



agriculture

Agricultural Engineering Services
Project Planning
REPUBLIC OF SOUTH AFRICA

Revitalisation of the Vaalharts/Taung Irrigation Scheme

Agricultural Engineering Services

Revitalisation of the Vaalharts/Taung Irrigation Scheme

Master Plan 2007/2008



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Revitalisation of the Vaalharts/Taung Irrigation Scheme

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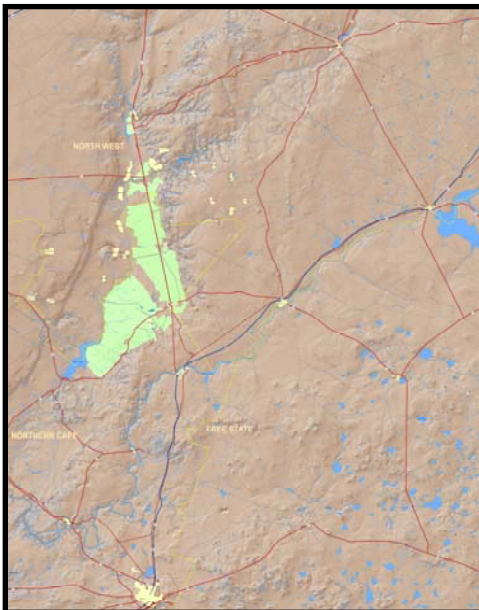


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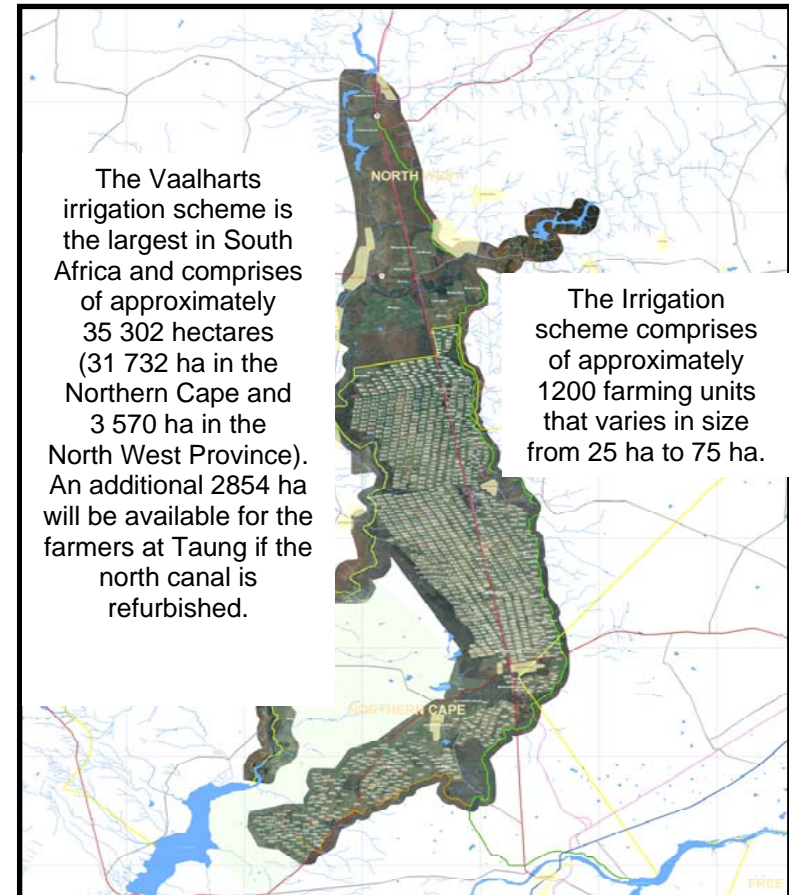
Revitalisation of the Vaalharts/Taung Irrigation Scheme

1. Introduction

The Vaalharts/Taung revitalisation project involves the optimization of agriculture in the area focusing on the upgrading and the development of infrastructure thus maximising economic feasibility of the scheme. The project is part of the Accelerated and Shared Growth Initiative (ASGISA) and serves as a pilot project for irrigation development throughout South Africa.



The Irrigation Scheme is on the border of Northern Cape and North West Provinces. The scheme is enclosed from east by Harts River and from south by Vaal River. Approximately 100km south is Kimberley and 90km north is Vryburg. The main road is R47 from Warrenton to Vryburg and a railway line runs South-North through the middle of the area.





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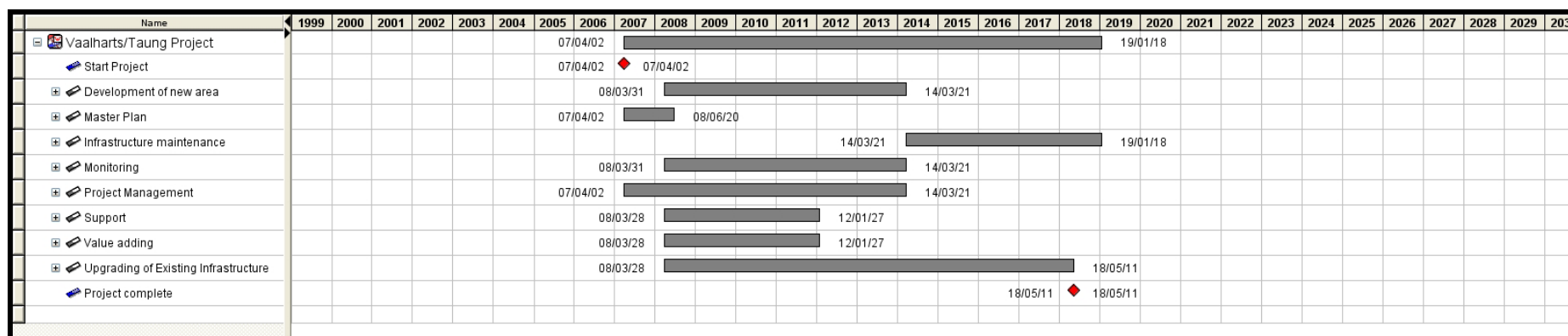
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2. Scope of the project

The project will include surveying, planning, feasibility, design and rehabilitation of the existing irrigation scheme (Refer to the Systems Design). The canal system will be expanded for the development of the additional 2854 ha in Taung. The existing infrastructure and related systems will be assessed and restored. Solutions to minimise the existing problems such as salinity, water loss and water logging will be implemented. The “saved” water can be redistributed to the resource poor farmers. The project will enable the Irrigation scheme to produce agricultural products in a sustainable manner indefinitely.

The project will be aligned with the Local Integrated Development Plans (IDP) and the Strategic Plans of the National and Provincial (Northern Cape and North West) Department of Agriculture (DoA). The project will form part of the conservation of natural resources on agricultural land through the Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983). Planning and Implementation will be in accordance with other National Legislation such as the National Environmental Management Act (NEMA), Occupational Health and Safety Act (OHSA) and the Engineering Act.

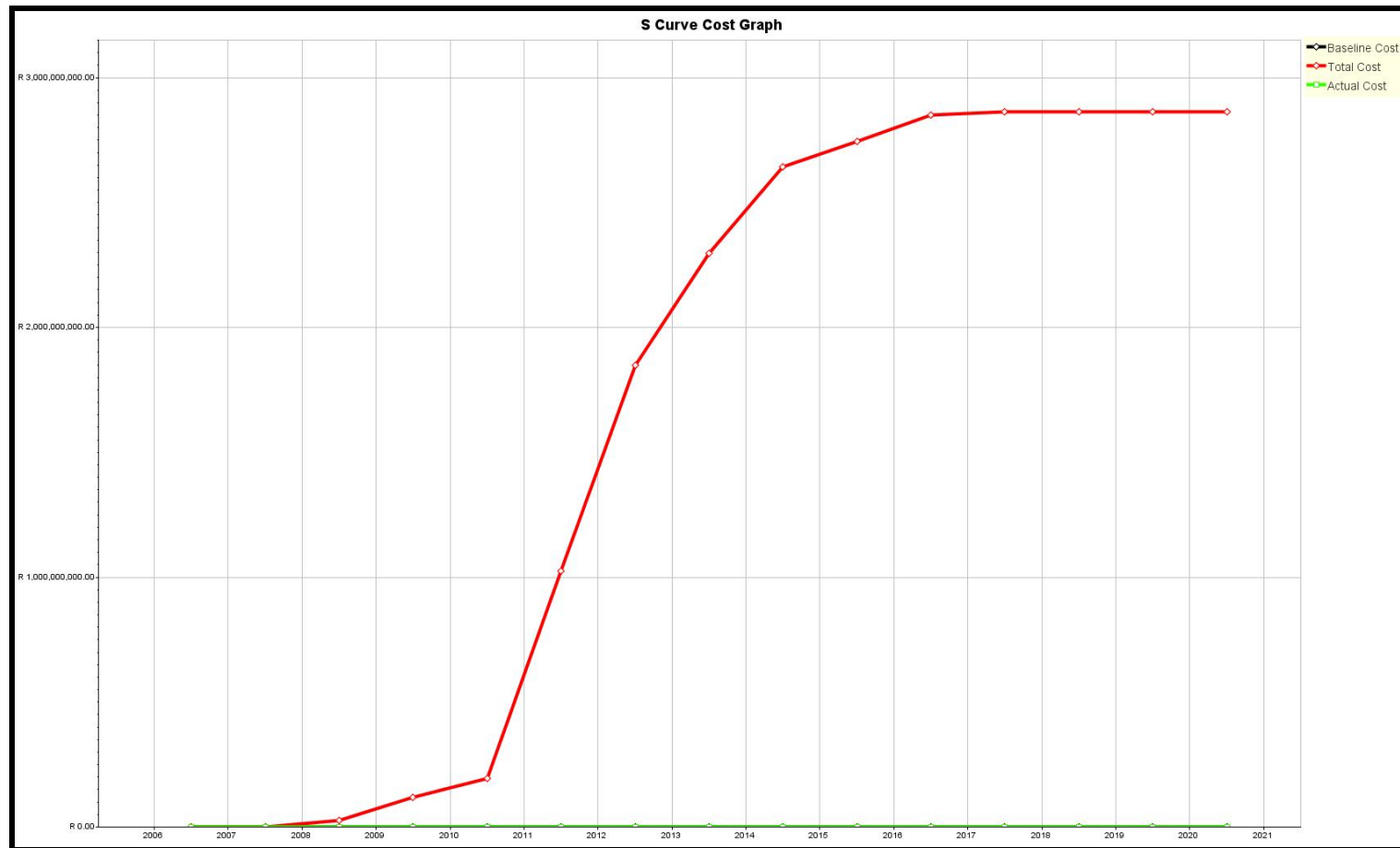
The estimated budget for the project is R 2 864 000 000. The development of the new area in Taung is expected to be completed in 2014 and the upgrading of the existing infrastructure in 2018. Refer to the Gantt chart and S-Curve. The cost breakdown of the project is given in Section 8 – Project Cost.





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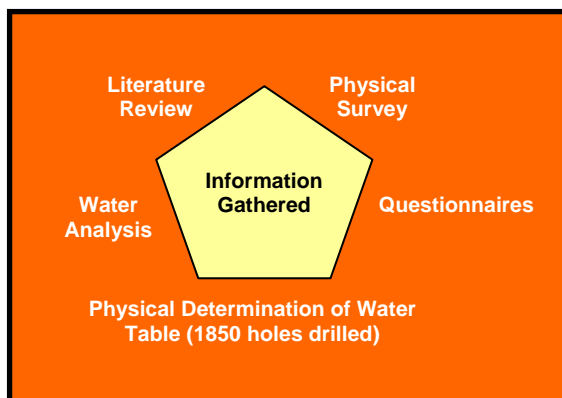




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3. General Overview of the Area



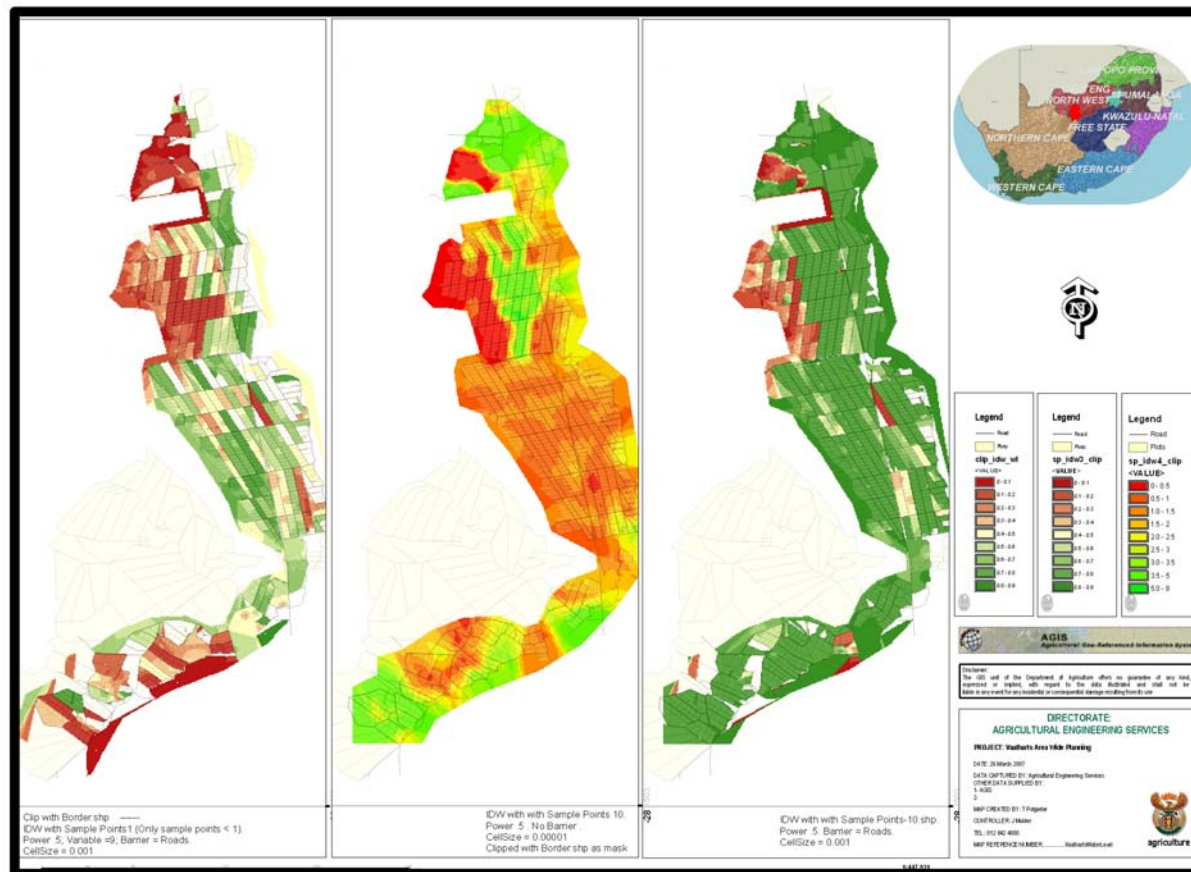
3.1 Climate

The project area has a semi arid climate characterized by very hot summers and cool winters, and a predominantly summer rainfall. The mean annual precipitation is 477 mm (climate stations: Vaalharts-agr and Jan Kempdorp) and 450mm (climate station: Taung).

	Minimum		Maximum	
	Value	Month	Value	Month
Mean Average Temperature	3°C	July	35°C	January
Relative Humidity	52-53%	July	64-65%	February
Potential Evaporation "Lows"	104mm	June	344mm	December
Mean Annual Potential Evaporation	2650mm		2750mm	
Potential Evotranspiration	62mm	June	256mm	December
Solar Radiation	16.6MJ/m ² day	June	33.9MJ/m ² day	December
Heat Units	13-15 degree days	July	472-490 degree days	December/January

Winds occur predominantly in the North-North West direction at a speed of 3.5 to 5.6m/s. The first heavy frost in the area is likely to occur during second half of May and ends towards the end of July. The number of days with heavy frost is between 23 and 32 days.

3.2 Water Table



The groundwater table has risen from about 24m to 1m below ground level (Herold [1996]). The current water table in the area was physically determined and correlated from 1850 measurements.

The water table was modeled to determine the impact of infrastructure on the natural drainage in the area.

Roads only had an impact on certain portions of the scheme. Very high localized water tables occurred where no Departmental drains were provided.



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3.3 Land Type

The Vaalharts Irrigation Scheme falls in the Drainage Area C, Quaternary sub-catchments C31F, C32D, C33A and C33B. The median annual simulated runoff in the area is in the range of 20 and 41 mm with the lowest 10 year recording of 4.8 to 9.3mm. (R.E. Schulze). The topography has a high altitude with values ranging from 1050 to 1175m above sea level with a low rate of change towards the west. The irrigation scheme is predominantly flat as 70% of the area comprises of slopes less than 1%. Rocks of the Bothaville Formation overlie the Hartswater Group which comprises of the lower Mhole Formation and the upper Phokwane Formation. The area comprises of a Harts-Dry Harts Valley (stratum of calcrete) that runs in a north – south direction.

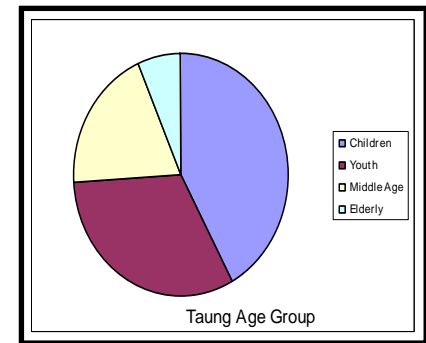
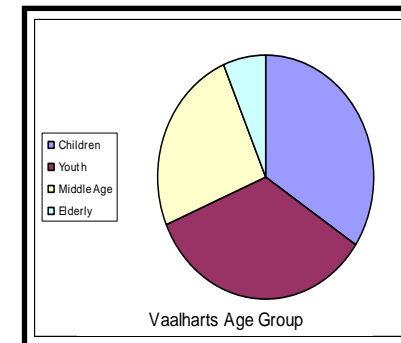
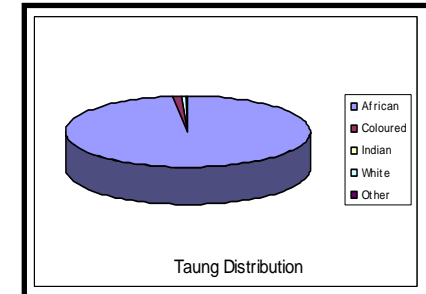
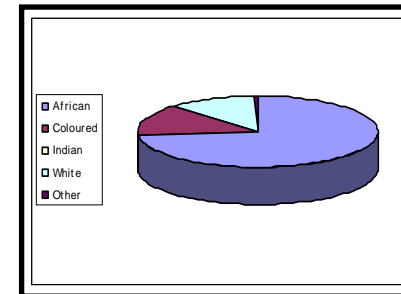
3.4 Soil

The soils in the area are described as Kalahari Sand, (Vaalharts Groundwater Protocol for on site Sanitation). The soil consists mainly of sand, silt and clay (on average 75% sand, 15% clay and 10% silt). Underlying the red Kalahari Sand is the Dwyka shale and tillite, calcrete and Vetersdorp lava. There are areas where the calcrete is impermeable.

3.5 Water Quality

The water is sourced from the Vaal River, by means of the canal system. Some of the drainage water is recycled for irrigation and the rest flows back into the Harts River. According to the analysis, the total dissolved solids (TDS); chlorine content, inorganic nitrogen, sodium and Sodium Adsorption Ratio (SAR) were above the acceptable range.

3.6 Demography



The population distribution data was obtained from Statistics SA 2002 Census. Currently 62.6% of the population is employed in Vaalharts and 32.6% in Taung.



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3.7. Current Practices

The current practices in the Vaalharts area were obtained from the questionnaire analysis.

	% of farmers that comply
Use scheduling services	43.7
Crop factors	55.8
Plant salt tolerant crops	38.6
Utilise crop rotation	60.2
Unused land (3 months)	37.8
Unused land (full season)	13.2
Crop residues worked back	70.0
Gypsum applied last two years	18.1
Private Soil analyst services	92.0
Drainage subsidised	26.0
System planned and surveyed	48.3
Drainage System cleaned within last two years	8.2

Three agricultural co-ops serve the farmers. Three grain silos are situated at Jan Kemp, Hartswater and Magogong, which also serves the Taung area. SA Maltsters has a contract with the farmers for growing Barley.

Cash Crops	Tons
Barley	33000
Maize	90000
Wheat	35000
Groundnuts	20000
Lucern	90000
Cotton	5000
Permanent Crops	Tons
Pecan Nuts	4400 ha
Citrus	350 ha
Olives	200 ha
Wine Grapes	300 ha



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Agro Industries	Quantity	Workers	Job Opportunities
Vaalharts Chickens	1	60	60
Trista feedlot	1	50	50
Olive Factory	1	10	10
Citrus packing Fas.	5	50-200	± 600
Pecan Shelling Fact.	8	10-20	± 120
Aquaculture farm	1	Pilot project	5
Vaalharts Wine Cellar	1	10	10
Grain Mills	3	10	30
Cattle/sheep Feed Fact	1	45	45
Groundnuts Shelling plants	9	70/250	± 1600
Groundnuts roasting plants	2	20	40
Traders in Cattle/Sheep fodder	7	20	140

Pecan nuts, groundnuts, citrus and olives are exported to the USA, Europe and Japan.

The two agricultural Unions that operate in the area are Agri-Northern Cape and National African Farmers' Union (NAFU). 8 - 10 land reform projects are currently running. A strong business chamber exists for the towns. An agricultural research station at Jan Kempdorp serves the entire community.

In Vaalharts, the extension office is situated at the Vaalharts Research Station in the Pokwane Municipal area. The aim of this office is to give extension support to the farmers for the Pokwane Municipality area. Only one extension officer is working in the area and is mainly concentrating on the emerging farmers who have received irrigation plots through LRAD. CASP funds are being used to help farmers to become commercial and independent.

In Taung, the extension offices are situated in Pudimoe, Basele, Mokasa, Ipelegeng and Tshidiso.

Waiting for Information from N. West

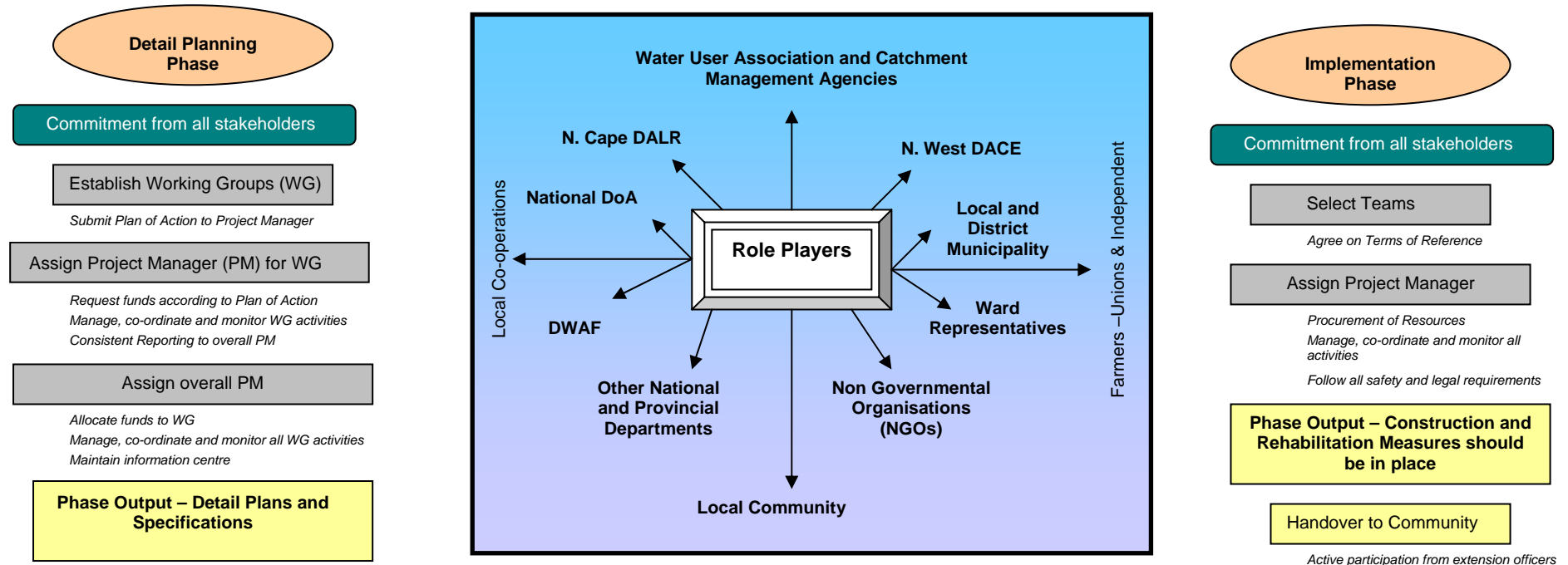


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4. System Design

The Systems Design comprises of the phases required for the successful implementation of the Vaalharts/Taung Project. It should be used in conjunction with the detail planning to reduce the project cost, implementation time and project risks. The Systems Design will provide a foundation for planning, initiating, implementing, monitoring and evaluating the project.

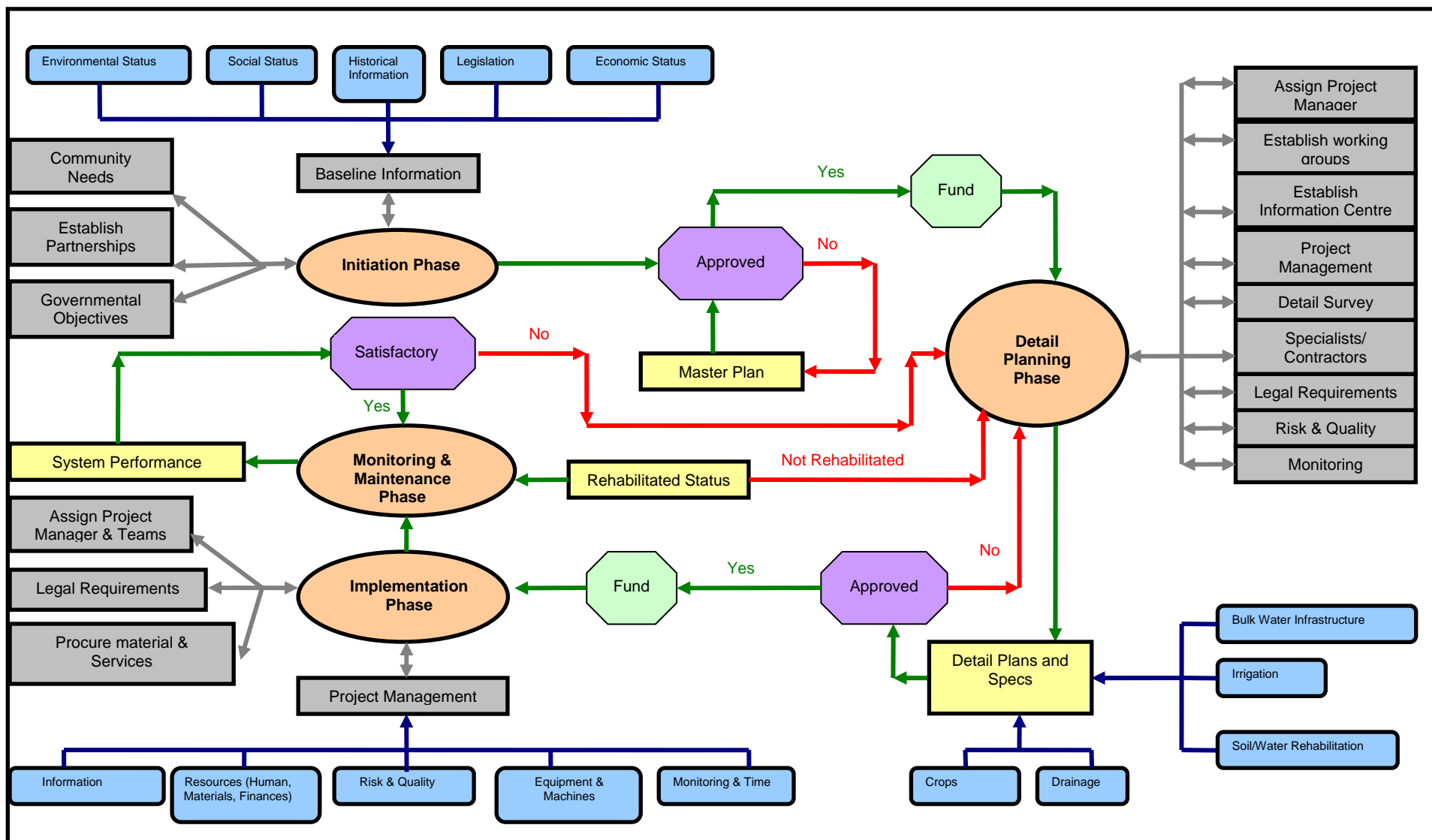


The implemented projects should be monitored and maintained. Community ownership is essential for the sustainability of the projects. Results of the projects should be published, as valuable information can be obtained for future reference. Maintenance should be performed regularly to extend the lifespan of the projects.



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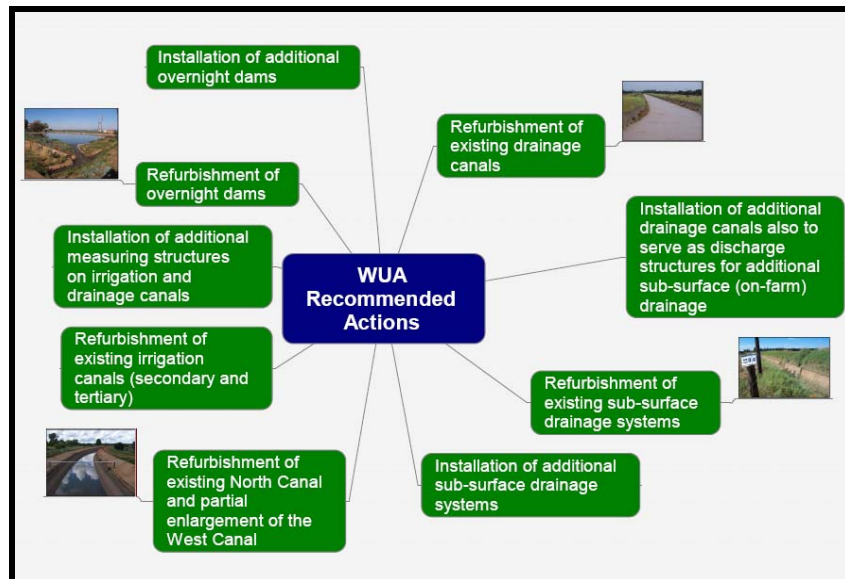
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5. Main Stakeholder Objectives

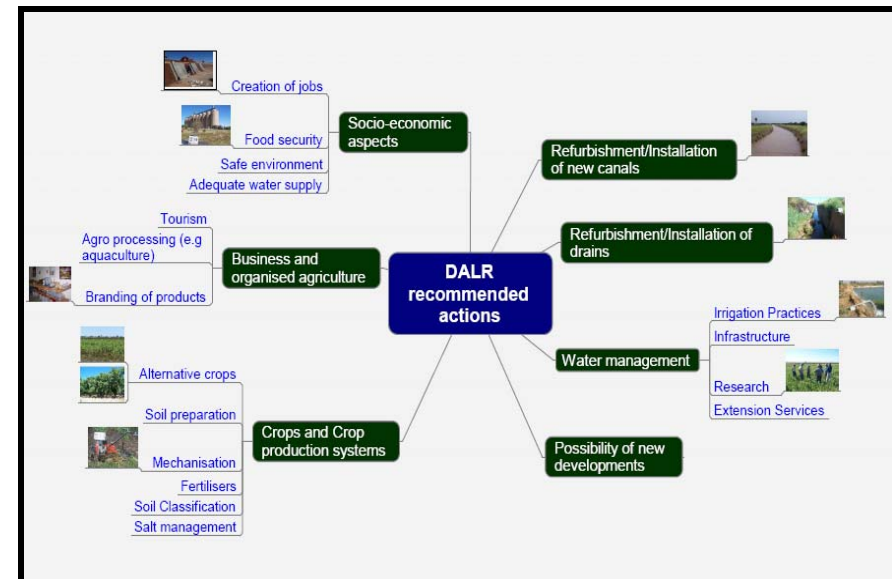
5.1 Vaalharts Water User Association (VWUA)

The irrigation canals are more than sixty years old, while most of the drainage canals are forty years and older. These canals need to be refurbished urgently. The Main Canal was enlarged by raising the concrete lining to increase the capacity from 28 m³/s to 48 m³/s. This action increased the leakages through the old deteriorating concrete lining. The secondary and tertiary canals were not enlarged and are also in a bad condition.



5.2 N. Cape Department of Agriculture and Land Reform

Sub-surface drains were installed as early as 1974. Since then until 31 January 1998, 1 040 km of drains was designed by the Dept. of Agriculture and installed by the land owners (29% of the Vaalharts area). A total of 412 km was designed but not installed by the land owners. No further technical advice has been given to land owners.





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5.3 N. West Department of Agriculture, Conservation and Environment

Waiting for Information from N. West

5.4 Vaalharts Agricultural Union

A Vaalharts Tourism Association should be established.

The Vaalharts Agricultural Union will fully support and co-operate with the project team.

5.5 Extension Support

Assistance from soil conservation, engineering, crop scientists, research and irrigation experts are required.

The following requirements are necessary for Extension:

- Appointing well trained extension officers with experience;
- Training of existing personnel in crop science and irrigation;
- Liaise with all relevant role players in the industry;
- Training of farmers in water scheduling.



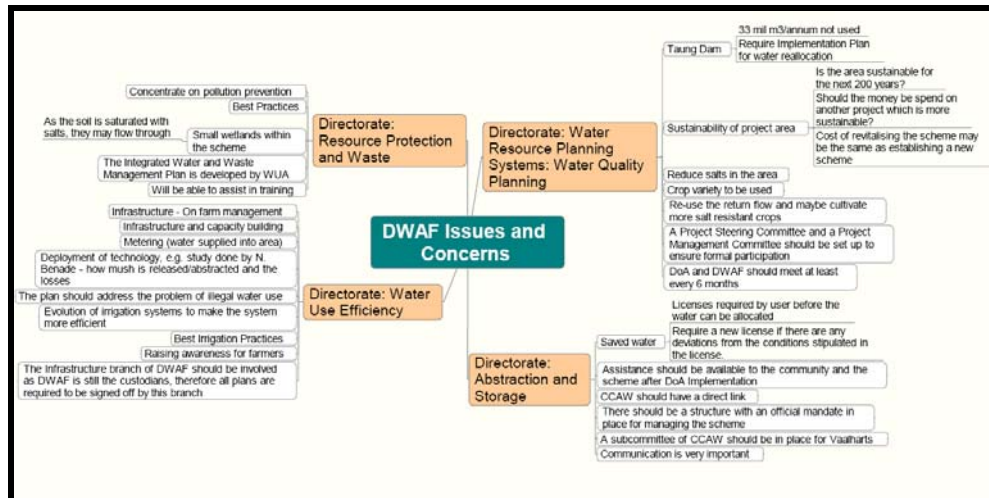
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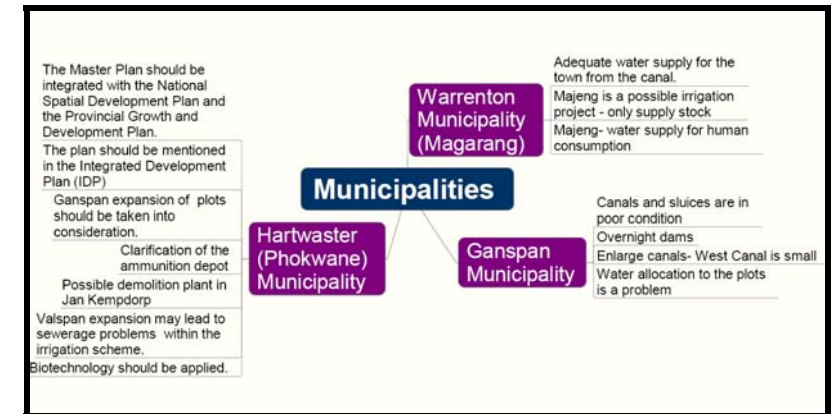
5.5 Department of Water Affairs and Forestry

The water losses should be minimized. The Priority areas include:

- Expansion of the Taung Canal
- The Main Canal should cut down on the 30% loss (must have measurement techniques in place to compare before and after loss)
- Saved water should be used efficiently for resource poor farmers according to the DWAF policies.



5.6 Municipality



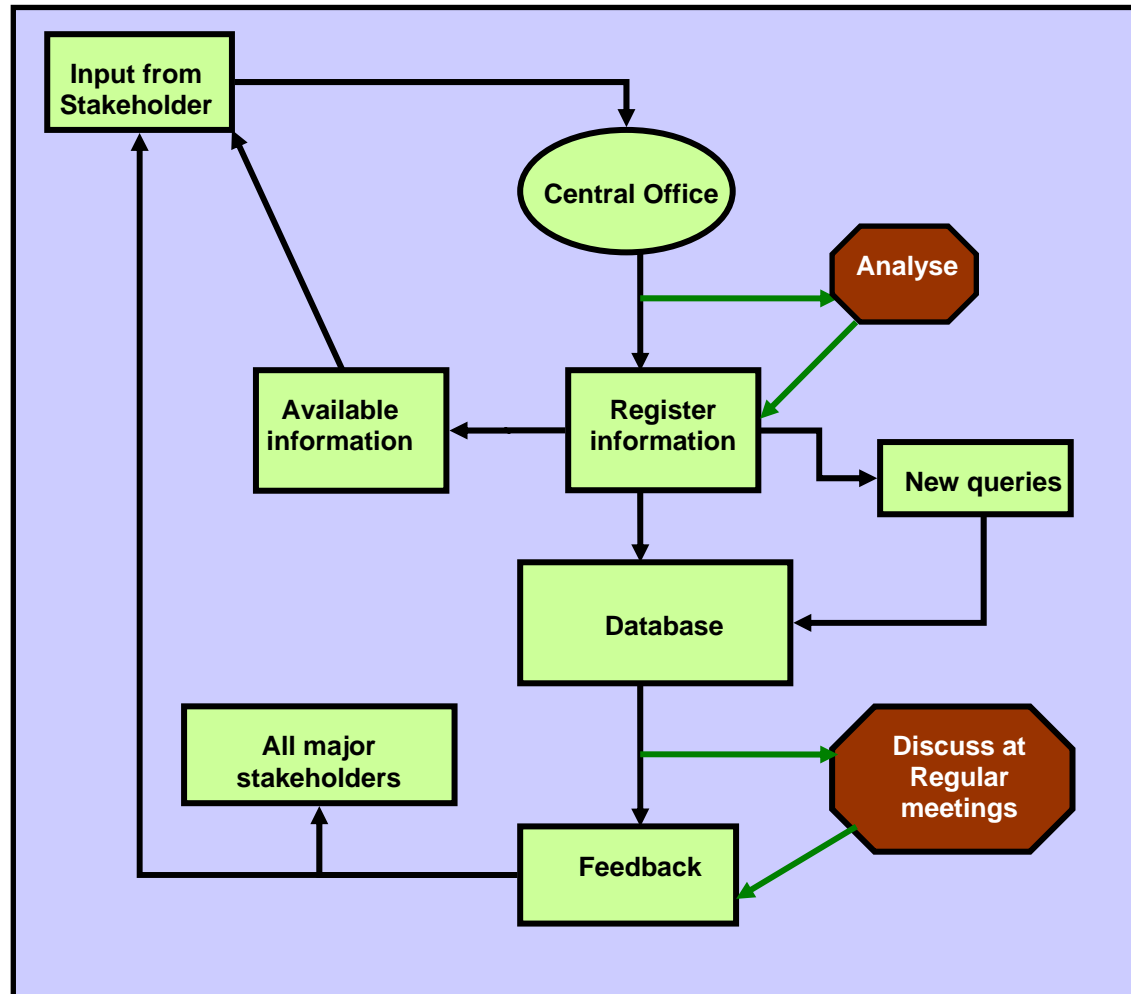
5.7 Business Chamber

The main issues are:

- Skills development especially in the fields of building and construction.
- Municipal Dams
- Communication with role players
- Water Supply



6. Communication Plan



An overall co-ordinator should be selected to manage the communication between stakeholders. A central office should be selected for all information to be forwarded to. Once filtered, the relevant information should be captured on AGIS, where all users can access the information.

Regular meetings must be held where all stakeholders from both the National and Provincial Departments are involved. The project should be included on committees such as the Co-ordinating Committee on Agricultural Water (CCAW) where regular feedback will be given. A Project Steering Committee and a Project Management Committee should be established when the detailed Communication Plan is drawn up.



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7. Possible Project Options

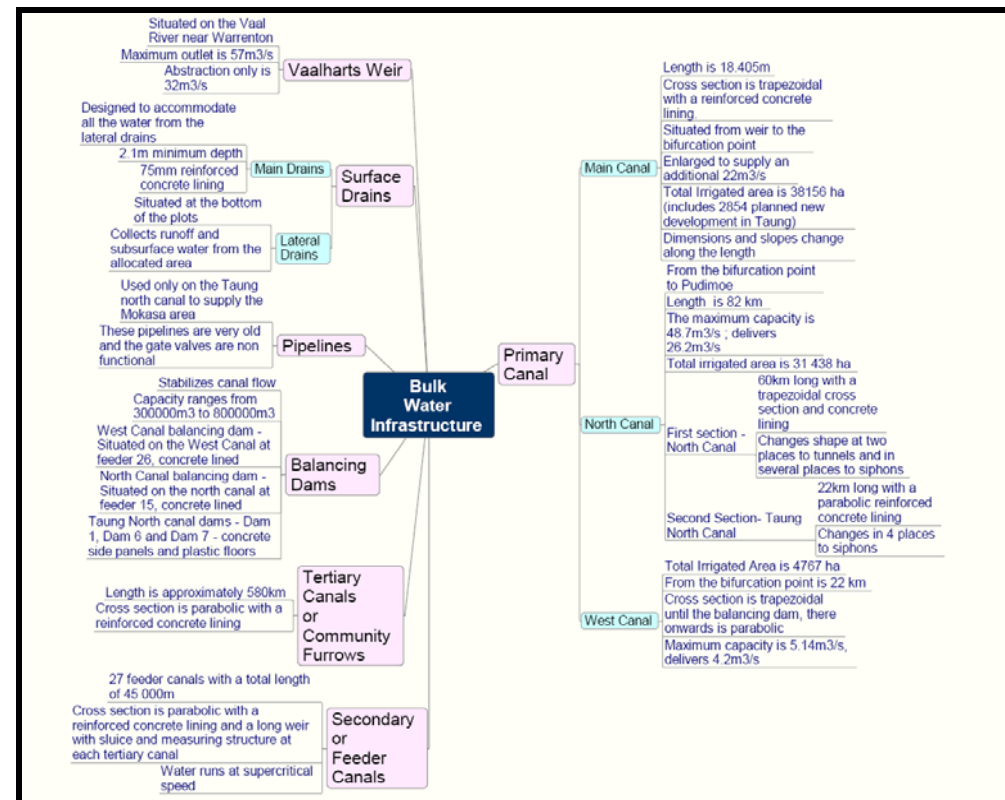
7.1 Bulk Water

Current Situation

The Department of Water Affairs and Forestry (DWAF) is the custodian of the Vaalharts bulk water system while Vaalharts Water Users Association (VWUA) is responsible for the operation, management and maintenance of the bulk water system. This includes the inlet structures and tunnel in the weir, the balancing dams and all sluices along the system. Clearing of vegetation along all the canals is the responsibility of the VWUA. This process is currently in place through an existing tender process. The clearing of vegetation on the community furrows is the responsibility of the farmer.

The water right for the Vaalharts Irrigation Scheme was amended in 1979 when the quota was increased from 7700m³/ha/annum to 9140m³/ha/annum. However the condition of the current canal system does not have the adequate capacity to distribute the extra volume to the end user.

The bulk water system is losing on average 35% of the water through seepages due to the poor condition of the infrastructure. Only the main canal was enlarged. A new canal was installed for sections from the Vaalharts weir up to the Warrenton-Vryburg tar road, from there onwards it was relined and enlarged at the top.





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Analysis of Current Situation



A groundwater flow map was correlated from 1820 holes that were drilled within the scheme. Verification was performed on the scheme at the intersection of the stream lines and the infrastructure to determine the problems.

	Problem Areas	Total Area	% Problem
Main canal	3723m	18 405m	20.2 %
North canal	47 000m	60 000m	78.3 %
Taung north canal	22 000m	22 000m	100 %
West canal	22 000m	22 000m	Enlarge
Secondary or feeder canals	45 000m	45 000m	Enlarge
Secondary or feeder canals	176 diversion and measuring structures	176 diversion and measuring structures	100 %
Tertiary canals or community furrows	580 000m	580 000m	100 %
Tertiary canals or community furrows	176 diversion and measuring structures	176 diversion and measuring structures	100 %
Balancing dams	3 dams	5 dams	60 %



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Limitations

The flow of allocated water cannot be stopped during the construction phase as it is fully operational. During winter, the water flow is stopped for a two week period on three occasions. Two days of the 14 days is required for water seepage back into the canal and another 2 to 3 days are required for curing of the specified lining. Construction can take place during the remaining 9 days. On parts of the system where construction is planned alongside the existing canal or enlargements without the water allocations being hampered, construction can take place through out the year.

Specifications, details norms & standards and allocations will be provided in the detail designs.

Monitoring

A system will be implemented within the scheme to monitor the water usage, quality and loses within the scheme. Probes will be installed at strategic locations such as in the canal, off-takes and drains. Data will be recorded, logged and transferred to a database. This system will be valuable in the planning, implementation and maintenance phases to prioritise the problem areas and minimise leakages.

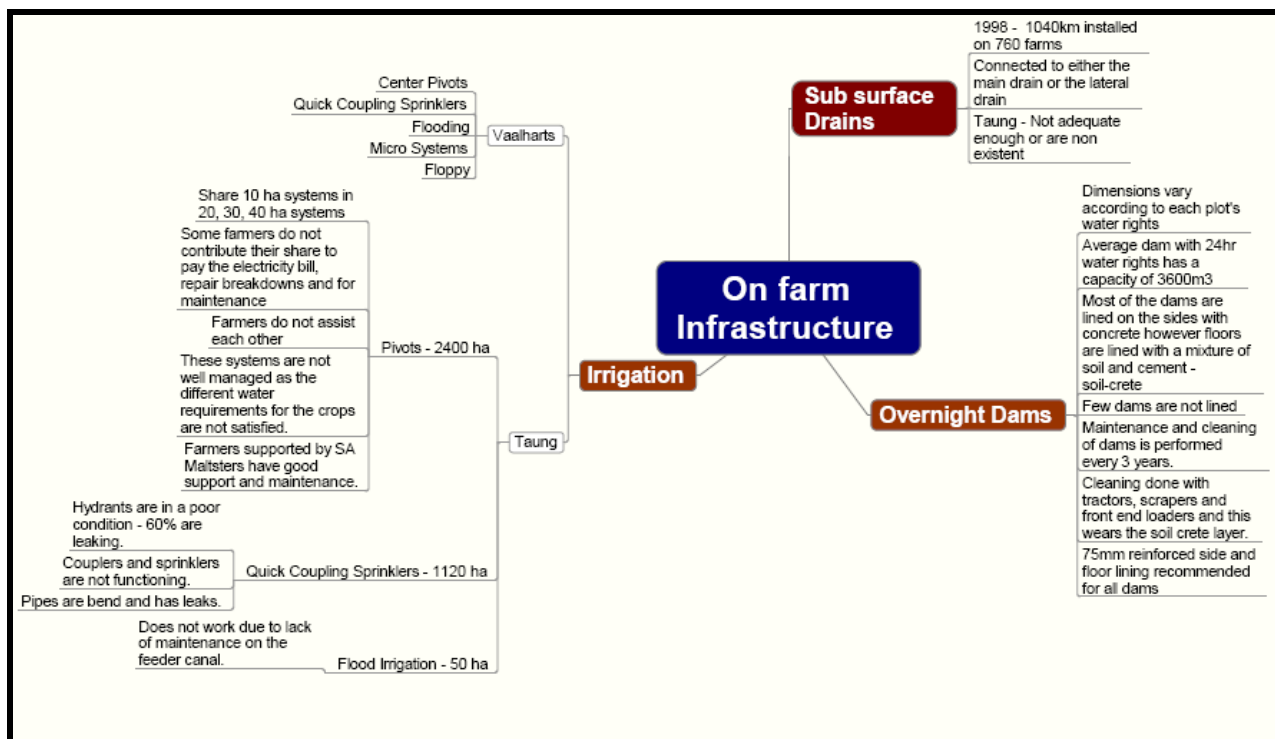


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7.2 On Farm Infrastructure

Current Situation



GIS analysis from the determined water table indicated that almost 67% of the 1250 dams have an adjacent ground water level of less than 1m.

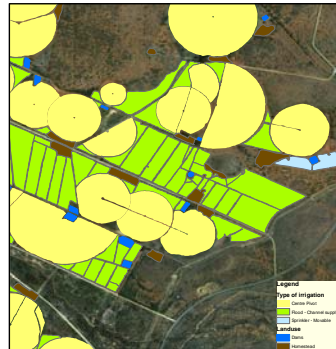
Water level	No Dams (total)	% of total dams (1250)
0 – 0.1 m	80	6.4
0 – 0.3 m	226	18.08
0 – 0.5 m	458	36.64
0 – 0.7 m	752	60.16
0 – 0.9 m	841	67.28



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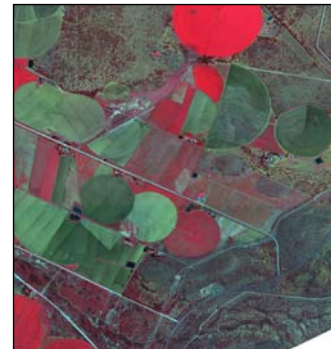
Analysis of Current Situation



LAND USE - TYPE OF IRRIGATION



ORTHO IMAGE - RGB



ORTHO IMAGE - NIR



VISUAL DRAINAGE PROBLEMS



CORRELATION LESS THAN 1M



CORRELATION LESS THAN 0.5M

GIS analysis was performed to obtain the extent of the problems.

Irrigation Type	Area (ha)	Visual Drainage Problems for specified water table (%)	
		0.5m	1.0m
Drip	283.09	18.94	57.71
Centre Pivots	911.13	7.20	12.39
Flood	17592.48	10.30	26.98
Sprinkler	2119.58	44.63	49.24
Micro	475.49	4.88	12.40



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7.3 Extension

A Support system is recommended for the Vaalharts area, comprising of soil conservation, engineering crop scientists, research and irrigation experts. The purpose of the system will be to provide technical expertise to the farmers. Records should be kept comprising of the information to limit the recurring problems:

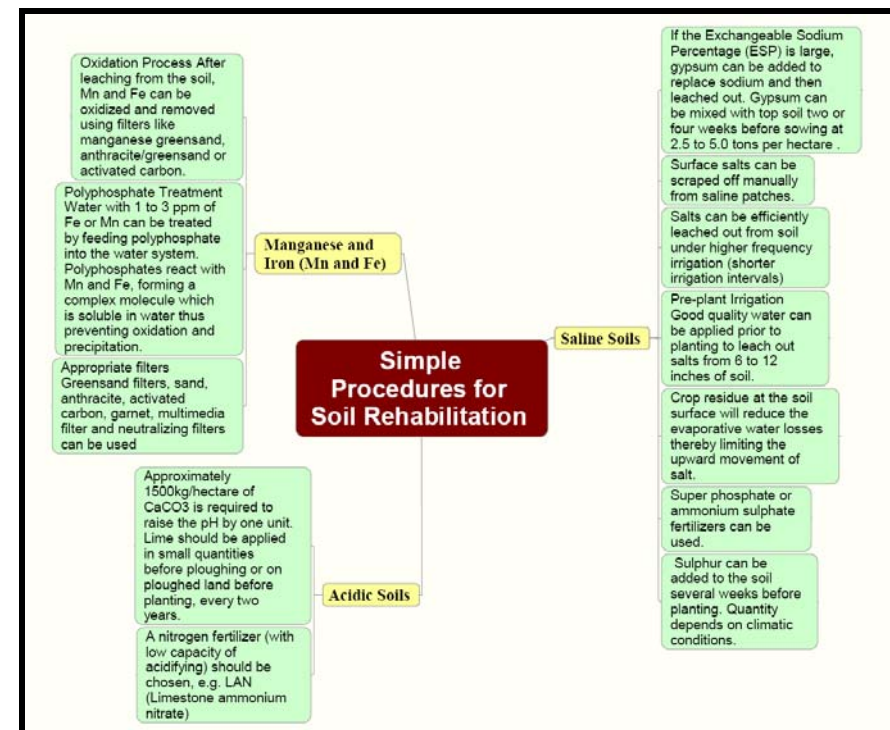
The extension service also ensures that farmers use good management practises. Service Providers should be utilised until the necessary skills are acquired. Workshops or training may be required to empower the extension officers and farmers in the area. Examples of management practices are:

Correct application of the right fertilizers			
Good irrigation practices	Residue Management	Crop rotation practices	Weeds management, pest control
Management of accumulated salts/elements within the soil			

Waiting for Information from N. West

7.4 Soil Treatment

In addition to installing infrastructure to provide drainage and leaching, additional simple procedures can also be used to rehabilitate the soils. Soil analysis should be done on a regular basis and records should be kept.





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7.5 Water Quality

	Range (mg/L)
TDS	287 to 2597
Chlorine	88 to 477
Inorganic Nitrogen	8.3 to 39
Manganese	0.041 to 0.716
Iron	0.22 to 0.84
Boron	0.109 to 0.216
Sodium	59 to 178

From the few samples that were analysed, salinity- TDS, chlorine content, inorganic nitrogen, sodium - Sodium Adsorption Ratio (SAR) were found to be relatively high. This can lead to clogging of irrigation system, corrosion, and scale deposits.

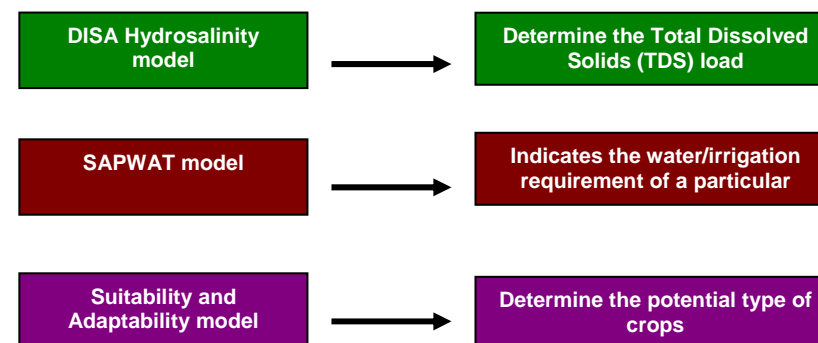
In order to select a feasible option, further analysis of more water samples taken during the different seasons is required. The quality of the water should be monitored on a continuous basis to obtain the varying concentrations of the constituents and to determine the effect that the different phases of farming have on the water quality.

Depending on the analysis, water quality treatment options such as desalination plants, controlled artificial wetlands, aquaculture and recycling after dilution should be considered. Recycled water can also be used for crops that are salt tolerant.

7.6 Crop Potential

Crop potential is influenced by various factors such as the type of crops, crop yields, soil conditions, water requirements, climate and market viability of the crops. Due to the large extent of salinity in the area, more salt tolerant crops should be considered.

In order to optimize crop production in the area, potential crops and the requirements should be determined using various models like:



Good practices such as scheduling, using crop factors, crop rotation and the selection of viable crops should be included in the extension services.



7.7 Marketing and Export

Waiting for Information from N. Cape

Waiting for Information from N. West

7.8 New Development in Taung

Waiting for Information from N. West



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8. Project Cost

Project Tasks	Cost (R)
Development of new area in Taung	
Area for expansion	5, 000, 000.00
Legal Requirements	1, 000, 000.00
Detail Planning	12, 000, 000.00
Plans and Specifications	12, 000, 000.00
Implementation Plans	6, 000, 000.00
Construction	608, 000, 000.00
Closure and Handover	6, 000, 000.00
Total Costs	650, 000, 000.00
Monitoring	49, 000, 000.00

Project Tasks	Cost (R)
Upgrading of existing Infrastructure	
Overhead Planning	10, 000, 000.00
Irrigation Systems	94, 600, 000.00
Sub-Surface Drainage	420, 000, 000.00
Overnight Dams	589, 500, 000.00
Community Furrows	367, 500, 000.00
Feeder Canals	52, 500, 000.00
Main Canal	315, 000, 000.00
Surface Runoff	10, 500, 000.00
Departmental Drains	210, 000, 000.00
Balancing Dams	95, 400, 000.00
Total Costs	2, 165, 000, 000.00



9. Maps

The attached CD comprises of the following maps:

1. Area of Project
2. Climate
3. Condition of Bulk Water System
4. Current Crops in Area
5. Effects of Crop Cultivation
6. Existing Infrastructure – Markets, Processing, Clinics etc
7. Groundwater Stream lines
8. Land Type
9. Location of Project Area
10. Permanent, Cash and Unused Area
11. Questionnaires
 - 11a. Community Furrow
 - 11b. Dams
 - 11c. Drainage
 - 11d. Drainage with Iron and Manganese
 - 11e. Feeder
 - 11f. Management Practises
12. Type of Irrigation
13. Verification of stream lines
14. Visual Drainage Problems
15. Water Table



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Revitalisation of the Vaalharts/Taung Irrigation Scheme

SENIOR ENGINEER: PROJECT PLANNING SECTION

Date: _____



DIRECTORATE AGRICULTURAL ENGINEERING SERVICES

Revitalisation of the Vaalharts/Taung Irrigation Scheme

Recommendation

CHIEF ENGINEER: AGRICULTURAL ENGINEERING SERVICES

DATE: _____



DIRECTORATE AGRICULTURAL ENGINEERING SERVICES

Revitalisation of the Vaalharts/Taung Irrigation Scheme

Recommendation

DIRECTOR: AGRICULTURAL ENGINEERING SERVICES

DATE: _____