penetration. Two additional Enercon wind turbines and a low load diesel generator were installed and the town sources about 36 percent of its electrical energy from the wind. A second low load diesel was installed in 2005.

Denham has a unique wind/diesel system which allows new equipment to be tested with the wind farm and a diesel generator, without affecting the customers in the town.

The system comprises four Enercon E-30 wind turbines (total capacity 690KW), two single low load diesel generators (250KW), four conventional diesel engines (1,720KW total), a Dynamic Grid Interface (100KW) and the power station control system. This was the first installation of low load diesel generator technology and the system has significantly increased wind energy penetration.

It is expected that the annual average wind energy penetration in Denham will exceed 44 percent as a result of this low load diesel generator technology.

EXISTING PROJECTS

Horizon Power's renewable energy partner, Verve Energy has recently carried out work to improve the power system in Denham. The work included installation of a fourth wind turbine and increased the capacity of the power station.

OPPORTUNITIES FOR PROJECTS

Underground Power

This project is a whole of Gascoyne region project to provide underground power to Carnarvon, Exmouth and Denham.

Wind Turbines

There is potential to add more wind turbines in Denham, plus potential for solar power generation.

Waste Heat from Power Stations

Waste heat could be used for evaporative desalination of artesian water to green parks and gardens.

5.5 UPPER GASCOYNE

CURRENT STATUS OF INFRASTRUCTURE

Horizon Power's station in Gascoyne Junction has been replaced by a new diesel fuelled facility built, owned and operated by Energy Generation Pty Ltd (EnGen). The new facility, located adjacent to the existing power station, supplies Horizon Power's electricity needs in the town under the terms of a 10 year contract.

There are approximately 37 customers and the area is serviced by 4km of 22 kV high voltage overhead power lines and two feeders. Electricity demand growth is approximately three percent per annum.

Gascoyne Junction has 5 x 80 kW diesel generators with a minimum of two running at any one time. Maximum capacity is 400kW, maximum load is around 200 kW and minimum is around 50 kW.

Burringurrah

Burringurrah Settlement has a self-managed community owned and operated power station which supplies the Community. The Community have appointed Pilbara Meta Maya as the contractor responsible for maintenance of the plant. Currently at Burringurrah Community Power Station there are 3 generators including:

- Unit#1 Hino K13D 150KW;
- Unit#2 Cummins 6CT 8.3-G2 100KW; and
- Unit#3 Cat 3406 200KW.

The last service completed in 2010 showed the community demand was at 234KW.

EXISTING PROJECTS

With a proposed police station complex, roadhouse and caravan park being considered, consideration may need to be given to upgrading the capacity of the existing power station.

OPPORTUNITIES FOR PROJECTS

Burringurrah Power Station Upgrade

Upgrading the capacity of the existing power station to service proposed infrastructure including the police station complex, roadhouse and caravan park. This is also required for further industrial land development.

6. AIRPORTS

Airports in the Region vary greatly from international standard to bush strips of which there are several hundred including private light aircraft strips located at mine sites and pastoral leases. Some have the capacity to take RFDS aircraft while most are used for aerial mustering.

A table of airstrips in and around the Gascoyne has been compiled from The Western Australian Country Airstrip Guide 27th Edition March 2008 and is attached.



Carnarvon Airport Terminal



Shark Bay Airport Terminal



Learmonth Terminal Exmouth



Learmonth Terminal Lounge

6.1 CARNARVON

CURRENT STATUS OF INFRASTRUCTURE

Carnarvon has a sealed runway suitable for Fokker 50 turbo prop aircraft. The airport is owned and operated by the Shire of Carnarvon. It is unsuitable for commercial jets on a regular basis. It has a daily air service from Perth using turbo prop aircraft.

The location of the airport within the town built up area prohibits extending the runway to accommodate jet aircraft. The flight path building height restrictions inhibit development in the town. Approaches to the runway for landing require aircraft to fly low over residential areas and sub-surface water and unstable soils are a major issue in achieving a suitable base for a new runway.



Carnarvon Airport

EXISTING PROJECTS

Upgraded Terminal & Runway

An upgraded terminal was recently opened following the refurbishment of one of the brick buildings originally occupied by flight services, adjacent to the existing terminal. Upgrades to the new terminal will continue with additional facilities to be provided. The runway was resealed and repaired in 2010 to last a further ten years until a new airport is built.

OPPORTUNITIES FOR PROJECTS

Relocation of Carnarvon Airport

The Shire of Carnarvon is undertaking a detailed study to identify the relative merits and cost benefits of moving the airport to a new site to the north of the town and upgrading to commercial jet standards.

6.2 EXMOUTH

CURRENT STATUS OF INFRASTRUCTURE

Exmouth is serviced by a civilian passenger terminal at Learmonth Airport which was originally constructed as a military airbase. The airport can handle very large jet aircraft and has a well appointed civilian terminal building. It is situated approximately 30 minutes drive from Exmouth. Concerns have been raised regarding the condition of flood ways between the town and airport in cases where emergency services may be required, particularly during or after a major rain event. A recent emergency involving an international flight highlighted these concerns.



A second light aircraft and helicopter airstrip is located between Learmonth and the town of Exmouth.



Helicopter Airstrip



Helicopter Airstrip

EXISTING PROJECTS

There are currently no infrastructure projects at Learmonth Airport.

OPPORTUNITIES FOR PROJECTS

Airfreight for Export of Fresh Fruit and Vegetables

There is an untapped opportunity to use the capacity of Learmonth to handle large aircraft. Out of season fresh fruit and vegetables could be transported to Learmonth from Carnarvon, only 350km away and then air freighted into Singapore, Hong Kong,

Indonesia and China. If the scale of production in Carnarvon expands as expected, this could be a profitable export earner for the prime grade produce, which now has to be transported 1,000 km by road to Perth before being on-sold. Consideration would need to be given to quarantine and customs services.

Upgrade as Alternative Airport for Emergencies

Due to recent history of emergency landings by international aircraft at Learmonth Airport, a review of the capacity to handle such emergencies may be warranted. The level of infrastructure at the civil terminal to handle access to various large aircraft, fire fighting equipment, ambulance and other support services would need to be included in the review.

Access to and from Learmonth from Exmouth is also an issue raised in the section dealing with roads. In times of heavy rain and cyclonic activity, Exmouth is cut off from the airport and Burkett Road. This leaves both Exmouth and Learmonth isolated from each other and the wider community to the south and east.

6.3 CORAL BAY

CURRENT STATUS OF INFRASTRUCTURE

The airstrip at Coral Bay is a typical “bush strip” suitable for light aircraft and has RFDS approval for day/night operations.



Coral Bay Airstrip

The airstrip was recently given an upgrade to meet Civil Aviation Safety Authority (CASA) and RFDS requirements. The airstrip is situated on Cardabia Station, which is owned by the Baiyangu Aboriginal Corporation. Until recently, Coral Bay Fire and Emergency Services Authority (FESA) has been responsible for all emergency procedures required for RFDS usage and purchased new lighting for the purpose. The Department for Transport funded the upgrade to the airstrip and is now sourcing funds for a part-time manager.

OPPORTUNITIES FOR PROJECTS

Transfer of Ownership of Airstrip to Carnarvon Shire

As the main airstrip servicing the growing township of Coral Bay, it may be appropriate for the Coral Bay airstrip to come under the control of the Carnarvon Shire which already operates the Carnarvon Airport.

6.4 DENHAM

CURRENT STATUS OF INFRASTRUCTURE

The airport at Denham is located only a few km from the town and is relatively new. It can cater for commercial turbo prop aircraft. The terminal has only basic facilities and inadequate if the experience of fly in/ fly out (FIFO) tourists is to be enhanced. The strip is owned and maintained by Shark Bay Airport Pty Limited.



Shark Bay Airport



Shark Bay Terminal

EXISTING PROJECTS

There are currently no infrastructure projects at Shark Bay Airport.

OPPORTUNITIES FOR PROJECTS

Development of the terminal would enhance tourist visits and provide additional security for travellers.

6.5 UPPER GASCOYNE

CURRENT STATUS OF INFRASTRUCTURE

Gascoyne Junction

Serviced by an all weather gravel strip capable of servicing light aircraft and smaller commercial aircraft. The strip is located within several hundred metres of the Shire Offices. The strip is maintained by the Shire of Upper Gascoyne and is approved for use by RFDS. The Gascoyne Junction Air Strip has recently been resealed.



Gascoyne Junction Airstrip

Burringurrah

An airstrip capable of servicing light aircraft and RFDS aircraft is located within a few minutes of the community centre. It is a gravel strip.

The airstrip servicing Mt Augustus is a pastoral strip located on Mt Augustus Station.

EXISTING PROJECTS

No projects are currently underway.

OPPORTUNITIES FOR PROJECTS

A Review of All Pastoral and Government Owned Airstrips in the Gascoyne region is required to catalogue all airstrips with a report on status, condition, and suitability for



Mt Augustus Airstrip

RFDS and other types of aircraft. The report would make recommendations on refurbishing selected airstrips in the Region to RFDS day/night operational capacity to ensure RFDS ability to service growing numbers of “outback tourists” to the Gascoyne.

7. HARBOURS

7.1 CARNARVON

BACKGROUND

Within the Shire of Carnarvon, there are two harbours. The first is located at Cape Cuvier some 90km north of Carnarvon. It is a privately owned operation by Rio Tinto, and used to export salt from the Lake MacLeod solar salt operation.

The second is the Small Boat Harbour situated adjacent to the Fascine and accessed from Douglas Street. This harbour is operated by the Department of Transport.

CARNARVON SMALL BOAT HARBOUR

In the early 1970's, the Public Works Department commenced planning for the provision of a boat harbour at Carnarvon, for use by local prawning and fishing vessels. Harbour dredging and reclamation works commenced in 1973. The boat harbour, incorporating a dredged basin and channel, "T" head service jetty, and berthing facilities for Government vessels was formally opened by the then Minister for Works Mr. D.H. O'Neil (MLA) on 28 July 1976.

The harbour basin was created by dredging. Access to the basin is via a dredged entrance channel, approximately 1 km long, which connects to Teggs Channel. The latter is a channel approximately 3.5 km long, partly dredged and partly natural, which is the major maritime entry point for Carnarvon, connecting both the boat harbour and the Fascine to the open sea.

The boat harbour basin and entrance channel has a dredged depth of three metres with certain areas within the harbour having a slightly greater depth.



Salt Loading at Cape Cuvier



Carnarvon Small Boat Harbour

Teggs Channel has been dredged at various levels (incorporating a sand trap), to provide a minimum useable depth of three metres. Teggs Channel and the harbour entrance are susceptible to siltation with significant maintenance dredging being required every five to six years to maintain adequate water depth for larger vessels using the boat harbour.

Subsequent improvements to the harbour included the provision of:

- a slipway facility which has a design capacity of 180 tonnes;
- a low level jetty to cater for the smaller type fishing vessels;
- leasehold land, provided for industry to develop their own infrastructure associated with harbour purposes;
- a limited number of boat mooring pens;
- a small extension to the mooring basin; and
- a small craft launching ramp.

In addition to the five pens provided off the Snapper Jetty, 12 serviced pens for vessels of various size, up to 20 m, have been constructed within the harbour. 10 of these are located along the foreshore between the service jetties and two are off the southern side of the "T" service jetty neck. A number of piles are maintained within the boat harbour as temporary mooring points. The lengths of the pens are:

- 5 x 12 m
- 5 x 15 m
- 2 x 20 m

Norwest Seafoods is the largest single fishing operator utilising the harbour for its fleet of scallop and prawning trawlers, there is also several private fishing, prawning, crabbing and marine support businesses that operate out of the location. There is a slipway rated at 180 tonnes currently operated under arrangement by Norwest Seafoods.

"T" Service Jetty

The "T" Service Jetty is one of two service jetties in the harbour. The "T" Jetty has alongside berthing of 100 metres (face 60 metres, and two inside sections of 20 metres each). The Jetty caters mainly for the loading and unloading of prawn trawlers and scallop vessels and for the fuelling of vessels. A lower level finger jetty with mooring piles has been constructed off the northern side of the "T" Jetty neck for use by Government and private vessels if required.



"T" Jetty – Carnarvon Small Boat Harbour

The Jetty has five single phase power outlets, with three phase power outlets, four water outlets and three refuelling (marine diesel) outlets, rubbish receptacle and a waste oil receptacle.

Snapper Service Jetty

The second service jetty is a low level finger jetty, with a berthing face of 55 metres and access to five mooring pens. The Jetty caters for the loading and unloading of smaller vessels such as those engaged in the snapper fishery.

The Jetty has four single phase power and two three phase outlets, 4 water outlets and rubbish receptacle.

Boat Ramp

The Boat Ramp is equipped with a catwalk and is located in the northern corner of the harbour. Public car parking is provided adjacent to the two service jetties and the boat launching ramp.

Slipway

The Slipway is currently capable of accommodating vessels up to 180 tonnes, the slip has two cradles with one of these having the capacity to side slip. Power and water is available for vessel maintenance. The slipway facility is currently leased to NorWest Seafoods.

EXISTING PROJECTS

Rio Tinto Plans for Expansion of Operations

Rio Tinto – Dampier Salt Ltd is proposing to increase production capacity by a factor of three over the next four years, which will mean larger bulk carriers mooring at the salt loading facility at Cape Cuvier. The Panamax size ships of up to 80,000 tonnes will require larger tugs to handle them.

The types and size of the tugs required is currently being assessed, but it envisaged that they will have draft (including safety clearance) of around 5.0 metres. The tugs will be a major investment by the company and their continual operational availability will be paramount. If the vessels need to travel to Perth, Geraldton or Karratha for slipping, this will have flow on effects of lost loading time, lost production and lost income for the company and support industries of the Region.

OPPORTUNITIES FOR PROJECTS

Bejaling Deep Water Port Development

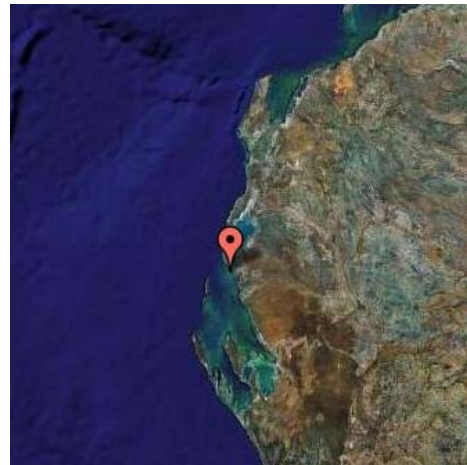
In 1961 Bejaling was recognised as a potential deep water port for the Gascoyne region in a report by Clough Engineering.

The lack of deep water port facilities between Geraldton and Dampier has been a matter of discussion by the Board of the GDC.

The salt industry, live cattle industry, and possible new commercial projects in the Gascoyne represent some of the potential products for a new port. This is discussed further in Section B, Mining.

Carnarvon Recreational Boat Ramp

Funding for this project has been provided by the State Government in 2010 under the Royalties for Regions Gascoyne Revitalisation Plan. The funding will be used to build a new boat ramp next to the Carnarvon Yacht Club pens. The Department of Transport are managing this project.



Bejaling Site - Potential Deep Water Port

7.2 EXMOUTH

CURRENT STATUS OF INFRASTRUCTURE

A marina has been constructed in Exmouth located off Murat Road south of the town. The Exmouth Boat Harbour was officially opened on 13 September 1997.

The Harbour concept originated in 1987 as a means of developing the local economy after the United States Defence personnel departed from the nearby communications station. The original plans were for a Coral Coast Marina, which became the Exmouth Boat Harbour over the ten year development period.



Exmouth Boat Harbour

There are 18 charter boat pens that are 15m, 20m, and 25m in length. Services include single and three phase power, water and lighting. Toilets, hot showers and telephone located nearby.

The Marina has 24 general purpose pens (floating) that are 10m and 15m in length. Services include single phase power, water and lighting. Toilets, hot showers and telephone are located nearby.

There are 8 trawler pen moorings that are 20m and 25m in length, with no power, water, or catwalks.

The service wharf has a 100m long berth face with single three phase power, water and lighting, and a diesel fuel facility. The wharf's load limits are berth face - 25m, 300T displacement vessel; deck stack load - 7.5kpa (760kg/M²); 10T mobile crane (maximum) - lifting 10T maximum load on outriggers; Truck loading (maximum) - Semi trailers - 44T gross; other trucks - 10T gross.



Exmouth Boat Harbour



US Navy Pier

The boat ramps are dual concrete ramps with wide sloping catwalks.

The harbour caters for commercial fishing and tourism boating requirements as well as recreational boating. A number of vessels up to 40 metres in size use the harbour as a base to service the Oil and Gas industries to the north and northwest. Support industries are growing on industrial land in the area. There is a serious threat of flooding and damage to the marina during major rain events as has been witnessed in the past. The

current level of protection of the harbour is considered inadequate.

At the northern end of the Cape, the US Navy has a port facility suitable for large vessels. The Jetty is a secure facility and access to the public is limited.

There are boat ramps for recreational use located at Bundegi Beach and Tantabiddi Beach, which contain private swing moorings and drinking water.

On the coast to the east of Learmonth airport, Learmonth Jetty was constructed during the early oil exploration days. This was previously known as WAPET Creek Jetty and was later used by commercial fishing and prawn trawlers as a refuelling depot, principally by the Kailis Group who operate a prawning fleet in the Exmouth Gulf. Their processing operation is a few kilometres north of this jetty. The jetty has been upgraded and repaired since suffering major damage during cyclone Vance in 1999.



Tantabiddi Boat Ramp

EXISTING PROJECTS

Exmouth Harbour Development

Proposals have been put forward for further development and expansion of the Exmouth Harbour by private sector interests in order to support the Oil and Gas exploration and production industry taking place in Exmouth Gulf and adjacent waters. The Department of Transport, GDC and Shire of Exmouth are working together to determine the future demand for harbour facilities by the Oil and Gas industry and suppliers and servicing companies.

OPPORTUNITIES FOR PROJECTS

Exmouth Marina Expansion

Expansion of the existing marina to assist commercial services and growth in the fisheries and mining sectors. The harbour as stands is currently operating at capacity thereby stifling further opportunities for growth.

Exmouth Boat Harbour (EBH) officially opened in September 1997 and provided 24 general purpose floating pens, 18 charter vessel pens, 8 trawler pens and a large service wharf. The uptake of these facilities was overwhelming with a current waiting list for use of between 2-3 years. With the further development of the thriving tourism industry, the interest from oil and gas service sector and the increasing popularity of game fishing competitions in Exmouth, the pressure on the facility has become extreme.

In 2008, the then Department for Planning and Infrastructure established the Exmouth Boat Harbour Development Committee chaired by Vince Catania to oversee and

provide strategic guidance for a public consultation process on the further expansion of the Harbour. In August 2008, the committee released the *Exmouth Harbour Development Community Consultation Report* which stated in the summary of main findings that there is substantial if not overwhelming support of the idea of expanding the harbour.

The only other refuelling options for vessels without the expansion in Exmouth includes Dampier, which already demands a lengthy waiting list, or Broome where vessels are referred to from Dampier. This involves a five day turn around, making it a costly operation which could be avoided.

Tantabiddi Boat Ramp

Development of the land based boat launching facilities, turnaround area, car and boat trailer parking, amenities, and signage facilities adjacent to the Tantabiddi Boat Ramp. This area is jointly vested and managed by the Shire of Exmouth and DEC.

Completion of the Tantabiddi Boat Ramp was originally scheduled to be undertaken with the Bundegi Boat Ramp however cost escalations resulted in Bundegi taking priority. The Department of Transport (DoT) is responsible for this boat ramp and negotiations with DoT over funding from their budget are to continue. Work required also includes a toilet block being built near the boat ramp.

Exmouth as an Iconic Seafood Region

The MG Kailis Group is expanding its Pilbara fishing operations with the launch of the Exmouth Fish Co (EFC) and acquisition of six Pilbara fish trawl licences. MG Kailis Group state that their vision is “to establish Exmouth as the iconic region for seafood in WA and that they are in a unique position to do this with key Pilbara fisheries situated close to their seafood logistic and processing base near Exmouth.

7.3 CORAL BAY

CURRENT STATUS OF INFRASTRUCTURE

Coral Bay is protected by the Ningaloo Reef and is a haven for recreational boats. In 2009, a boat launching facility was completed to facilitate access to boats at the edge of deeper water of the bay and discontinued the practice of launching boats from the beach in Bill's Bay.



Coral Bay Settlement

OPPORTUNITIES FOR PROJECTS

Stage Two of the Coral Bay Boat Launching Facility

Necessary amenities such as toilets and showers, adequate lighting and rubbish disposal need to be addressed as well as services such as fish cleaning and offal disposal. A wash down facility and relevant information for recreational boat users also needs to be provided. Landscaping of the area is required to prevent erosion and to enhance the visual amenity of the site.



Coral Bay Boat Launching Facility

7.4 DENHAM

CURRENT STATUS OF INFRASTRUCTURE

The Shire of Shark Bay hosts two harbour facilities. The first facility is a private facility for loading out salt from the Shark Bay Salt facility at Useless Loop. This facility performs a function similar to that located at Cape Cuvier. The solar salt pans were constructed once a levee was built across an embayment (Useless Loop). The salt is harvested and transported to an island load out dump, where it is to ships, moored in deep water, by means of a jetty conveyor system.



Useless Loop Salt loading Facility

The second facility is on the foreshore of Denham, what was once a very long jetty thrusting out to deep water is now a much shortened version with a dredged channel leading out to deeper water. This jetty and combined boat ramp and slipway caters for the commercial fishing fleet as well as tourist and recreational boats in the World Heritage area of Shark Bay. The facility requires upgrading and the Shire of Shark Bay and Department of Transport are investigating plans for redevelopment of the foreshore area including the boat launching and loading jetty.



Denham

Fishing in Denham was once a thriving snapper industry. However, catch limits have reduced this industry in recent years.

Whiting and mullet are still caught in large quantities and Shark Bay whiting is a delicacy enjoyed across the country.



Monkey Mia

Approximately 25km east of Denham is the hamlet of Monkey Mia and the famous Dolphin Resort. There is a jetty and boat ramp servicing recreational and commercial charter boats.

EXISTING PROJECTS

Expansion of Maritime Facilities in Denham

The Shire of Shark Bay and Department of Transport are considering an expansion of the maritime facilities in Denham. The development of these facilities would further enhance the tourism, commercial and recreational fishing, boating, sailing, windsurfing and scientific research activities in the area. The Strategic Plan for the Shire supports

the concept of a marina subject to preliminary investigations and public consultation. The current Denham jetty is in very poor condition and needs replacing in the short term.

The future provision of maritime infrastructure and the ultimate upgrade and expansion of existing jetty facilities at Denham is to be conducted through a community consultation process.

OPPORTUNITIES FOR PROJECTS

Eco Tourism

As the centre of the Shark Bay World Heritage Area, Denham has a unique opportunity to drive a tourism industry based on the pristine environment offshore and the work being done to return the peninsula to its original levels of flora and fauna through Operation Eden. With the resort at Monkey Mia and the famous visiting wild dolphins, opportunities for future tourist accommodation development, including maritime facilities development are considerable.



Denham Harbour with Dredged Channel

Widening the Monkey Mia Jetty

The project consists of the extension and widening of Monkey Mia jetty to accommodate increased pedestrian and commercial vehicle traffic.

8. SEWERAGE

8.1 CARNARVON

CURRENT STATUS OF INFRASTRUCTURE

Sections of Carnarvon have been serviced by deep sewerage for many years. This system was, until the late 80's, owned and operated by the Shire until it was handed over to the Water Authority (now Water Corporation). The localities of Morgantown, CBD, Brockman and parts of South Carnarvon have been connected. One of the motels has a private rising main to deliver waste water into No2 Pump Station in Robinson Street. Mungullah Village in Boor St also has a private pump station and rising main to the No2 Pump Station.

The system at Mungullah was designed to handle the original residential load of 110 persons. It is understood that, at times, the population of the community is at least double this figure and the system cannot handle the load through the 100mm rising main. This is leading to ongoing problems and failures of pumps at the Mungullah end. Bigger pumps will not resolve the issue due to the friction losses in the inadequately designed main.

The major part of South Carnarvon has yet to be connected. While the remainder of South Carnarvon is still on the infill program, engineering difficulties and high costs associated with acid sulphate soils, high water tables and other construction difficulties means that the project is considered to be one of low priority.

The area most affected from a development perspective is East Carnarvon where subdivision and construction of properties on land smaller than 2,000 m² requires deep sewerage as a condition of approval. This is the one existing area within the present flood protection works (with the exception of the airport land, should it be relocated) where land could be developed for housing, rural residential and light industrial purposes.

The current site of the waste water treatment works (WWTW), operated by the Water Corporation is a matter of contention. It is normal practice to surround a facility such as this treatment plant with a buffer zone based on an odour footprint. In the case of the Carnarvon plant, the designed buffer zone was deemed to be a 500 metre radius around the plant at the time it was first constructed and operated by the Shire of Carnarvon. Unfortunately the plant is squeezed between the river bank on one side and prime real estate on the other and the consequence has been that domestic residences have been constructed within 50 metres of the secondary treatment pond in the plant.

The Shire has constructed effluent storage ponds next to the existing plant and use the treated effluent water for greening of ovals etc. However during winter, when demand is greatly reduced, but output from the plant is at its highest, these ponds are severely tested and have overflowed on occasion.

Apart from the reuse scheme, the only other method of disposal is infiltration from an infiltration pond next to the treatment ponds. The treatment ponds lined, but during river flow events, the level of water on the river side of the levee banks is higher than the top water level of the treatment ponds and river water infiltrates back into the plant area through the leaky levee banks and up through the floor of the infiltration pond. It has been common practice over the years to lay sandbags on the inner embankments in the worst sections of the plant to prevent inflow during major river events.

EXISTING PROJECTS

Relocation of Waste Water Treatment Plant Carnarvon

The Water Corporation has been planning for the relocation of the WWTP plant for over 10 years. The relocation of the WWTP is expected to occur around 2014, when the existing plant reaches its treatment capacity.

The Water Corporation advises that:

- Ground and hydro geological studies have been carried out on the new WWTP site.
- The new WWTP will be constructed to minimise odours.
- High winds generally disperse any odours.
- Buffer area will be defined by odour modelling.
- The southern WWTP site was selected following consultation with stakeholders and members of the community.

Infill of South Carnarvon

There has been very little activity on the South Carnarvon in-fill for some time. Further details are stated below.

OPPORTUNITIES FOR PROJECTS

Completion of Deep Sewerage South Carnarvon & Infill for Remaining Localities

Completion of the deep sewerage project is required to reduce associated health issues relating to high water levels and decaying residential sewerage systems. There has been very little activity on the South Carnarvon in-fill for some time. The engineering issues with high water tables, black swamp (acid sulphate) soils and dewatering problems associated with installing even shallow vacuum sewerage has led to an escalation in project costs.

The original costing for this project was \$8m, however a different system is now required and Water Corporation advise that the cost may now double. Water Corporation further advised that the project has been deferred until at least 2014.

Wastewater Reuse Strategies

The Carnarvon Shire takes waste water from the Water Corporation under a reuse agreement. This water is used to green ovals and parks and gardens in conjunction with water from an artesian bore located near the Carnarvon Airport.

Location of New Waste Water Treatment Plant

Relocation of the Waste Water Treatment Plant is planned for 2014 when the existing plant is expected to reach treatment capacity. The preferred site for the new plant is on the mud flats on the South Common. Ground and hydro geological studies have been carried out at the site. Concerns were highlighted regarding the possibility of south westerly prevailing winds carrying odour across a large part of the town, and that the area is prone to flooding and tidal surge during cyclones, and also that the clay soils are unsuitable for infiltration as a method of disposal. The Water Corporation advise that the new plant will be constructed to minimise odours, and that high winds generally disperse odours. A buffer zone around the plant is to be defined by odour modelling.

If the site of a new waste water treatment plant was closer to the plantation areas (such as Bibbawarra Rd north of the river), up to 0.2GL of wastewater per annum could be made available for tree crops and other suitable horticultural produce, rising to a maximum of 0.4GL once the town is fully sewered.

Whilst the northern site is a preferred option from an environmental and engineering viewpoint, the pipeline crossing under the Gascoyne River would be subject to river flows and shifting river bed sands which may be more expensive to construct.

The Water Corporation have advised that the acquisition of land for the plant is currently underway and that the project will be completed in 2015.

Infill of East Carnarvon

This is a much needed project which could be a key to the development of the area for affordable housing and light industrial businesses. The current imposition of sub-division restrictions requiring that anyone developing lots of less than 2,000m² install deep sewerage as a condition of sub-division are onerous in the extreme. The nearest access point to the existing deep sewerage system is No.2 Pump Station located in Robinson Street (where the divided road finishes). This is more than two kilometres from the nearest lots that could potentially be developed.

If the area was a green fields development, the developer would install roads, power, water and sewerage services prior to sale of lots and economies of scale would ensure lowest per unit cost. This cost would be factored into the sale price of each lot and would therefore be spread across the whole area. Unfortunately, almost all of the land in question comprises freehold blocks, many of which are greater than 2,000m² in area and owned by individuals who simply cannot afford the costs associated with simple sub-division while this condition is still applied.

To progress the project:

- Sewerage should be installed in the area;
- Costs associated with this area are considerably less than those in the remaining South Carnarvon area (easy dewatering and with the majority of land being vacant, access issues are much simpler than the built up residential areas);

- Encourage development of this valuable, flood protected real estate, the sewerage could be installed as an infill project dealing with the whole locality and perhaps even the Kingsford locality.

Individual or Community Based On-Site Sewage Systems

If the Water Corporation charges and By-laws were the same as for other utility providers, that is; you only pay fees and charges if you avail yourself of the service (that is, connect), then there are many alternatives to deep sewerage that are environmentally friendly, simple and cost effective to install and have the added advantage of reusing effluent at the source. This reuse saves as much as 40 percent of residential drinking water consumption (40 percent of all water used in domestic areas is used to water gardens).

There are several systems on the market and they are being installed in single dwellings and also in green fields sites for community developments. However, in WA, if a property owner or developer installs such a system, it is difficult to get initial approval and even if approval is given, the Water Corporation has the right to charge sewerage rates and insist on customers connecting should they decide to install deep sewerage at a later date.

This is an area of legislation that could be reviewed and the applicable By-laws brought into line with those applied in other States of Australia.

8.2 EXMOUTH

CURRENT STATUS OF INFRASTRUCTURE

Due to the very rocky nature of the Exmouth town site, septic sewerage systems were never feasible. Consequently Exmouth was constructed with a deep sewerage system from the start. The waste water treatment plant was located on the eastern side of Murat Road in close proximity to both the golf club and the football oval.

The Shire of Exmouth has an agreement to take effluent from an overflow pond located on the boundary of the plant and to use it to green the oval.

According to the Shire of Exmouth, the program of effluent reuse for the greening of the town oval and other public spaces is hampered by the condition (quality) of effluent. The Water Corporation state that the effluent quality is within the ranges specified.

The Shire advises that the effluent is of such poor quality that at times it is forced to ban the use of effluent for watering purposes due to high bacteriological counts. The filtration and treatment (chlorination) of effluent is the responsibility of the end user. In this case the Shire of Exmouth.



Exmouth Waste Water Treatment Plant. The Golf Course Bounds the North and East

The plant was intended to have aerators installed with one of the ponds being divided in order to improve the primary treatment of waste water once the below ground Imhoff tanks were decommissioned. The Imhoff tanks have been decommissioned, but no aerators are evident.

EXISTING PROJECTS

Relocation of Waste Water Treatment Plant

Water Corporation has responsibility for the existing plant that was constructed during 1970s and pre-dates current planning regulations. The project will allow for development of the areas close to the CBD. Land released is of high value for tourist accommodation and possible resort development. Relocation has been rescheduled from 2008 to 2016. The Water Corporation is currently acquiring land for the relocation.

This project has been considered since the mid 1990's, however it would appear that the triggers set to bring this project into construction phase are such that it may still be many years before it happens. The Water Corporation state that this is likely to be 2015/2016, however acquisition of the land for the new plant is proceeding.

The Water Corporation also state that, should any developer have a proposal that required earlier relocation, the Water Corporation would consider a pre-funding arrangement. The sporting and recreational activities within the existing buffer zone fall within compatible use guidelines. Residential development that has occurred within the buffer has been at the objection of the Water Corporation.

The current situation is:

- The plant is surrounded by residential, recreational and sporting facilities, with the result that there is no effective buffer zone to deal with the potential odour footprint of the plant.
- The plant is located on land that has no room for expansion.
- The overflow pond is totally inadequate for storage of effluent.
- The current reuse scheme results in flooding of the oval in order to prevent overflow onto the golf course.

All of the above is regarded by the Shire of Exmouth as sufficient reason to relocate in terms of amenity, environment, potential for pollution and disposal of excess effluent. It is understood that the Defence Department has approved in principle, relocation of the WWTP to a location on the southern side of the high frequency transmitter buffer area adjacent to the Exmouth Golf Course.

8.3 CORAL BAY

CURRENT STATUS OF INFRASTRUCTURE

The early settlement and subsequent development of Coral Bay grew in an ad hoc manner and sewerage disposal and potential contamination of groundwater and the Bay was of concern.

The Water Corporation has now installed a deep sewerage system with treatment ponds located in an area to the east of the town, which minimises hazards to the community and environment.

OPPORTUNITIES FOR PROJECTS

Decommissioning of Bay View Holiday Village Sewerage Ponds

Decommissioning of on-site sewerage ponds at the Bayview Holiday Village can now occur, and would minimise the possibility of contamination of the town's water supply and beach area.

8.4 DENHAM

CURRENT STATUS OF INFRASTRUCTURE

Denham was constructed with only septic systems available to businesses and residents. In the late 1990's, it became evident that a visible line of contamination was caused by leaching into the sea along the Denham foreshore. Due to its World Heritage listing, Denham was fast tracked for deep sewerage under the infill program. A treatment plant was constructed on the eastern side of the Monkey Mia Road and a pump station located at the southern end of Knight Terrace.



Denham Waste Water Treatment Plant is Located Away from the Town Site

OPPORTUNITIES FOR PROJECTS

Effluent Reuse

As Denham grows and the loading on the existing Waste Water Treatment Plant increases, there is a fast approaching need to find uses for the effluent produced. The obvious choice would be Shire reuse schemes similar to those in place in Carnarvon and other regional towns throughout WA. If a reuse scheme is not practical, then planning for alternative disposal methods needs to be considered. One of the issues with effluent in Denham is the high level of salinity. While all treated effluent from Waste Water Treatment Plants has a tendency of high salinity, the condition is further exacerbated in Denham due to the highly saline source water used from the artesian bores for toilet flushing etc.

In such an arid environment as Shark Bay, consideration should be given to an economically sustainable process that could provide a suitable use for this potential resource.

8.5 UPPER GASCOYNE

CURRENT STATUS OF INFRASTRUCTURE

Gascoyne Junction

Gascoyne Junction has no deep sewerage and all treatment of waste is by septic tank and leach drains. The population is very small, however as residential areas are located adjacent to the river and the natural flow of surface and groundwater is towards the river, contamination of the water supply is possible, particularly in light of the location of the water bores in the same area of the river.

Burringurrah

Burringurrah had deep sewerage installed in the 1990's and it is understood that there can be issues with maintenance and operation of the two pump stations, which is a reflection of the system of self management which requires untrained staff to carry out day to day operational and maintenance checks.

OPPORTUNITIES FOR PROJECTS

In-fill sewerage for Gascoyne Junction is a possibility, but hard to justify on economic or environmental conditions when the population numbers are taken into account.

9. INDUSTRIAL LAND

9.1 CARNARVON

Carnarvon has areas designated for light industrial and general industrial purposes. The areas involved are mainly in the Kingsford and Greys Plain localities. Questions have been raised regarding the rezoning of some light industrial zoning to general industrial in order to allow for 24 hour operations of metal fabrication and similar industry. This has led to the commencement of a rezoning process in small areas of the above localities.

The major industries conducting operations from these localities at present include earthmoving, transport depots, fuel storage, metal fabrication and light engineering.

CURRENT STATUS OF INDUSTRIAL LAND DEVELOPMENT

As mentioned previously, industrial land is required due to high sale prices set by the current owners. It may be worth considering when future releases are considered that similar conditions be placed on development as are placed on residential releases, including construction commencing within a number of years.

Carnarvon Land Group

In July 2010, the Shire of Carnarvon, LandCorp, and GDC held the first meeting of the Carnarvon Land Group. The Group is designed to provide a strategic framework and direction for the development and release of residential and industrial land in Carnarvon into the future.

OPPORTUNITIES FOR PROJECTS

Service Hub for the Gascoyne

Given the level of exploration for oil and gas and the associated activity that follows, opportunities for Carnarvon to become a service hub for the mining industry are certainly worth considering. Every kilometre that plant and equipment has to be transported adds to downtime and the inevitable escalation of costs in lost production.

Travelling south from Karratha, there is no real support services before Geraldton some 1100km away. Carnarvon is situated almost halfway between the two centres and is ideally placed on the North West Coastal Highway to make a huge difference in cost and downtime for developing mining interests. If land at the right price can be made available and zoning issues allowing for round the clock operations are resolved, it may well be that service industry companies could be attracted to Carnarvon to take advantage of Carnarvon's geographic and economic potential.

9.2 EXMOUTH

CURRENT STATUS OF INDUSTRIAL LAND DEVELOPMENT

Exmouth has a Light Industrial Area (LIA) to the west of Murat Road in the areas around Maley Street and Patterson Way. There is room for expansion within this area and to the west. Exmouth also has industrial zoned land in the areas around Welch Street and Koolinda Way west of Murat Road near the entrance to Exmouth, as well as south of Exmouth on the east side of Murat Road.



Light Industrial and Industrial Zoned Areas of Exmouth



EXISTING PROJECTS

The proposed Harbour expansion project is expected to generate traffic from oil and gas exploration and support vessels as well as coastal shipping. This will inevitably lead to demand for onshore support industry and the LIA is the recommended area for this to take place.

OPPORTUNITIES FOR PROJECTS

If the development of the Harbour continues and demand for support industry services grows, it may become necessary to consider an additional area for industrial land in the near future. The proposed harbour expansion project has potential to take place in the immediate future and has been strongly supported by the Shire Council and local community.

There is already significant demand for the harbour expansion in regards to tourism and recreational boating needs.

9.3 CORAL BAY

CURRENT STATUS OF INDUSTRIAL LAND DEVELOPMENT

Suitable land for industry is available in Coral Bay, but it is unlikely that anything beyond minor support businesses will develop in the next few years. Coral Bay is predominantly a tourist destination and support for tourist accommodation, fuel supplies and recreational boating support services are likely to be the major areas of take-up of industrial land in the foreseeable future.

OPPORTUNITIES FOR PROJECTS

Accommodation

There is a pressing need for accommodation to house the labour force.



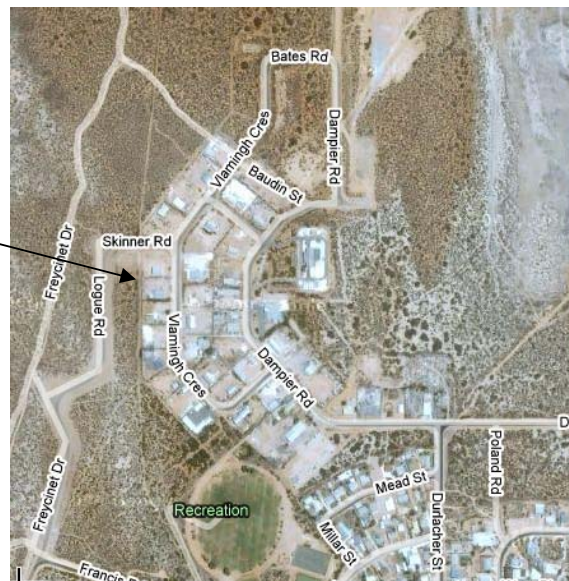
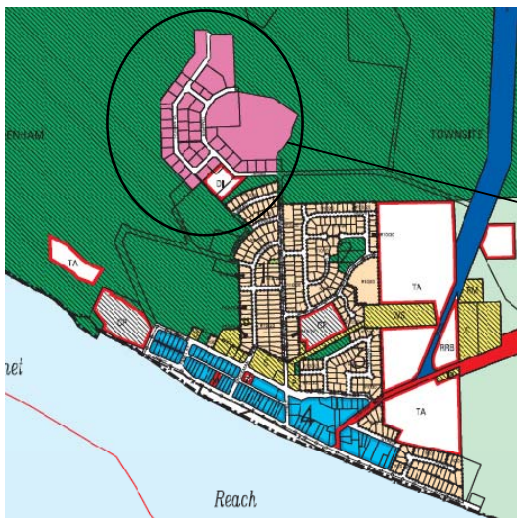
Land available for industrial sites

9.4 DENHAM

Denham is situated within the World Heritage Area of Shark Bay and industry is mainly concentrated on fishing and tourism. A light industrial area is zoned within the eastern section of the town in proximity to the power station and behind the coastal ridge.

CURRENT STATUS OF INDUSTRIAL LAND DEVELOPMENT

Industrial land is well utilised in Denham and expansion in the future is well catered for in this location.



LIA Denham

EXISTING PROJECTS

Most industrial land in Denham contains businesses that support fishing, boating and tourism. The building industry and building services are also well represented considering the size of the community.

9.5 UPPER GASCOYNE

CURRENT STATUS OF INDUSTRIAL LAND DEVELOPMENT

Gascoyne Junction services the passing tourist trade and the pastoral industry. Most supplies are transported into the town from Carnarvon 176 km to the west.

The Shire workshops would be the major industrial site, followed by the power station.

There is little industry in the town which has a very small population.

Land Release

The Shire of Upper Gascoyne is currently developing seven residential and seven industrial blocks of land. Total cost of project is approximately \$500,000.



Gascoyne Junction

10. COMMUNICATIONS

10.1 CARNARVON

CURRENT STATUS OF COMMUNICATIONS

BROADBAND CAPABILITY

Fibre

Telstra's Optic Fibre network runs up the North West Coastal Highway less than 3km out of Carnarvon. The Fibre cable branches off and runs into the town's main exchanges.

Exchange Information

Carnarvon is supported by two main exchanges, one in the centre of town (CVON) and the other in the north plantations on the other side of the Gascoyne River (CVNN).

ADSL Capability

Telstra is the only service provider for ADSL in Carnarvon. Other ISP's have the option of utilising Telstra's network to re-sell.

Exchange	Number Range	Broadband	Free Ports	Scheme
CVON	99411000 - 99414999	ADSL2+	1 ADSL / 171 ADSL2+	
CVNN	99418000 - 99419999	ADSL	183 ADSL	Broadband

Wireless Internet Coverage

Telstra NextG is the only 3G enabled network in Carnarvon. Optus provides access via their 'yes'G Network (maps unavailable).

Mobile phone communications is an area of frustration for growers and service industries in the plantation areas and coverage to the fringes of the town are poor. Part



Map of mobile phone coverage around Carnarvon.

of the problem is due to the location of the phone tower at the north exchange on the north side of the Bibbawarra Crossing. This location is an anomaly when the topography of the area is taken into consideration. It is located on the bank of the river in a low lying tree covered area. The tower is not as tall as most mobile phone towers found elsewhere.

When viewing the surrounding area, the remaining tower at the site of Radio Australia presents a potentially improved location for a mobile phone tower. Receiving a signal from a tower in this location and at such a high

elevation, would possibly resolve the problems faced by growers whose phones suffer from attenuation through the greenery of their crops and the distance from the existing low level tower.

Several ISPs operate in Carnarvon and ADSL is available to many residents, however there are still major issues with some areas of the community only having access to dial up or satellite broadband. The network continues to be upgraded.

Television and radio service needs are well met with commercial, ABC and SBS services available.

OPPORTUNITIES FOR PROJECTS

Relocation of Mobile Phone Tower

Mobile phone communications could potentially be greatly improved if the site of the tower mounted equipment on the north side of Bibbawarra Crossing was relocated to the tower on Brown Range which was formally used by Radio Australia.

FORMER OTC SATALLITE EARTH STATION SITE CARNARVON

CURRENT STATUS OF INFRASTRUCTURE

The former OTC (Overseas Telecommunications Commission) Satellite Earth Station is a site of major technological heritage significance, incorporating large antennae representing the first two generations of satellite communications technology.

Opened in 1966, the Satellite Earth Station was originally constructed to support NASA's Carnarvon tracking station, which was located about 10km from Carnarvon on the Brown Range sand hills. The OTC station was initially used to send data received by the NASA station to the US via satellite and thus played an important role in the Space Race of the 1960s, contributing to the US Gemini, Apollo and Skylab programs. OTC Carnarvon was also a major ground station for the Intelsat satellite consortium, which managed international satellite tele-communications from the mid 1960s. In November 1966, the first satellite broadcast from Australia to the UK, the longest distance satellite broadcast at the time, took place between Carnarvon and London. "Down Under Comes Up Live" linked families in Australia with their relatives back in the UK, live via satellite.



To service the growing demand for satellite communications services to and from Australia, the large parabolic antenna, or "Big

"Dish" was constructed in 1969, and the original cassegrain horn antenna (known as the "sugar scoop") was assigned to carry out 'housekeeping' duties on communications satellites, known as TTC&M (tracking, telemetry, command and monitoring). It became one of Intelsat's main satellite control facilities, servicing satellites over the Indian and Pacific oceans.

The OTC facility was also used to provide communications for the NAVCOMSTA (Harold E Holt Naval Base) in Exmouth and in 1985-86 was the location of a deep space tracking station developed by the European Space Agency to support its Giotto mission to Comet Halley.

Closed in 1987, the former OTC Satellite Earth Station site is the last physical relic of Carnarvon's involvement in space exploration and the developing communications technologies that have changed the world in which we live.



OTC Site Carnarvon

Having been allowed to deteriorate for many years, the site is significantly run down and requires extensive restoration and refurbishment, together with conservation of the two major antennae.

EXISTING PROJECTS

Since 2001, the Shire has commissioned studies into the feasibility of converting the site into an interpretive centre that would attract tourists to the town. This has involved the creation of a conservation plan for the site, as well as the development of an interpretation plan, both under the umbrella of a Master Plan for the site. The Plan involves a phased redevelopment taking place over a 3-5 year time span, with a vision for further heritage, educational and entrepreneurial activity on the site as development funding permits. The Master Plan has not yet been adopted by the Shire, envisages an interpretation centre/museum, a café and shop and other facilities on site to attract both locals and tourists.

There is also a possibility that, rather than remaining a museum object, the large parabolic antenna may be converted by the University of Tasmania for use as a radio telescope, operating in conjunction with other radio telescopes in Australia on VLBI (Very Long Baseline Interferometry) astronomy projects. An operating radio telescope would have major benefits for education potential in Carnarvon.

OPPORTUNITIES FOR PROJECTS

Clean Up Site, Site Signage and Information

The immediate priority is to clean the site up, secure the land and assets (as some doubt exists over tenure and ownership) and install initial interpretation signage so that visitors at least know what the site represents. The OTC site is often confused with the former NASA tracking station, of which nothing now remains.

Square Kilometre Array Project Support

The University of Tasmania and Curtin University have expressed interest in the future use of the main antenna for radio astronomy work. If this project proceeds, there is the possibility of using the antenna to support the Square Kilometre Array, should that project come to fruition in Western Australia.

Educational Precinct and Radio Telescope

The interest being shown by universities in returning the main dish to operational status as a radio telescope could have far reaching flow-on effects for students in the Region, who have little opportunity for exposure to science in the world outside the classroom. Professional staff from various universities visiting the site, together with possible guest users of the facility from overseas, would offer a rich pool of visiting lectures for school and public education programs. Developing a strong science-based education program around the former OTC site and a possible radio telescope would further enhance the reputation of Carnarvon as a significant location in the history of space exploration.

OPPORTUNITIES FOR PROJECTS

Mobile Phone Coverage

Mobile phone coverage along the length of the North West Coastal Highway needs to be expanded and improved. As well as for business and personal use, mobile phone coverage is needed for safety purposes. Mobile phone coverage in Carnarvon also needs to be improved as the service does not work consistently in many parts of the town with breaks in reception a common occurrence.

Relocation of Mobile Phone Tower

Mobile phone communications could potentially be greatly improved if the site of the tower mounted equipment on the north side of Bibbawarra Crossing Carnarvon was relocated to the tower on Brown Range (ex Radio Australia).

10.2 EXMOUTH

CURRENT STATUS OF COMMUNICATIONS

BROADBAND CAPABILITY

Fibre

Telstra's Fibre network branches off from the main ring and runs into the town of Exmouth. This was originally to service defence obligations in the town.

Exchange Information

Exmouth is supported by one exchange (EXMH).

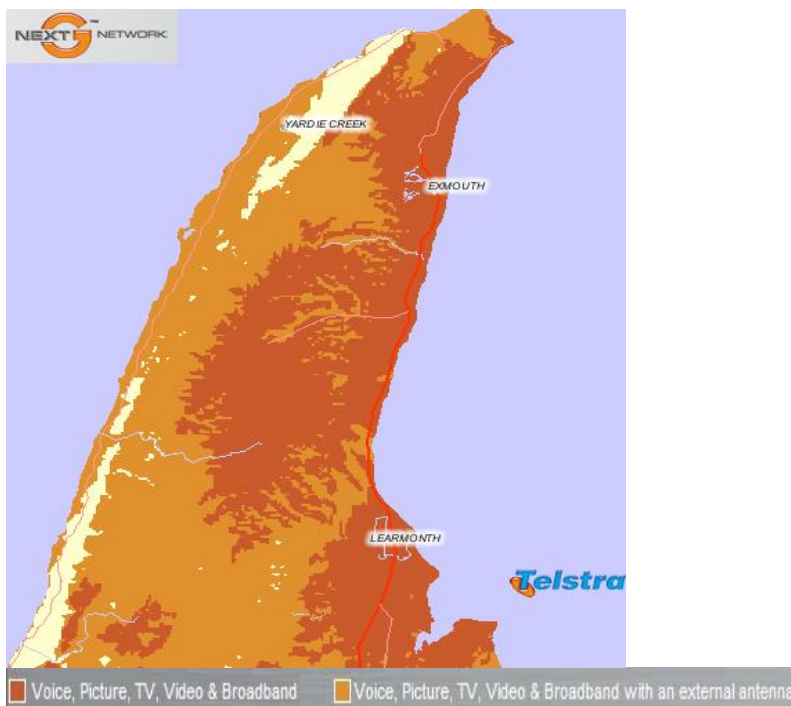
ADSL Availability

Telstra is the only service provider for ADSL in Exmouth. Other ISP's have the option of utilising Telstra's network to re-sell.

Exchange	Number Range	Broadband	Free Ports	Scheme
EXMH	99491000 – 99492999 99494000 - 99494999	ADSL	156 ADSL	ADSL 2

Wireless Internet Coverage

Telstra NextG is the only 3G enabled network in Exmouth. Optus provides access via their 'yes'G Network (maps unavailable).



Map of Mobile Phone Coverage Around Exmouth.

OPPORTUNITIES FOR PROJECTS

Mobile Phone Coverage

Mobile phone coverage is required along the length of the North West Coastal Highway and the Minilya – Exmouth Road. Other areas requiring coverage include the western side of the North West Cape and Learmonth Airport which acts as an international terminal and emergency runway for international flights to Perth. As well as for business and personal use, mobile phone coverage is needed for safety purposes.

10.3 CORAL BAY

CURRENT STATUS OF COMMUNICATIONS

BROADBAND CAPABILITY

Fibre

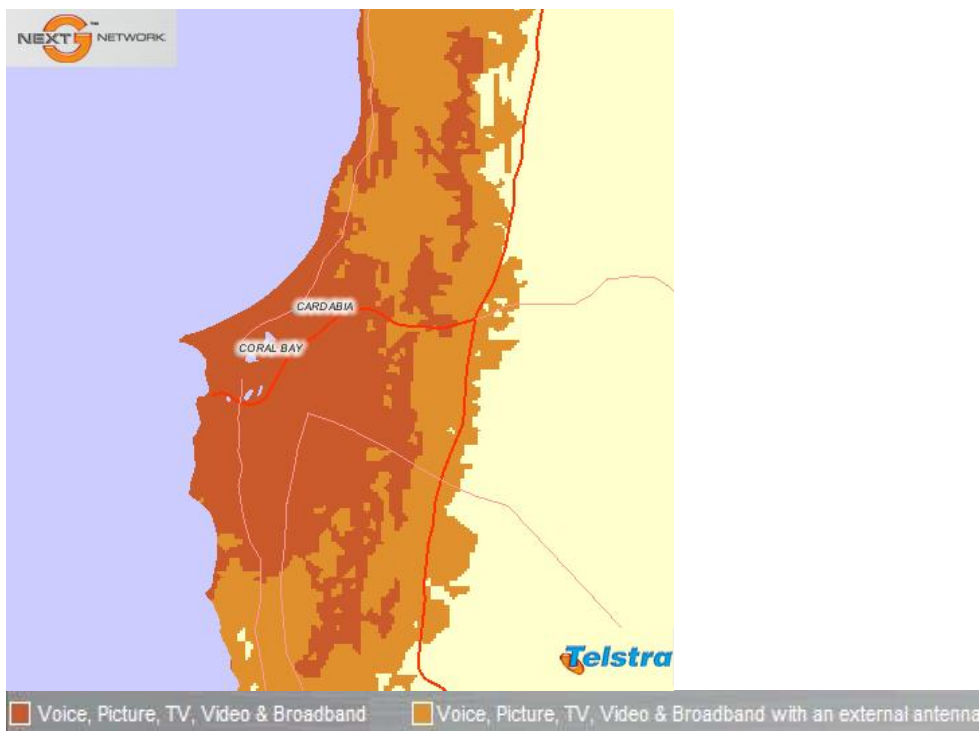
Coral Bay is supported by the same fibre that runs into Exmouth.

Exchange Information

Coral Bay is run off the Yaringa exchange.

ADSL Availability

ADSL is not available in Coral Bay.



Map of Mobile Phone Coverage Around Coral Bay.

Wireless Internet Coverage

Telstra is the only Wireless Internet provider in Coral Bay.

EXISTING PROJECTS

A grant was acquired from the ABC to install a TV and radio tower in Coral Bay. This was completed in mid 2007; however, the current equipment is not strong enough to broadcast to the outer extremities of the town. There are currently four one watt transmitters installed for television.

The contractor commissioned to install the current equipment has advised the need for a five watt four way transmitter to ensure the town receives an adequate signal.

OPPORTUNITIES FOR PROJECTS

Upgrade Television and Radio Transmission Capacity

As mentioned above, an upgraded system of transmitters for TV and radio could be completed at minimal expenditure.

Multi-Use Telecommunications Centre

A multi-use Community Resource Centre has been proposed and funding is being sought.

10.4 DENHAM

CURRENT STATUS OF COMMUNICATIONS

BROADBAND CAPABILITY

Fibre

Fibre from Telstra's network branches off from the main ring and runs into the town of Denham.

Exchange Information

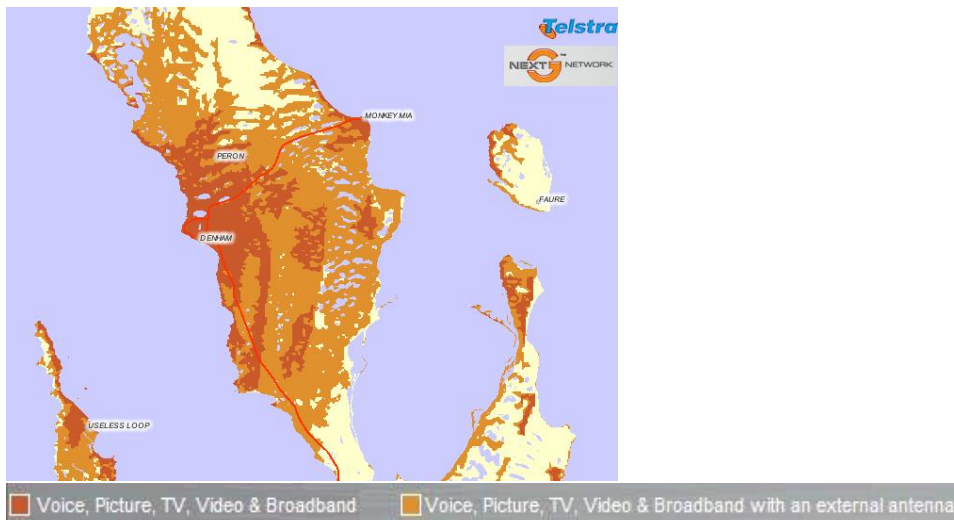
Denham is supported by one exchange (DNHM).

ADSL Availability

There are a number of providers for ADSL 2 in Denham. ISP's have the option of utilising Telstra's network to re-sell.

Wireless Internet Coverage

Telstra NextG is the only 3G enabled network in Denham. Optus provides access via their 'yes'G Network (maps unavailable).



Map of Mobile Phone Coverage Around Denham.

OPPORTUNITIES FOR PROJECTS

Mobile Phone Coverage

Mobile phone coverage requires expanding in Denham. An improved service is also required at Useless Loop. As well as for business and personal use, mobile phone coverage is needed for safety purposes.

10.5 UPPER GASCOYNE

CURRENT STATUS OF COMMUNICATIONS

Telstra has communications facilities in the Shire of Upper Gascoyne to service Burringurrah, Gascoyne Junction and the pastoral stations.

The Gascoyne region's telecommunications infrastructure is predominantly Telstra owned with the exception of mobile communications in some of the major town sites. The main fibre optic link, owned by Telstra, following the North West Coastal Highway runs past four out of five of the key settlements for the region. This allows good access to telecommunications services for these towns.

Due to the remoteness of a majority of pastoral stations in the Gascoyne, Telstra has deployed the Digital Radio Concentrator System (DRCS) to meet its Universal Service Obligations. This system provides a basic telephone service to remote stations and communities such as Burringurrah where mobile phone communication is not available. The DRCS system underwent a major overhaul in the past five years but does not have the capacity to carry high speed data services. This results in a vast swath of the Gascoyne region relying on satellite services for internet access.

Due to the remoteness of most of these customers, they are eligible to apply for a subsidised service from a qualifying Australian Broadband Guarantee Internet Service Provider. The Australian Broadband Guarantee provides all Australian residential and small business premises with access to broadband services that reasonably compare to broadband services available in metropolitan areas (metro-comparable).

The major issue facing a majority of consumers in this Region is the cost of an internet service. A 2008 submission by the then Department of Industry and Resources to the Regional Telecommunications Independent Review (RTIR) commissioned by the Commonwealth Government stated that the cost of providing a service on the same fibre optic that runs from Perth to Port Hedland as being around \$2,500 per month per Megabytes per second (Mbps) compared to a cost of Sydney to Perth of \$350 per month per Mbps. This higher cost is delivered onto the consumer in ways of more expensive and less competitive internet plans.

In 2008, the Commonwealth Government through the Department of Broadband, Communications and the Digital Economy funded the Pilbara Development Commission through the Clever Networks Program to investigate broadband services in the Pilbara and Gascoyne regions, make recommendations about issues faced in the Region and present opportunities for improved services. The study was completed in 2009.

Further to this, in early 2010 the Gascoyne Development Commission working in consultation with the Gascoyne's four local governments finalised the Gascoyne Regional Development Plan 2010- 2020. The plan details major initiatives and projects required in the Gascoyne to enhance the Region's economic and social development. Ninety three projects were identified, twenty of which were classified as Flagship

projects defined as *'absolutely essential to the Gascoyne region and need to be progressed substantially or completed within the next five years'*. Mobile phone coverage throughout the Gascoyne was identified as a Flagship project.

The remote Burringurrah community has a Community Resource Centre, however it is presently underutilised. Although an ideal location for videoconferencing (rural/ remote) the cost of operating VC equipment via satellite is cost prohibitive for the community. Internet services are available by 'dial up' or satellite connection.

The Shire of Upper Gascoyne is currently in negotiations to build a new Community Resource Centre in Gascoyne Junction.

GASCOYNE JUNCTION - BROADBAND CAPABILITY

Fibre

No fibre runs into Gascoyne Junction.

Exchange Information

Gascoyne Junction is connected to the Upper Gascoyne exchange. Services are provided to the town via an analogue radio system. This connection has capacity to provide wireless/ADSL coverage to the town.

ADSL Availability

ADSL is not available in Gascoyne Junction.

Wireless Internet Coverage

There is no wireless internet coverage in Gascoyne Junction.

BURRINGURRAH - BROADBAND CAPABILITY

Fibre

No fibre runs into Burringurrah.

ADSL Availability

ADSL is not available in Burringurrah.

Wireless Internet Coverage

There is no wireless internet coverage in Burringurrah.

OPPORTUNITIES FOR PROJECTS

Mobile Phone Coverage

As well as for business and personal use, mobile phone coverage is needed for safety purposes. This is a very remote part of the Region that is experiencing increasing tourist visitation. Consideration is also being given to developing a resort in the Shire.

11. FLOOD MITIGATION

11.1 CARNARVON

CURRENT STATUS OF FLOOD MITIGATION WORKS

In 2000, flooding in the Lower Gascoyne caused approximately \$20m in damages. Similar floods occurred in 1960, 1980 and 1995.

Stage one of the Carnarvon flood mitigation works is completed. This stage included the construction of two flood-ways south of Brown Range on North West Coastal Highway (NWCH).



NWCH and the Plantation Area 2000

Stage two comprises the remaining flood mitigation works which need to be completed as a single project in order to be effective. The total estimated cost of stage two is approximately \$45m, however due to rising costs this figure has changed twice since 2008 and needs to be confirmed.

OPPORTUNITIES FOR PROJECTS

Carnarvon Flood Mitigation Strategy

This project includes the completion of the flood mitigation strategy to protect town and industry assets. A later Stage of the project includes consideration of developing land south of NWCH and east of Brown Range by relocating the NWCH levee banks 500 metres south of the highway.



South River Rd after Flood recedes

Land Development

With the completion of the planned flood mitigation works, a large area of Carnarvon that is adversely affected by flooding from the river will either be more protected or be less affected by flooding than in the past.

This may lead to opportunities for increased development of land in the Kingsford and Grey's Plain areas of Carnarvon. The location of the southern levee will also open up some 400 ha south of the highway for possible horticultural development as the land in question will no longer be inundated to the extent it is at present.

Transport and Tourism

The construction of the flood mitigation works, aligned with the new bridge over the Gascoyne River, should result in road closures due to flooding being less frequent and

of shorter duration. This will result in the NWCH being open to all traffic much more quickly than has been the case until now. The NWCH is the main north south coastal artery servicing the Gascoyne and the Pilbara from Perth and Geraldton. Road closures are an expensive exercise for businesses that rely on road transport, particularly tourism and heavy transport.

The roadhouses at the intersection of Robinson Street and NWCH will no longer be put out of commission for extended periods of time as they will be fully protected.

11.2 EXMOUTH

CURRENT STATUS OF FLOOD MITIGATION WORKS

Flood mitigation works in Exmouth are required.

The levee banks raised to protect the harbour are considered to be of poor design and far too low to be effective in the type of event already experienced. The levees could in fact add to the damage if they are overtopped during a major event. Failure of the levees would increase the flow rate and volume of water impacting the harbour.

Mitigation works around the light industrial area are simple bunds of dirt and rock pushed up and do not comprise a well designed and constructed protection system.

A report on the engineering findings is available at the Exmouth Shire website.



Reid Street Floodway

EXISTING PROJECTS

The Shire currently maintains the existing levees and the breakout south of the harbour in an attempt to provide as much protection as possible within current funding constraints.

Floodways in Reid Street are due for upgrading to better handle flows experienced in the recent past.

OPPORTUNITIES FOR PROJECTS

Exmouth Flood Mitigation Works

This project includes completion of flood mitigation works at two locations including the Light Industrial Area (Reid Street) and Market Street. This project is essential to protect the light industrial area and ensure a large proportion of the main road out of Exmouth is not washed away. A flood study and Market Street design is complete and ready.

Murat Road Causeways

The floodways across Murat Road/Minilya - Exmouth Road can isolate residents and emergency services from evacuation possibilities as well as access to Learmonth Airport in the event of an emergency landing of aircraft as has happened twice in the recent past. While emergency services were able to access Learmonth Airport on both occasions, it has highlighted the strategic location of Learmonth for international aircraft during an emergency. All weather access to the airport from Exmouth is a critical factor in the positive resolution of such an emergency.

11.3 CORAL BAY

There are no known issues with flooding of Coral Bay. However being close to sea level, Coral Bay is prone to flooding and damage from tidal storm surge during cyclonic activity.

CURRENT STATUS OF FLOOD MITIGATION WORKS

There are currently no flood mitigation works or projects in progress. The GDC is unaware of any planned flood mitigation works in the future.

11.4 DENHAM

Similarly to Coral Bay, Denham does not have a flooding problem associated with rain or rivers. It is however prone to tidal storm surge during cyclonic activity and damage has been suffered by properties along Knight Terrace in the past.

CURRENT STATUS OF FLOOD MITIGATION WORKS

Upgrading of Knight Terrace in recent years has raised the road surface marginally and some protection is afforded to properties along the foreshore. It is however inadequate should a cyclone pass close by coinciding with high tides.

EXISTING PROJECTS

The GDC is unaware of any existing projects.

OPPORTUNITIES FOR PROJECTS

Raising of a bund or sea wall along Knight Terrace could be an option, but would not be acceptable to most as it would destroy the visual amenity for existing residents along the Terrace.

11.5 UPPER GASCOYNE

CURRENT STATUS OF FLOOD MITIGATION WORKS

Gascoyne Junction has suffered from flooding many times in the past, however the majority of residences affected are few. Most flood damage is incurred by the historic landmark, the Gascoyne Junction Hotel, which proudly displays the flood levels above the bar from many previous floods.

Short of relocating the hotel to higher ground, flood mitigation is not seen as a high priority in the community at this stage.

EXISTING PROJECTS

There are currently no existing or planned projects.

12. HORTICULTURE

CURRENT STATUS OF INFRASTRUCTURE

The Horticultural industry in the Gascoyne is conducted predominantly at Carnarvon in the Carnarvon Irrigation Area (CIA). The CIA is centred on the banks of the Gascoyne River extending from its mouth 19km inland.

Grapes and other crops are grown in small volumes at Wooramel and Gascoyne Junction. A date palm plantation was established some years ago in Gascoyne Junction but the majority of the plantings have died due to lack of suitable maintenance.

Some pastoral leases have widened their scope of operations to include wild flowers, sandalwood, corn and other broad acre crops and all have had varying degrees of success to date.



Gascoyne River with Plantations on Either Side Leading to Carnarvon's Town Site and Indian Ocean.

Carnarvon is a major centre for winter vegetables, tropical and sub-tropical fruit production. The semi-arid, sub-tropical climate of Carnarvon is suited to growing a range of tropical and sub-tropical fruits and vegetables. The major crops are bananas, table grapes, tomatoes, capsicums, avocados and mangoes.

These crops take advantage of the Region's sub-tropical climate enabling it to supply produce to the Perth market out of season with traditional production areas.

The area zoned for intensive horticulture in Carnarvon is approximately 2,000ha, with only 50 percent of the land actually under crop. In 2009, the crop was valued at \$76m compared to \$73m in 2008. Increased plantings and sales of bananas and table grapes are amongst the prime movers in this growth of economic return to the Region.



Bananas Plantation in Carnarvon

The Annual Production by Crop figures for 2008/ 2009 were as follows:

	2008	2008	2009	2009	% Change	% Change
Fruit Crop	Tonnes	Value	Tonnes	Value	Tonnes	Value
Avocado	15	61,666	32	122,125	108.8	98
Bananas	6,369	11,691,824	5,383	11,849,421	-15.5	1.3
Grape	1,865	9,648,012	1,649	11,092,504	-11.6	15
Grapefruit	254	389,171	258	422,425	1.4	8.5
Mango	1,607	4,705,221	1,413	4,340,793	-12.1	-7.7
Pawpaw	236	485,032	116	270,016	-50.7	-44.3
Other Fruit	155	809,878	155	923,285	0.2	14
TOTAL FRUIT	10,502	27,790,804	9,007	29,020,570	-14.2	4.4

	2008	2008	2009	2009	% Change	% Change
Vegetable Crop	Tonnes	Value	Tonnes	Value	Tonnes	Value
Basil	102	117,332	104	118,829	1.7	1.3
Beans	326	2,166,024	382	2,536,195	17.2	17.1
Butternut	612	586,672	582	671,392	-4.9	14.4
Capsicum	3,217	10,052,278	4,143	9,237,733	28.8	-8.1
Chilli	213	1,325,643	283	1,194,999	32.4	-9.9
Cucumber	1,025	2,519,693	1,188	3,155,155	15.9	25.2
Eggplant	633	1,456,945	737	1,857,813	16.4	27.5
All Melons	6,669	6,157,312	8,303	7,627,612	24.5	23.9
Pumpkin	2,490	2,050,210	2,165	1,656,340	-13.1	-19.2
Sweetcorn	440	813,600	431	718,641	-2.1	-11.7
Cherry Tomato	1,424	5,172,506	1,899	6,985,716	33.3	35.1
Tomato	5,144	9,114,700	5,853	7,344,377	13.8	-19.4
Zucchini	1,553	2,703,628	1,770	2,975,215	14	10
Other Veg.	142	820,355	180	706,030	27.1	-13.9
TOTAL VEG.	23,991	45,056,898	28,020	46,786,047	16.8	3.8

TOTAL FRUIT & VEG.	34,493	72,847,702	37,027	75,806,617	7.3	4.1
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2008 – 2009 Carnarvon Plantation Industry Production Statistics provided by Department of Agriculture and Food WA

HISTORY

Security of water supplies has been a huge factor in the revitalisation of the industry over recent years. Prior to the move to local ownership of the irrigation distribution system, growers received water from a Government owned enterprise.

Most growers have access to private bores located in “prolongations” of their property side boundaries out to an imaginary centre line in the river.

The business of irrigation water distribution was transferred to growers in 2003 and the distribution assets were transferred in 2004. The bore field remains in the hands of the Water Corporation as this is also the source of the town water supply for Carnarvon.

The increased security of supply resulting from the contracts between Water Corporation and Gascoyne Water Co-operative has seen an expansion of land under crop, where growers see the risks associated with loss of water supplies at critical times being greatly reduced.



The Gascoyne River in Flood

BETA CAROTENE

Beta Nutrition is located on Lake MacLeod and was intended to produce beta carotene, a substance extracted from algae (plant) grown in highly saline water. While not strictly horticulture, the product is a plant form of algae, grown with fertilizer and harvested on a continuous basis.



Beta Nutrition's Beta Carotene Growing Ponds

When eaten, Beta Carotene, or Pro-Vitamin A, gradually converts the Beta Carotene into Vitamin A. Natural Beta Carotene is completely non-toxic and is safe to eat in any quantity.

The plant had reached a successful conclusion to the pilot project and is ready to expand into larger growing ponds and commercial production.

Broad Acre Crops

Over recent years, there have been projects initialised to trial corn, sandalwood and other crops on a larger scale on pastoral leases, using artesian water and other groundwater sources. Anecdotal evidence would suggest that due to the high Total Dissolved Solids (TDS) of the water used, one or two seasons of corn followed by a season of melons or other more salt tolerant crops will lead to a build up of salts that make the ground unsuitable for other crops.

Switching to perennial crops such as sandalwood will not be successful once rain drives the surface salts, deposited during the earlier plantings, down to the root zones. Combining Sandalwood with a host plant such as Horseradish Tree or Pongam



Seeds Ripening on Sandalwood

Tree may serve the dual purpose of providing a host to the sandalwood and a productive oil seed crop at the same time.

Horticultural experts believe that weather stations should be installed in these potentially productive areas so that wind, temperature and other factors can be collected and matched with the water quality to determine suitable crops and to avoid the “suck it and see” methods that are currently being applied.

Burringurrah

In the past, successful fruit and vegetable gardens have been funded at Burringurrah, but have yet to be realised as a viable source of fresh fruit and vegetables to the community.

Mt Augustus

The Mt Augustus area has a capability for horticulture development provided that fresh groundwater of sufficient quantity and quality is developed near to areas of deep soil, that management is of sufficient quality and judicious selections of crops are made.

Consideration of horticultural options for Mt Augustus can therefore be divided into three broad areas;

- Community Gardens - supplying communities and settlements with fruit and vegetables and incorporating training and social components.
- Commercial Horticulture – horticultural products for which production methods and costs are well established, where markets exist and where management expertise is available.
- New Productive crops – new and innovative crops that are being investigated for introduction into Western Australia and other less well established new crops.

Department of Agriculture and Food Western Australia (DAFWA) commissioned a study of the water supply in the vicinity of Mt Augustus to identify sources of water that could supply potential horticultural areas. The study indicated that the water tested was suitable for irrigation, albeit with some impurities that would limit choice, and that a commercial area of one hundred hectares could be irrigated.

Currently DAFWA is in the process of determining their resource capability to make recommendations about the location, design and ongoing monitoring options for a weather station in the Mt Augustus area.

EXISTING PROJECTS

Gascoyne Food Bowl Initiative

This is a State Government initiative to maximise opportunities for the industry and includes the investigation of opportunities to expand the industry through infill development, amalgamation of blocks and the release of new land for agriculture. Any expansion depends on the availability of water and the expansion of the Carnarvon borefield.

13. MINING

13.1 CARNARVON

Texada Mines was formed in 1965 primarily to produce potash with salt production as a by-product. Construction was completed and initial salt shipments commenced in April 1969. Dampier Salt took over the venture in 1978 and began operating the field. In 1990 Lake MacLeod field capacity expanded to 1.5m tonnes. The opening ceremony for the Lake MacLeod gypsum operation was in June 1997. In August 1997 the first shipment of 40,000 tonnes of gypsum were exported to Yoshino Gypsum in Japan. By December 2004, gypsum sales exceeded 1.3m tonnes for the year. In February 2006 Rio Tinto Minerals was formed between Dampier Salt, US Borax and Luzenac Talc to leverage Rio Tinto's global presence. The 10 millionth tonne of gypsum was shipped from Lake MacLeod in January 2007. August 2007 saw Lake MacLeod expanded to 1.9m tonnes of salt per year.

At Lake MacLeod, brine comes from a natural salt-rich aquifer lying below the surface of the lake. Evaporation, due to the energy of the sun and assisted by the wind, results in the water becoming progressively more concentrated. When this brine is saturated with salt (sodium chloride), it is pumped into crystallising ponds (crystallisers) where further evaporation causes salt to crystallise as a solid deposit. The brine which remains after most of the salt has crystallised is called bitterns, and this is returned to the ocean.



Ship to Shore and Aerial View Photos of the Lake MacLeod Ship Loading Facility.

About once a year, each crystalliser is harvested by a mechanical harvester after 20 to 40 centimetres of salt has been deposited. The salt is washed to remove impurities and stockpiled for shipment.

Salt produced at Lake MacLeod is shipped from dedicated stockpiling and shipping facilities located at Cape Cuvier.

CURRENT STATUS OF MINING INFRASTRUCTURE

Lake MacLeod Operation

The saturated brine contained in Lake MacLeod is approximately 10 times saltier than normal seawater, eliminating the need for a series of concentration ponds normally required to evaporate water to reach "salting" point (sodium chloride saturation). A 7.1 km four metre deep collection ditch has been cut into the halite layer to recover brine from Lake MacLeod. The brine is pumped at an average rate of 55 cubic metres per minute from the collection ditch into 8.5 km of transport channel to a common collection point before being pumped into the crystallisers.

A total of 1,650 hectares of evaporators have been constructed on Lake MacLeod. Over 20 crystallisers averaging 20 hectares each are used for salt production. The excess area is used to store residual brine containing other dissolved salts.

The crystallisers for salt production have a 300 mm thick salt pavement to support the equipment used in the harvesting operation and to prevent contamination of the salt during harvesting. Deposition is stopped by draining the remaining brine when about three quarters of the sodium chloride has been deposited and before other dissolved salts come out of solution in significant quantities. The residual brine called bitterns contains high concentrations of potassium, magnesium and other salts and is a potential source of these minerals.

Harvesting of salt is carried out using a laser controlled salt cutter with an average capacity of 1,000 tonnes per hour discharging directly into three 60 tonne trailers hauled by a prime mover. Laser equipment enables accurate control, leaving an even surface for the next year's growth of crystals. After harvesting, the crystallisers are cleaned and refilled with brine. To ensure high quality salt with a minimum of impurities, the harvested salt is washed with saturated brine at the wash plant. This removes the soluble impurities (magnesium, sulphate and chloride) and the insoluble solids (gypsum and soil).

The washed salt is drained on stainless steel mesh belts before being conveyed to the washed salt stockpile. The salt drains in this stockpile for approximately two months for the moisture content to decrease below 2.5 percent. Dry salt is hauled by road trains of up to 240 tonne capacity, 24 km to a 200,000 tonne stockpile at Cape Cuvier for shipment.

Reclaim for ship loading is by dozers which push the salt into a hopper, which feeds onto the ship loading conveyor. Ships are held in position beneath the ship loader by mooring lines attached to six buoys and are positioned under the ship loader by the vessel's own winches.

Process Overview - Lake Macleod 2008 Salt Field Data:

- Current production capability is 2m tonne per year;
- Average fresh water evaporation is 3,000mm per year;

- Average ship loading rate of 2,500-3,000 tonnes per hour;
- Total Lease Area is 219,200h;
- Peak ship loading rate is 3,300 tonnes per hour;
- Berth depth at low water 18 m;
- Average rainfall is 240mm/year; and
- Salt deposited in crystallisers is 200 mm per year.

EXISTING PROJECTS

Increased Salt Production

Rio Tinto Dampier Salt Ltd has intentions to increase annual salt production from the current 2.0m tonnes by a factor of two or three. This increase to 4.0 – 6.0m tonnes comes with an associated increase in the size of bulk carriers loading at the Cape Cuvier ship loading facility. The flow on aspect of this is that larger, more powerful tugs will be required to manoeuvre the carriers at the mooring buoys. The tugs are likely to require a draft clearance of five metres or more and will be unable to use the Carnarvon Small Boat harbour for cyclone mooring or for repairs and maintenance. They will also be too big for the existing slipway. The lack of upgrading and redevelopment of the Small Boat Harbour could be a major barrier to this development of the largest mining asset in our Region.

13.2 EXMOUTH

LIMESTONE

Exmouth Limestone Pty (EXL) is owned by ASX listed company Adelaide Brighton (51%) and private company Whitecrest Enterprises (49%). EXL operates a quarry near Mowbowra Creek approximately 8.5kms south of the Exmouth town centre. EXL has been granted approval to develop a Barge Load-out Facility (BLF) to a depth of 6m adjacent to Murat Road, on an 18ha industrial zoned block. EXL is now investigating funding opportunities to progress the BLF, with the potential to use the facility to integrate a common user marine supply base development to support the current and future offshore oil and gas projects.

OIL AND GAS

Woodside

Woodside is an Australian publicly traded oil and gas exploration and production company, with a global perspective on energy supply. Based in Perth, Western Australia, Woodside has major operational assets and exploration and development interests in five continents including Australia and the United States.

EXISTING PROJECTS

In the Greater Exmouth area, Woodside operates and has a 60% interest in the Enfield and Vincent oil fields and has a 50% interest in the nearby Stybarrow oil field.

Enfield

The A\$1.48 billion Enfield project in Western Australia started production in July 2006. Oil is produced through five subsea wells connected to the floating production storage and offloading vessel, *Nganhurra*. The vessel has a maximum design production rate of about 100,000 barrels per day and a storage capacity of about 900,000 barrels of oil.

Enfield, a substantial oil resource, was discovered in 1999 along with the nearby Vincent and Laverda oil fields.

The project, discovered in 1999, is located 50km north-west of Exmouth in a water depth of 600m. Joint ventures in this project are Woodside (operator) with 60% equity and Mitsu E&P Australia Pty Ltd with 40% equity.

Stybarrow

The Stybarrow oil project in Western Australia started production in November 2007. The project involves a subsea development and a FPSO (floating production, storage and offloading facility). The facility has a design production capacity of 80,000 barrels of oil a day and will have a storage capacity of 900,000 barrels.

The Stybarrow discovery is part of a new oil province in the deep waters off North West Cape, which includes Woodside's Enfield, Vincent and Laverda discoveries. The

Stybarrow FPSO (floating production, storage and offloading vessel) is the second producing asset off North West Cape, after the *Nganhurra* FPSO on the Enfield field.

The project, discovered in 2003, is located 50km north-west of Exmouth in a water depth of 800m. Joint ventures in this project are BHP Billiton (operator) with 50% equity and Woodside with 50% equity.

Vincent

The Vincent oil project started production in August 2008. Vincent was discovered in 1998 and is about 50km north-west of Exmouth, in Western Australia. Oil is produced through eight (four dual lateral) wells connected to the Maersk *Ngujima-Yin* FPSO.

The project, discovered in 1998, is located 50km north-west of Exmouth in a water depth of 350m. Joint ventures in this project are Woodside (operator) with 60% equity and Mitsu E&P Australia Pty Ltd with 40% equity.

BHP

Pyrenees

First oil production commenced ahead of schedule from the BHP Billiton operated Pyrenees project in the first quarter of 2010. The full project involves 13 subsea wells, an extensive subsea gathering system and a FPSO facility with production capacity of approximately 96,000 barrels of oil, and gas reinjection capacity of 60 million cubic feet of gas per day (100 per cent basis). As planned, the wells will be drilled and brought on in phases, with approximately half the field ramping up from first oil and the other half over the following six months.

The Pyrenees FPSO is a double-hulled vessel with a disconnectable turret mooring system. Gas produced by the development will be reinjected into the reservoir of the nearby Macedon gas field for future recovery. The project is located in production license area WA-42-L. The joint venture partners are BHP Billiton (71.43% and Operator) and Apache Corporation (28.57%).

Ravensworth

Part of the Ravensworth field is located in production license WA-43-L where operator BHP Billiton, Operator, holds 39.999%. Other joint venture partners in WA-43-L are Apache Corporation (31.501%) and INPEX (28.5%). This separate segment of the Pyrenees project will have its own wells and gathering system.

A commercial arrangement has been made between the WA-42-L and WA-43-L Joint Ventures, whereby oil from production license WA-43-L will be produced into the WA-42-L owned facility via a tie-in agreement. Production from the WA-43-L areas will commence in late 2010.

Macedon

The Macedon gas field is located in offshore WA-42-P; formerly Retention Lease WA-12-R. The field is situated in the Northern Carnarvon Basin, approximately 90km west of Onslow and 40km north of Exmouth, Western Australia.

Project Information includes:

- Project Location is 90km west of Onslow, WA;
- Project Manager is BHP Billiton Petroleum;
- Project Owner is BHP Billiton Petroleum and Apache Corporation;
- Construction period is scheduled for the third quarter of 2010 to the last quarter of 2012;
- Project status is a Front End Engineering Design (FEED); and
- Project Constructor and the project value are yet to be announced.

The license for WA-42-P is held jointly by BHP Billiton Petroleum (71.43%) and Apache Energy Australia (28.57%). BHP Billiton Petroleum, as operator of offshore permit area WA-42-P, proposes to develop the Macedon gas field in to produce domestic gas for use by Western Australian consumers.

The Macedon Project includes the following components:

- Four initial subsea wells, manifold, 20" subsea wet gas pipeline and umbilical to shore;
- Onshore Gas Plant (OGP) for dehydration, dew pointing, water and condensate treatment and sales gas compression;
- Sales gas pipeline from OGP to Dampier to Bunbury Natural Gas Pipeline tie-in; and
- Onshore infrastructure including Construction Camp and Access Road to site.

EXPLORATION PROJECTS

Furness

BHP is progressing plans to drill the Furness commitment exploration well. The *Ocean Epoch* Offshore Drilling Unit (MODU) will be used for this activity and is expected to be carried out following the Pyrenees campaign.

Black Pearl – 1

BHP is progressing activities related to the drilling of the Black Pearl-1 exploration well. Exact timing of the well is yet to be determined. Ocean Epoch MODU to be used to conduct the activity which is expected to take around 12 days.

Apache Corporation

Apache Energy Limited (Apache), on behalf of the Van Gogh joint venture participants, has developed an oilfield, known as Van Gogh, off the Exmouth coast.

Van Gogh Location

Exploration permit WA-155-P(1) has been obtained by Apache who will seek approval for a production licence. The site includes the following details:

- In the Exmouth Sub-basin (Commonwealth waters), and is part of the Carnarvon Basin on the North West Shelf;
- Water depth in development area varies between 340 – 370m; and
- Located 30 km from Ningaloo Marine Park boundary, 35 km from Muiron Islands Marine Management Area, 42 km from Muiron Island South, 45 km from Ningaloo Reef proper, 45 km north-north-west from North West Cape, 53 km north-north-west from Exmouth.

Development Costs for construction are over \$1 billion and first oil was achieved in February 2010.

The FPSO vessel – *Ningaloo Vision*, is a double-sided hull (but no double bottom), which can receive reservoir fluids (oil and water) and associated gas. Production will be in the order of 23.8ML (150,000bbls) fluid per day. The FPSO is designed for a 15 year life period without docking.

OPPORTUNITIES FOR PROJECTS

While Oil and Gas development is ongoing, opportunities for provision of support services to the engineering and maritime industries are potentially great prospects.

Salt Mining

There are further prospects of salt mining on the east side of the Exmouth Gulf.

13.3 CORAL BAY

There is no known current or planned mining activity in the Coral Bay area.

13.4 DENHAM

Salt

Situated around 830 kilometres north of Perth in the Shark Bay World Heritage area, the 7,000 hectare Shark Bay salt field may be in the perfect environment for harvesting "crystal clear" solar marine salt. The fiercely protected pristine seawater from which the salt is derived, extremely low rainfall and the strong Australian sun are certainly major natural advantages.

Securing Stable Salt Supply

With surging demand in China for salt for use in the chlor-alkali industry placing greater pressure on salt supply, Mitsui and Co. took two decisive steps, making Shark Bay Salt Joint Venture a wholly owned subsidiary in 2005 and acquiring Onslow Salt Pty Ltd. in 2006.

Emerging Demands on Salt

The world of salt extends far beyond the saltshaker on your table or salt's traditional use as a preservative in food processing. In Japan, for instance, table salt and salt for food



Useless Loop Salt Fields



manufacturing and so forth account for only around 20 percent of salt use, with the remaining around 80 percent being used as a raw material for production of caustic soda, chlorine and soda ash in the chlor-alkali industry.

Caustic soda is used in the manufacture of pulp and paper, textiles, soaps and detergents. Chlorine's applications include the extremely versatile polyurethane plastics used in automobile components, PVC (polyvinyl chloride) employed as a building material, water purification and as a disinfectant. Soda ash is used most commonly in the production of glass.

Since salt is a raw material for many commodities, demand for it is closely tied to economic growth and performance. In China, rapid economic development and the emergence of Chinese chlor-alkali manufacturers has led to soaring demand for industrial-use salt, to the extent that in 2004 China shifted from being a net exporter to a net importer of salt. As a result of such rising demand for salt in China, supply has become tight in Asia.

CURRENT STATUS OF MINING INFRASTRUCTURE

Salt

Mitsui's policy is to increase sales of Shark Bay salt to the food production market in Japan, where it can show its distinctive strengths. Shark Bay Salt's harvesting process is natural and environmentally friendly, using only the wind and the heat of the sun. It also creates high-quality salt, which has won plaudits from Japanese soy sauce

manufacturers and tsukemono pickle producers who value it for its texture, and marine product processors, many of whom refuse to use any other salt. Shark Bay salt is also sold for food use in Taiwan, Indonesia and the Philippines.

EXISTING PROJECTS

Shell Grit

Shell is mined at Shell Beach by a small contractor. The grit is harvested for grit for birds such as shell grit for chickens etc. Block grit has also been mined as evidenced by the Old Pearler Restaurant and church constructed of the material in Denham.

OPPORTUNITIES FOR FUTURE PROJECTS

Mineral Sands

Gunson Resources proposes to develop the Coburn mineral sands project located south of Shark Bay. It contains total ore reserves of 308Mt at an average grade of 1.2% heavy minerals, all of which lie within the portion of the project area that has received government environmental approvals for mining.

At the proposed mining rate of 17.5Mtpa, the Coburn mine life is estimated to be 17.5years which could be extended by six years if the northern area receives government approvals for mining.



The Definitive Feasibility Study was completed in December 2009 and Gunson is now working towards completing a zircon offtake and investment agreement with a large overseas zircon consumer. Expenditure on the project is expected to be \$169m, with 170 staff employed during construction reducing to 110 staff during operations.

13.5 UPPER GASCOYNE

Mineral production in the Shire of Upper Gascoyne area is varied. The southern Pilbara towns of Paraburdoo and Tom Price are home to significant multinational mining operations. In contrast, the inland Gascoyne has little mining development although there is considerable ongoing exploration.

Natural resources found in the area include gold, magnetite, rare earths, copper, lead, zinc, gems and semi precious stones, uranium, iron ore, barite, dimension stone, tin, tantalum, lithium and traces of hydrocarbons and diamonds. Exploration is underway into the pre feasibility planning for magnetite found in the Dooley Downs vicinity.

In the Kennedy Range National Park and Proposed Additions Management Plan N°59 2008, DEC states *“the Kennedy Range National Park planning area has petroleum potential, is actively mined for the semi-precious gemstone mookaite, and may contain a major heavy mineral deposit(s) on the western side of the Range.”*



Kennedy Range National Park

CURRENT STATUS OF MINING INFRASTRUCTURE

Should a large scale mining venture be proposed, Bejaling directly north of Carnarvon has been identified as a potential site for a deep-water port. In 1961 Harold Clough of Clough Engineering surveyed the coast between Port Gregory and Dampier identifying possible locations to construct ports for bulk salt. Bejaling was identified along with Useless Loop and Cape Cuvier. The latter two locations were subsequently developed for the transportation of salt.

In 2009, the Gascoyne Development Commission formed a steering committee to revisit the Clough Engineering study to determine if there is a suitable area for a deep-water port between Carnarvon and the Blowholes, this includes the Bejaling area. With ports in the Pilbara region working at capacity, the Commission viewed that further investigations into the preliminary Clough studies would place the Region at a strategic advantage should a large scale mining venture eventuate.

In 2010 consulting firm AECOM Australia Pty Ltd was engaged to provide a detailed report into the future feasibility of a deep water port north of Carnarvon that encompasses the general suitability of the area for a deep water port as well as the current and possible future exports from the proposed port. The results of this study are due to be finalised in the latter part of 2010.

EXISTING PROJECTS

There are some minor mining operations in the Upper Gascoyne area, but nothing that would be considered a major project.

OPPORTUNITIES FOR PROJECTS

Given the significant mining resources in the inland Gascoyne, there is potential for commercial mining to be established in the future. However, the GDC is not aware of any project close to fruition.

14. REFERENCE INFORMATION

14.1 GASCOYNE REGION AIRSTRIPS & THEIR RFDS STATUS

RFDS Serviceable Y/N If blank – not listed by RFDS	Airstrip Name	Day/ Night D/N RFDS	Lighting	Latitude	Longitude	Elevation Feet AMSL	Phone	Strip directions and Lengths in Metres	Listed in WA Country Airstrip Guide 27 th Edition March 2008	Strip Surface and comments
Y	Ashburton Downs RFDS	D	Nil	23° 22.851'S	117° 01.535'E	775	0891898161	12-30 800, 18-36 600	Y	Unsealed Beware of livestock. Capricorn Range South of field. Permission required
Y	Ashburton Downs Homestead		Nil	23° 24.348' S	117° 04.974'E	795	0891898161	13-31 1200	Y	Unsealed Beware tall scrub. Capricorn range south of field
N	Beringarra		Nil	26° 02.691'S	116° 57.279'E	1155	0899812907	09-27 1000, 17-35 1200	Y	Unsealed loam Permission required
	Billabong Station		Nil	27° 25.058'S	115° 50.084'E	845	0899637986	02-20 1100	Y	Unsealed brown dirt. Not an all weather strip
	Billabong HS Hotel/Motel		Nil	26° 49.327'S	114° 36.676'E	445	0899425980	18-36 900	Y	Caution after rain
N	Bidgemia GSJ								N	L/W
	Boolarly Station		Manual	26° 59.335'S	116° 32.211'E	1080	0899637987	03-21 1000, 15-33 1100	Y	Not all weather strip Permission required
Y	Bullala	D							N	
	Bulloo Downs Station		Nil	24° 00.846'S	119° 33.192'E	1895	0891757012 0891757013	03-21 800 09-27 1000	Y	Beware trees. Permission required
Y	Burringurrah	D/N								
Y	Byro	D/N								
	Cardabia Station		Nil	23°06.457'S	113°48.219'E	5	0899425935	04-22 800	Y	Coral Bay Strip 1.5nm away Permission required
Y	Carey Downs	D								(Marginal)
Y	Carnarvon	D/N								

RFDS Serviceable Y/N If blank – not listed by RFDS	Airstrip Name	Day/ Night D/N RFDS	Lighting	Latitude	Longitude	Elevation Feet AMSL	Phone	Strip directions and Lengths in Metres	Listed in WA Country Airstrip Guide 27 th Edition March 2008	Strip Surface and comments
	Carnegie Station		Flares by arrangement	25°47.840'S	122°56.534'E	1500	0899812991	11-29 1900 18-36 1100	Y	Beware livestock Permission required
N	Cobra		Nil	24°12.312'S	116°29.199'E	1225	0899430565	13-31 1500	Y	Unsealed Rolled gravel Beware livestock and traffic on road when landing runway 13 Dry weather only
Y	Coral Bay (Maud landing)	D/N	Portable emergency only	23°07.728'S	113°46.842'E	5	0899425935	02-20 1100	Y	Unsealed white crushed coral and clay Beware wind turbines.
Y	Dairy Creek	D								
	Dalgaranga Station		Nil	27°47.491'S	116°59.642'E	1435	0899637993 0897525555	03-21 1000	Y	Unsealed red loam Not currently maintained
N	Dalgety Downs		Emergency flares only	25°16.103'S	116°13.425'E	980	0899430531	09-27 1500 06-24 800	Y	Unsealed red dirt Permission required, but visitors welcome
	Diamond Well Station		Nil	26°11.042'S	119°32.250'E	1855	0899645978	09-27 1400 14-32 1000	Y	Now managed by DEC. Not maintained
	Doolgunna Station		Nil	25°41.914'S	119°11.712'E	1840	0899812968	02-20 900 11-29 900	Y	Unsealed red-brown gravel Now managed by DEC. Not maintained and dry weather only
	Doorawarrah Station		Nil	24°48.825'S	114°26.030'E	260	0899425949	14-32 600	Y	Beware Telecommunications aerial Permission required
Y	Edmund	D								
Y	Erong	D								
	Erong Springs Station		Nil	25°33.630'S	116°39.633'E	1300		13-31 1200	Y	Park at east end of strip

RFDS Serviceable Y/N If blank – not listed by RFDS	Airstrip Name	Day/ Night D/N RFDS	Lighting	Latitude	Longitude	Elevation Feet AMSL	Phone	Strip directions and Lengths in Metres	Listed in WA Country Airstrip Guide 27 th Edition March 2008	Strip Surface and comments
	Ethel Creek Station		Nil	22°53.150'S	120°10.246'E	1415	0891757008	08-26 1000 12-30 1000	Y	Permission required
	Eudamullah Station Homestead		Nil	24°26.601'S	115°36.577'E	765	0899430548	10-28 650 18-36 650	Y	Courtesy call required Beware telecommunications tower at homestead
Y	Eudamullah Station RFDS		Nil	24°26.347'S	115°39.027'E	800	0899430548	11-29 1600	Y	Unsealed red brown dirt
Y	Exmouth	D/N	Electric	22°02.481'S	114°06.130'E	30	0899491399	02-20 1400	Y	Landing fee payable Shire Ranger 0427491399
Y	Gascoyne Junction		Emergency flares only	25°03.306'S	115°12.156'E	490	0899430988	13-31 1200	Y	Sealed Shire after hours 0899430640
	Gifford Creek Homestead		Nil	24°02.868'S	116°13.095'E	1060	0899430576	13-31 890	Y	Permission required
Y	Gifford Creek Homestead		Nil	24°04.576'S	116°14.783'E	1085	0899430576	18-36 1890 Cross strip not in use	Y	Permission required Park on old cross strip
Y	Giralia Station	D	Nil	22°40.929'S	114°21.508'E	80	0899425937	10-28 900 18-36 900 18-36 900	Y	Unsealed red clay. Landing fee payable Permission required
Y	Glenburg	D								
	Gnaraloo Station		Nil	23°47.664'S	113°31.705'E	30	0899425927	03-21 900 17-35 600	Y	Unsealed gravel and hard clay Permission required
	Hamelin Station		Nil	26°25.265'S	114°12.727'E	110	0899425914	05-23 1500	Y	Unsealed red clay Beware livestock Cross strip unserviceable. Park near hanger. Permission required
Y	Innuendy	D								

RFDS Serviceable Y/N If blank – not listed by RFDS	Airstrip Name	Day/ Night D/N RFDS	Lighting	Latitude	Longitude	Elevation Feet AMSL	Phone	Strip directions and Lengths in Metres	Listed in WA Country Airstrip Guide 27 th Edition March 2008	Strip Surface and comments
N	Jimba Jimba GSJ									L/W
	Karijini National Park		Nil	22°29.228'S	118°28.092'E	2325	0891898157	10-28 1300	Y	DEC Managed. Permission required. Visitor centre 0891898121
N	Kooline									L
	Koonmarra Station		Nil	26°16.494'S	117°47.365'E	1510	0899812904	09-27 1000 18-36 500	Y	Beware buildings. Permission required
	Kumarina Roadhouse		Nil	24°42.726'S	119°35.886'E	2015	0899812930	09-27 1000	Y	Unsealed gravel and clay Accommodation available. Permission required
	Lake MacLeod Salt Mine		Nil	24°24.280'S	113°29.555'E	30	0899563256	17-35 1200	Y	Unsealed gravel. Beware power lines northern end. Permission required except emergency.
Y	Landor Race Course RFDS	D	By prior arrangement	25°07.293'S	116°56.311'E	1220	0899812911	18-36 1200	Y	RFDS Standard. Graded each year by Shire. Permission required. Note: There are 21 airstrips on Landor Station.
Y	Landor Station Homestead	D	By prior arrangement	25°07.750'S	116°54.000'E	1210	0899812911	09-27 800	Y	Permission required. Note: there are 21 airstrips on Landor
Y	Learmonth	D/N								
Y	Lyndon Station	D	Nil	23°38.616'S	115°14.160'E	725	0899430540	17-35 1000	Y	Unsealed natural gravel. Permission required
Y	Lyons River Station	D	Nil	24°37.624'S	115°19.822'E	615	0899430551	04-22 1200 18-36 700	Y	Unsealed clay/gravel Dry weather only. Permission required
	Madoonga Station		Nil	26°55.013'S	117°37.963'E	1635	0899815881 0899812941	06-24 1300 09-27 600	Y	Unsealed red dirt. Weld Range to south. Permission required.

RFDS Serviceable Y/N If blank – not listed by RFDS	Airstrip Name	Day/ Night D/N RFDS	Lighting	Latitude	Longitude	Elevation Feet AMSL	Phone	Strip directions and Lengths in Metres	Listed in WA Country Airstrip Guide 27 th Edition March 2008	Strip Surface and comments
	Manfred Outstation		Nil	26°26.641'S	116°32.655'E	1025	0899812913	04-22 1000 11-29 800	Y	Unsealed red. Caution: Road crosses 04-22. Beware telephone mast. Permission required.
N	Maroonah									W
Y	Marron	D/N								
	Middalya Station		Nil	23°54.412'S	114°45.883'E	435	0899430542 0899430648	09-27 1000	Y	Unsealed red clay. Dry weather strip only. Permission required.
	Mileura Station		RFDS emergency lighting by request	26°22.068'S	117°20.256'E	1320	0899812927	09-27 2000 18-36 1000	Y	Unsealed red loam. Stock hazard exists, Beware wildlife. Permission required
N	Milly Milly									W
	Mingah Springs Station		Nil	24°56.807'S	118°43.241'E	1730	0899812938	09-27 1000	Y	Unsealed natural red. Permission required
N	Minilya Station		Nil	23°51.155'S	113°58.685'E	45	0899425903	17-35 1000	Y	Unsealed red soil. Beware livestock, wildlife, washouts, and rough areas. Permission required.
N	Minnie Creek									W
Y	Moogoorie Station	D	Nil	24°03.617'S	115°11.603'E	705	0899430541 0899430617	06-24 1000 10-28 1200	Y	Unsealed brown dirt. Permission required.
N	Mooka									L/W
Y	Mooloo Downs Station	D	Nil	25°01.559'S	116°00.833'E	820	0899430571	09-27 1200	Y	Unsealed graded dirt. Do not use after heavy rain.
	Mooloogool Station		Nil	26°06.547'S	119°05.403'E	1745	0899645978	09-27 1000	Y	DEC. Not maintained. Suitable for emergency only. Permission required.

RFDS Serviceable Y/N If blank – not listed by RFDS	Airstrip Name	Day/ Night D/N RFDS	Lighting	Latitude	Longitude	Elevation Feet AMSL	Phone	Strip directions and Lengths in Metres	Listed in WA Country Airstrip Guide 27 th Edition March 2008	Strip Surface and comments
Y	Mt Augustus Station	D	Emergency battery lanterns only	24°18.060'S	116°54.331'E	1275	0899430577	12-30 1600	Y	Unsealed red gravel. Beware fences. Permission required.
	Mt Clere Station		Nil	25°05.653'S	117°35.413'E	1375	0899812943	18-36 900	Y	Unsealed red dirt. 18-36 is primary runway. Landing fee payable. Permission required.
	Mt Hale Station		Nil	26°07.047'S	117°30.902'E	1370	0899812923	11-29 1100	Y	Unsealed gravel. Permission required.
	Mt Narryer Station		Nil	26°35.361'S	115°56.016'E	980	0899637972	02-20 900 10-28 900	Y	Gravel and clay. Permission required. Park near windsock.
N	Mt Phillip									Too short
Y	Mt Sandiman	D								
	Mount Seabrook		Nil	25°35.732'S	117°43.016'E	1525	089812950	09-27 1200	Y	Talc mine. Unsealed brown earth. Beware radio tower and trees. Permission required.
	Mount Vernon Station		Nil	24°13.476'S	118°15.096'E	1335	0899812966	04-22 1000	Y	Unsealed red/brown gravel. Taxiway only available to single engine aircraft.
	Muggon Station		Nil	26°36.885'S	115°32.868'E	850	0429117108	04-22 900	Y	Unsealed. Managed by DEC. Not maintained.
	Mulgul Station		Nil	24°49.744'S	118°28.448'E	1685	0899812936	11-29 1100	Y	Unsealed red dirt. Beware fences, trees, cattle, wildlife, and hills. Permission required.
	Munjina (Auski)		Emergency only	22°21.884'S	118°40.944'E	1495	0891766988	12-30 1320	Y	Unsealed compacted gravel. Beware telecom mast. Hamersley ranges south of strip.
	Murgoo Station		Nil	27°21.966'S	116°25.010'E	1010	0899637985	02-20 1000 09-27 600	Y	Unsealed natural clay. Dry weather strip only. Permission required.

RFDS Serviceable Y/N If blank – not listed by RFDS	Airstrip Name	Day/ Night D/N RFDS	Lighting	Latitude	Longitude	Elevation Feet AMSL	Phone	Strip directions and Lengths in Metres	Listed in WA Country Airstrip Guide 27 th Edition March 2008	Strip Surface and comments
	Nanga Station		Nil	26°14.826'S	113°49.103'E	20	0899483010	05-23 1000	Y	Unsealed white/grey clay. Permission required.
Y	Nanutarra ERLS (NWCH)	D/N								
	Ned's creek Station		Nil	25°30.017'S	119°37.504'E	1895	0899812967	03-21 1200	Y	Unsealed brown gravel. Permission required.
Y	Ningaloo	D								
N	Nookawarra									
N	Nyang									W
Y	Onslow	D/N								
	Overlander Roadhouse		Nil	26°24.464'S	114°27.245'E	220	0899425914	12-30 1000	Y	Unsealed red. Located on Hamelin Station. Used by RFDS. Dry weather only. Permission required. Roadhouse 0899425916
	Peak Hill		Emergency only	25°36.705'S	118°41.711'E	1880	0892709222	08-26 1600	Y	Unsealed red/brown dirt Not maintained. Emergency use only
N	Pimbee									L
	Rhodes Ridge		Nil	23°06.132'S	119°21.672'E	2195	0891752303	10-28 1600	Y	Unsealed natural earth. Dry weather only. Permission required.
Y	Shark Bay	D/N								
Y	Talisker	D								
	Tangadee Station		Nil	24°25.168'S	118°58.150'E	1850	0899812941	11-29 900	Y	Unsealed gravel. Mail plane uses this strip weekly. Permission required
Y	Towrana	D								

RFDS Serviceable Y/N If blank – not listed by RFDS	Airstrip Name	Day/ Night D/N RFDS	Lighting	Latitude	Longitude	Elevation Feet AMSL	Phone	Strip directions and Lengths in Metres	Listed in WA Country Airstrip Guide 27 th Edition March 2008	Strip Surface and comments
	Turee Creek Station		Nil	23°37.376'S	118°39.163'E	1745	0891757015 0428757080	09-27 1200 Cross strips 600	Y	Unsealed gravel. Permission required
	Useless Loop		Emergency flares	26°09.481'S	113°23.703'E	40	0899481226 0899481129 a/h	01-19 1500	Y	Unsealed white dirt. Permission required.
	Waldburg Station		Nil	24°43.018'S	117°20.734'E	1560	0899812942	08-26 1000 17-35 1000	Y	Unsealed red soil. Managed by DEC. Not maintained. Beware trees and stock.
Y	Wanna	D	Nil	23°54.678'S	116°33.655'E	1915	0899430576	01-19 1200	Y	Unsealed red dirt. Homestead is now outcamp of Gifford Creek. Cross strip closed. Permission required.
	Warroora Station Homestead		Nil	23°28.481'S	113°47.967'E	35	0899425920	05-23 1200	Y	Unsealed Pindan. Permission required.
	Warroora Station RFDS	D	Nil	23°26.766'S	113°50.910'E	20	0899425920	05-23 1200 13-31 1200	Y	Unsealed Pindan. Permission required.
N	Williambury		Nil	23°51.431'S	115°08.545'E	650	0899430541	06-24 1000 11-29 600 18-36 600	Y	Unsealed red dirt. Permission required.
Y	Winderie Station	D	Nil	25°18.489'S	115°08.712'E	640	0899430519	15-33 1250	Y	Unsealed red earth. Beware stock on strip. Permission required
N	Winning Pool H/S		Nil	23°09.062'S	114°32.950'E	250	0899430523	08-26 900 17-35 900	Y	Unsealed white. Beware fence at southern end. Permission required.
	Woodlands Station		Nil	24°48.312'S	118°06.981'E	1585	0899812939	03-21 1300 07-25 1600 15-33 500 15-33 1400	Y	Unsealed red/brown dirt. Beware telecomm tower. Short 15-33 to be used in wet weather. Caution: short 15-33 is narrow. Permission required.

RFDS Serviceable Y/N If blank – not listed by RFDS	Airstrip Name	Day/ Night D/N RFDS	Lighting	Latitude	Longitude	Elevation Feet AMSL	Phone	Strip directions and Lengths in Metres	Listed in WA Country Airstrip Guide 27 th Edition March 2008	Strip Surface and comments
Y	Woodleigh	D	Nil	26°03.416'S	114°45.263'E	550	0899425909	18-36 1000	Y	Unsealed red dirt. Beware telephone Satellite dish on approach to runway 18. Permission required.
Y	Wyloo	D/N								
Y	Yalardi	D								
N	Yalbalgo		Nil	25°10.924'S	114°40.899'E	305	0899430556	07-25 600 13-31 600	Y	Unsealed red dirt. Beware trees and fences. Dry weather only.
N	Yanrey Station homestead		Nil	22°30.679'S	114°47.894'E	110	0899430532	17-35 700	Y	Unsealed red sandy clay. Beware 110ft tower. Permission required.
Y	Yanrey Station RFDS	D	Nil	22°30.679'S	114°47.894'E	110	0899430532	17-35 1700	Y	Unsealed red sandy clay. Beware 110ft tower between homestead and shearing shed. Permission required.
Y	Yinnietharra	D								
	Yuin Station		Emergency RFDS only	27°58.219'S	116°02.107'E	950	0899637982 0429637982	18-36 1200 10-28 700	Y	Unsealed brown gravel. Beware kangaroos; sheep etc. 10-28 is not all weather. Permission required.

14.2 GLOSSARY

TERM	EXPLANATION
Abstraction	The pumping of groundwater from an aquifer.
ADSL	Asymmetric Digital Subscriber Line - a data communications technology that enables faster data transmission over copper telephone lines than a conventional voice band modem can provide.
ADWG	The Australian Drinking Water Guidelines.
AEDO	Aboriginal Economic Development Officer.
AEP	Annual Exceedance Probability - the probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.
AHD	Australian Height Datum (is equal to the height of land, in metres above mean sea level).
ANZECC	Australian and New Zealand Environment Conservation Council.
Aquifer	A geological formation or group of formations able to receive, store and transmit significant quantities of water.
ARI	The average, or expected, value of the periods between exceedances of a given rainfall total accumulated over a given duration.
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand.
Austrade	Australian Trade Commission.
AWTS	Aerated Wastewater Treatment Systems (self contained treatment systems for domestic and community use).
BLF	Boat Launching Facility.
CEO	Chief Executive Officer.
Confined Aquifer	An aquifer that is confined between non-porous rock formations (such as shale or silt-stone) and therefore contains water under pressure.
CSCR	Cabinet Standing Committee on Regional Policy.
CSIRO	Commonwealth Scientific and Industrial Research Organisation.
DAFWA	Department of Agriculture and Food.
DEC	Department of Environment and Conservation.
DEEAC	Defense Estate Environment Advisory Committee (Exmouth).
DET	Department of Education and Training.
Diffuse Source	Pollution originating from a widespread area (eg. urban stormwater run-off).
DIMA	Department of Immigration & Multicultural Affairs.
DLGRD	Department of Local Government & Regional Development.
DOIR	Department of Industry & Resources.
DoT	Department of Transport
DoW	Department of Water.
DPI	Department for Planning & Infrastructure.
EDPO	Economic Development Project Officer.

TERM	EXPLANATION
Effluent	The liquid, solid or gaseous wastes discharged by a process, treated or untreated.
EMV	Exmouth Marina Village.
EOI	Expression of Interest.
EPSG	Education Precinct Strategy Group.
ERA	Economic Regulation Authority.
ERS	En Route Supplement (Guide provided by Air Services to airstrips in Australia).
FED	Flash Evaporation Distillation.
FMS	Floodplain Management Strategy.
GAHCC	Gascoyne Aboriginal Heritage & Cultural Centre.
GDC	Gascoyne Development Commission.
GHAC	Gascoyne Health Advisory Committee.
GL	Gigalitres (1 GL = 1,000,000,000 litres).
GMS	Gascoyne Murchison Strategy.
GTWG	Gascoyne Telecommunications Working Group.
Ha	Metric unit of land area (1ha=10,000 square metres).
HAZMAT	Hazardous Materials.
Hydrogeology	The study of groundwater, especially relating to the distribution of aquifers, groundwater flow and groundwater quality.
kl	Kilolitres (1kl = 1,000 litres).
Leaching	The process by which materials such as organic matter and mineral salts are washed out of a layer of soil or dumped material by being dissolved or suspended in percolating water. The material washed out is termed leachate.
LEMC	Local Emergency Management Committee.
LGMS	Lower Gascoyne Management Strategy.
LIA	Light Industrial Area.
MED	Multi Effect Distillation.
Mg/L	Milligrams per litre (0.001 grams per litre).
ML	Mega litre (1 ML – 1,000,000 litres).
MP	Member of Parliament.
MRWA	Main Roads Western Australia.
MWDC	Midwest Development Commission.
MWGACC	Midwest Gascoyne Area Consultative Committee.
NEDP	New Export Development Program.
NHMRC	National Health and Medical Research Council.

TERM	EXPLANATION
NRC	Ningaloo Research Centre.
NSDC	Ningaloo Sustainable Development Committee.
OAED	Office of Aboriginal Economic Development.
PATS	Patient Assistance Travel Scheme.
PDWSA	Public Drinking Water Source Area.
PV	Photo Voltaic (referring to electrical energy generated through solar panels).
Ramsar Convention	Convention on Wetlands, signed in Ramsar, Iran, 1971, is an intergovernmental treaty which provides the framework for national action and international cooperation for conservation and wise use of wetlands and their resources. Presently 158 Contracting Parties to the Convention, with 1822 wetland sites, totalling 168m hectares, designated for inclusion in the Ramsar List of Wetlands of International Importance.
RDC	Regional Development Council.
RDL	Department of Regional Development and Lands
RDS	Regional Development Scheme.
REBS	Renewable Energy Buyback Scheme.
Recharge	Water infiltrating to replenish an aquifer.
RFDS	Royal Flying Doctor Service.
RIF	Regional Investment Fund.
RO	Reverse Osmosis – Process using membrane technology to separate fresh water out of brackish or saline sources.
SBC	Small Business Centre- Gascoyne.
SBDC	Small Business Development Corporation.
SBH	Small Boat Harbour.
SCADA	Supervisory Control and Data Acquisition. A system of monitoring and control of equipment from a remote location.
SCARM	Standing Committee on Agriculture and Resource Management. Includes SCARM 73 Floodplain Management in Australia, Best Practice Principles and Guidelines (CSIRO 2000).
Scheme Supply	Water diverted from a source/s by a Water Service Provider and supplied via a distribution network to customers for domestic, industrial or Irrigation use.
Septicity	Relating to, involving, or causing sepsis. Highly septic sullage has the capacity to damage aerobic and anaerobic bacteria in treatment ponds, causing the ponds to “turn over” or become septic.
SMU	Skills Migration Unit.
Sullage	Waste collected from septic tank systems in domestic and industrial premises.
SWIS	Strategic Waste Initiative Scheme.
TDS	Total dissolved Salts, a measure of ions in solution such as salts in water (used to provide information on salinity). Measured in mg/L.
TEA	Trade Start Export Advisor.
TSS	Total Suspended Solids - Suspended solids refers to the mass of the suspended matter and is measured as mg/L.

TERM	EXPLANATION
Unconfined aquifer	Aquifer in which the upper surface of water is lower than the top of the aquifer structure. The upper surface is called the water table.
WALGA	Western Australian Local Government Association.
WAPC	Western Australian Planning Commission.
Wastewater	Water that has been used for some purpose and would normally be treated or discarded. It usually contains significant levels of pollutant.
WATC	Western Australian Tourism Commission.
WATC	Western Australian Treasury Corporation.
Water Allocation	The amount or proportion of a Water Entitlement that may be taken in a season. This is usually given as a percentage of entitlement or, in some cases a specific volume in Kilolitres or Mega litres.
Water Entitlement	The right to ownership of water measured as a volume and usually legally stapled to share certificates. This enables an entitlement holder to trade (buy and sell) the entitlement. This is not the water available to a holder unless a 100 percent Water Allocation is in place. (See Water Allocation).
Water Quality	The physical, chemical and biological measures of water.
Water Reserve	An area proclaimed under the <i>Country Areas Water Supply Act 1947</i> or the <i>Metropolitan Water Supply Sewerage and Drainage Act 1909</i> for the purposes of protecting a drinking water supply.
WC	Water Corporation.
Why use AEP instead of ARI?	<i>Australian Rainfall and Runoff (Inst. Engrs Aust., 1987)</i> , states: Use of the terms "recurrence interval" and "return period" has been criticised as leading to confusion in the minds of some decision makers and members of public. Although the terms are simple superficially, they are sometimes misinterpreted as implying that the associated magnitude is only exceeded at regular intervals, and that they are referring to the elapsed time to the next exceedance. The use of the term ARI can lead to confusion. It is preferable, therefore, to express the rarity of a rainfall event in terms of AEP. For example, a rainfall total of 159mm falling in three hours at Darwin Regional Office has a 0.010 (i.e. 1 percent) probability of being equalled or exceeded in any one year can be easier to understand than the equivalent statement of a rainfall total of 159mm in three hours has an average recurrence interval of 100 years. Source:Hydro Meteorological Advisory Service, April 2006.
WTP	Water Treatment Plant.
WWTP	Waste Water Treatment Plant (sewerage treatment).
WWTW	Waste Water Treatment Works (same as above).
YCN	Youth Coordinating Network.

14.3 BIBLIOGRAPHY

Section	Locality	Document Reference
Water	Australia	National Health and Medical Research Council & ARMCANZ 2004, <i>National Water Quality Management Strategy: Australian Drinking Water Guidelines</i> , NHMRC & ARMCANZ, Canberra, available http://www.nhmrc.gov.au/publications/synopses/eh19syn.htm
Water	Australia	National Minimum Bore Specifications Committee 2003, <i>Minimum construction requirements for water bores in Australia</i> , 2nd edition, Land and Water Biodiversity Committee, Queensland, available http://portal.water.wa.gov.au/portal/page/portal/LicensingWaterIndustryServices/Licensing/Publications/Content/MCRWBA.pdf
Water	Denham	Department of Water, Denham North and Denham South (D7-7) Water Reserves Drinking Water Source Protection Plan. Report No 68 May 2007
Water	Gascoyne Junction	Department of Water - Water Resource Protection Plan No.84 <i>Gascoyne Junction Water Reserve Drinking Water Source Protection Plan</i>
Water	Regional WA	Government of Western Australia 1947, <i>Country Areas Water Supply Act</i> , reprinted under the Reprints Act 1984 as at 1 February 2008, available http://www.slp.wa.gov.au/legislation/statutes.nsf/default.html .
Water	Rural Land	Agriculture and Resource Management Council of Australia and New Zealand(ARMCANZ) & Australian and New Zealand Environment and Conservation Council (ANZECC) 1996, <i>Draft Rural Land Uses and Water Quality – A Community Resource Document</i> , ARMCANZ & ANZECC, Canberra
Water	WA	Department of Health 2007, <i>Use of Herbicides in Water Catchment Areas</i> , Circular No: PSC 88, 28 February 2007, Department of Health, Perth.
Water	WA	Department of Water Various dates, <i>Water Quality Protection Notes – Various titles</i> ,
Water	WA	Department of Water, Perth, available www.water.wa.gov.au/Water Quality /Publications/Water Quality Protection Notes .
Water	WA	Government of Western Australia 1914, <i>Rights in Water and Irrigation Act</i> , Reprinted under the <i>Reprints Act 1984</i> as at 1 February 2008, available http://www.slp.wa.gov.au/legislation/statutes.nsf/default.html .
Water	WA	Water and Rivers Commission 2000, <i>State wide Policy No.2 – Pesticide Use in Public Drinking Water Source Areas</i> , Water and Rivers Commission, Perth, available www.water.wa.gov.au Policies .
Water	WA	Water and Rivers Commission 2003, <i>State wide Policy No.13 – Policy and Guidelines for Recreation within Public Drinking Water Source Areas on Crown Land</i> , Water and Rivers Commission, Perth, available www.water.wa.gov.au Policies
Water	WA	Water Corporation 2006, <i>SG097 Source Protection Operations Manual</i> , Water Corporation, Perth.
Water	WA	Western Australian Planning Commission 2003, <i>Statement of Planning Policy No. 2.7– Public Drinking Water Source Policy</i> , Government Gazette WA, 10 June 2003,pp. 2077-82, Government of Western Australia, Perth, available www.wapc.wa.gov.au/Publications/149.aspx
Water	WA	Western Australian Planning Commission 2006, <i>State Planning Policy No. 2.9 -Water Resources</i> , Government Gazette WA, 19 December 2006, pp. 5707-22Government of Western Australia, Perth, available http://www.wapc.wa.gov.au/Publications/1281.aspx
Water	World-Wide	World Health Organisation 1996, <i>Guidelines for Drinking-Water Quality – Volume 2 –Health Criteria and Other Supporting Information</i> , 2nd edition, World Health Organisation, Geneva, available www.who.int/water_sanitation_health/dwq/en/2edvol2p1.pdf
Water	Carnarvon	National Water Commission <i>Australian water Resources 2005, Regional Water Resource Assessment – GMU Carnarvon</i>

Section	Locality	Document Reference
Water	Carnarvon	Department of Water, <i>Lower Gascoyne Management Strategy 2003</i>
Water	Gascoyne	WA Government – Water Agencies (Powers) Act 1984 – Water Agencies (Charges) By-laws 1987
Water	Upper Gascoyne	Department of Water – <i>Gascoyne Junction Water Reserve Drinking Water Source Protection Plan – Gascoyne Junction Town Water Supply</i> . Report No 84 Feb 2008
Water	Gascoyne	Department of Water - <i>Carnarvon Artesian Basin Water Management Plan – Water Resources Allocation and Planning Series Report No WRAP 24</i>
Airports	Carnarvon	Department of Local Government and Regional Development – Gascoyne Development Commission, <i>The future demand and opportunities for air freight from the proposed new Carnarvon Airport</i> .
Airports	Region	RFDS Airstrip Standards and Reporting Arrangements Rev 1 Dated 26-Oct-98
OTC	Carnarvon	Carnarvon Shire Council, <i>OTC Satellite Earth Station Carnarvon – Master Plan 2007</i>
Horticulture	Carnarvon	<i>Agriculture WA Research Information System – Commercial cut flower production in Carnarvon – Wildflowers. Project: HAP Activity#: 95GA9 (DAFWA)</i>
Horticulture	Carnarvon	<i>Horticulture Industry Development Benefit Cost Analysis: Project Carnarvon Table Grape Industry Investment</i> . 15 June 2007 (DAFWA)
Horticulture	North West	<i>Wildflower Production in the North West – Amanda Lin & Digby Growns</i> .(DAFWA)
Horticulture	Northern Aust	<i>Draft Northern Australia Table Grape Industry Strategic Plan 2006-2009</i> (DAFWA)
Horticulture	Region	<i>Gascoyne Cut Flower Project Native Wildflowers – Interim report, January 1997</i> . (DAFWA)
Horticulture	Carnarvon	<i>Carnarvon Labour Market Committee - Plantation Training Course – Feasibility Study Tim Klinger Dec 1992</i>
Fishing	Gascoyne	Department of Fisheries – <i>State of the Fisheries Report 2006/07 Gascoyne Coast Bioregion</i>
Flood Mitigation	Australia	Commonwealth Scientific and Industrial Research Organisation, 2000, <i>Floodplain management in Australia: Best practice principles and guidelines</i> , CSIRO Publishing, Collingwood
General	Gascoyne	Carnarvon Shire Council, <i>A New Vision for Carnarvon July 2008</i>
General	Gascoyne	Department of Local Government and Regional Development - Gascoyne Development Commission, <i>Gascoyne Economic Perspective 2006</i>
General	Gascoyne	Ningaloo Sustainable Development Committee, <i>Ningaloo Coast Regional Strategy Carnarvon to Exmouth August 2004</i>
General	Gascoyne	Department of Local Government and Regional Development – Gascoyne Development Commission, <i>Annual report 2007/2008</i>
General	Gascoyne	Department of Local Government and Regional Development – Gascoyne Development Commission, <i>GDC Projects – Report on Activities (October 2008 onwards)</i>
General	WA	State Emergency Management Committee 2005, <i>Policy Statement No.7 Western Australian Emergency Management Arrangements</i> , Government of Western Australia, Perth.
General	WA	Western Australian Planning Commission 1997, <i>State Planning Strategy</i> , State Government of Western Australia, Perth, available www.wapc.wa.gov.au/Publications/52.aspx
Roads	WA	MRWA: <i>2007 Perth – Darwin Corridor Strategy - Building our National Transport Future</i>

14.4 USEFUL LINKS

Category	Agency	Description	Link (URL)
Airports	RFDS	Royal flying Doctor Service	http://www.rfdswa.com.au/
Business Development	SBC or BEC	Small Business Centre or Business Enterprise Centre	http://www.beca.org.au
Commerce & Trade	Austrade	Federal Government Trading Support	http://www.austrade.gov.au/
Communications	GTWG	Gascoyne Telecommunications Group	http://www.gdc.wa.gov.au/content.asp?documentid=54
Councils	WALGA	WA Local Government Association	http://www.walga.asn.au/
Development	GMS	Gascoyne Murchison Strategy	http://www.gms.wa.gov.au/main%20pages/index.html
Education	DET	Department of Education and Training	http://www.det.wa.edu.au/education/
Energy	HP	Horizon Power	http://www.horizonpower.com.au/
Environment	DEC	Department of Environment & Conservation	http://www.dec.wa.gov.au/
Environment	Ramsar	Locality of Agreement Meeting	http://www.ramsar.org/
Export	TEA	Trade Start Export Advisor	http://www.austrade.gov.au/TradeStart1400/default.aspx
Grants	State Government	Grants Directory	http://grantsdirectory.dlqrd.wa.gov.au/
Mining	GA	Geoscience Australia	http://www.ga.gov.au/
Harbours	DoT	Department of Transport	http://www.dol.wa.gov

Category	Agency	Description	Link (URL)
		& Infrastructure	
Health	GHAC	Gascoyne Health Advisory Committee	http://www.mmhr.org.au/sitemaplinks.asp
Horticulture & Agriculture	DAFWA	Department of Agriculture and Food WA	http://www.agric.wa.gov.au/
Immigration	DIMA	Department of Immigration and Multicultural Affairs	http://www.immi.gov.au/
Indigenous	GAHCC	Gascoyne Aboriginal Heritage and Cultural Centre	http://www.boards.dpc.wa.gov.au/index.cfm?fuseaction=bcv.bdetail&bno=1271
Regional Development	RDL	Department of Regional Development & Lands	http://www.rdl.wa.gov.au/
Mining	DMP	Department of Mines & Petroleum	http://www.dmp.wa.gov.au/
Mining	Geoscience Australia	Geological Resources	http://www.ga.gov.au/map/index.jsp#minerals
Mining	Gunson Resources	Mineral Sands Miner	http://www.gunson.com.au/html/news_f.html
Mining	BHP Billiton	Pyrenees Oil Field	http://www.bhpbilliton.com/bbContentRepository/pyreneesOilFieldBrochure.pdf
Planning	WAPC	WA Planning Commission	http://www.wapc.wa.gov.au/
Regional Development	GDC	Gascoyne Development Commission	http://www.gdc.wa.gov.au/
Regional Development	MWDC	Midwest Development Commission	http://www.mwdc.wa.gov.au/
Regional Development	RDC	Regional Development Council	http://www.rdcouncil.gov.au/
Regional Development	RDS	Regional Development Scheme	http://www.gdc.wa.gov.au/content.asp?documentid=49

Category	Agency	Description	Link (URL)
Regional Development	RIF	Regional Investment Fund	http://www.dlgrd.wa.gov.au/FinancialAssist/RIF.asp
Regulatory	ERA	Economic Regulation Authority	http://www.era.wa.gov.au/
Small Business	SBDC	Small Business Development Commission	http://www.sbdc.com.au/
Tourism	WATC	WA Tourism Commission	http://www.tourism.wa.gov.au/
Transport	MRWA	Main Roads WA	http://www.mainroads.wa.gov.au/Pages/Welcome.aspx
Transport	PATS	Patients Assistance Travel Scheme	http://www.wacountry.health.wa.gov.au/default.asp?documentid=409
Waste	SWIS	Strategic Waste Initiative Scheme	http://www.zerowastewa.com.au/index.php
Water	DoW	Department of Water	www.water.wa.gov.au
Water	NWC	National Water Commission	http://www.nwc.gov.au/www/html/7-home-page.asp
Water	USBR	US Bureau of Reclamation	www.usbr.gov/pmts/water/publications/reportpdfs/report081.pdf
Water & Sewer Services	Water Corporation	Water Corporation	http://www.watercorporation.com.au/

15. ATTACHMENTS

15.1 PROPOSAL FOR A HORTICULTURE EDUCATION PROJECT FOR CARNARVON – DECEMBER 2008

Proposal: *Establishment of a Horticulture Training Facility in Carnarvon*

Location: Carnarvon Agriculture Research Station and associated farm (Santa Rosa)

Outline: There is an opportunity to incorporate the need for horticulture training facilities in Carnarvon with land owned by a Government department; the desire to improve soils and irrigation techniques with the water resource protection that is so important to Carnarvon and the rest of the country.

The need for education and training, including agribusiness, in commercial horticulture in the Gascoyne has long been identified. Yet it is somewhat outside the brief of both training and agricultural research bodies in the Region. This proposal seeks to address that issue.

It would provide the means for growers to build upon their reputation as amongst the most efficient irrigators in Australia (in terms of water use efficiency) to achieve world's best practice in total farm management. Not only would this improve outcomes for individual growers but assist the sustainability of the industry and potentially develop a national and international reputation for the Region.

The Land

Flood mitigation research early this decade identified that the land occupied by Santa Rosa Plantation on South River Road would be required as a flood way to direct flood water returning to the river after a major flow event. The Department of Water (DoW) purchased Santa Rosa Plantation in preparation for the development of major flood mitigation works. Hydrologists and engineers have since decided the land is no longer required for this purpose. It is believed that Department of Water is seeking interested parties to purchase the property.

This property could become a model farm where soil improvement, fertigation systems, automated watering systems, remote monitoring and planting and harvesting techniques could be guided by expert advice and latest technology



Santa Rosa and surrounding plantations

The property would in effect become an open classroom. Growers and other students could learn the skills and put them into practice.

The governance structure for such a facility could include The Department of Agriculture and Food WA (DAFWA), Carnarvon Growers Association (CGA) and Durack Institute of Technology with the GDC in a developmental role. Alternatively, the GDC could conduct a feasibility study and business plan with a view to attracting interest from established agriculture and horticulture training service providers.

Environmental soil scientist Dr Peter Keating has indicated a willingness to be involved and there are many others within Carnarvon who have discussed this over the years.

The first step would be to request that the Department of Water defer their intention to sell Santa Rosa plantation and invite them to work with the GDC, CGA, DAF, Durack Institute of Technology and other stakeholders to turn the proposal into a working plan. They would report to the Minister for Agriculture/ Regions/ within a set time frame with a fully costed proposal and a business plan.

A similar project was suggested in 1992 (*Plantation Training Course – Feasibility Study – Tim Klinger 18th December 1992*), submitted to the Carnarvon Labour Market Committee. A copy of this document is held in the GDC library – Document Ref: HO51.

