3 Description of the Project

This chapter describes the Project, which would ultimately produce 400,000 t/a of raw sugar and 160,000 t/a of molasses for sale on export markets. The development and operation of the projected new agricultural lands are described, as well as the associated infrastructure facilities. Other topics covered include processing of the sugarcane crop into the final products, management of the waste products produced by the raw-sugar mill, and construction issues.

3.1 PROJECT SCOPE AND TIMING

3.1.1 Scope

The Project is based on development of flood-irrigated farmland within the Project Area predominantly for sugarcane production to provide feedstock for the operation of a 400,000 t/a raw sugar mill. The raw sugar and the molasses by-product would be trucked from the mill to purpose-built storage facilities at Wyndham where they would await export.

Wesfarmers–Marubeni would own and operate the proposed raw-sugar mill and associated export facilities at the port of Wyndham. Wesfarmers–Marubeni would also own approximately 29,000 ha of irrigated farmland and operate that farmland as one sugarcane plantation business. Over time and as the supply of cane with the desired quality attributes becomes well proved, the corporate farm may be gradually subdivided and sold down to independent sugarcane growers.

Approximately 3,000 ha of land within the Project Area would also be made available by Wesfarmers–Marubeni for sale to independent farmers on an unconditional basis with respect to the types of crops grown. The crops grown on this land may or may not include sugarcane.

The off-farm irrigation, drainage and flood protection infrastructure would be developed, owned and operated by the Water Corporation. It is envisaged that the cost associated with the development and operation of the irrigation infrastructure would be recovered through the sale of irrigation water to the corporate and independent farms.

Table 3.1 provides a summary of the scope of the Project.

Table 3.1 Scope of the Project

Item	Amount
Land within the Project Area	76,000 ha*
Land managed for conservation**	41,000 ha*
Infrastructure area	3,000 ha*
Wesfarmers–Marubeni sugarcane estate	29,000 ha*
Land for independent farms	3,000 ha*
Land outside Project Area	
M2 Channel (Lake Kununurra to Project Area)	690 ha
Wyndham Port facilities	1 ha
Production	
Raw-sugar	400,000 t/a
Molasses	160,000 t/a
Infrastructure	
Irrigation channels	160 km
Annual water requirement	740 GL
Drains	153 km
Flood protection levees	142 km
Balancing storage dams (operating volume)	5.6 GL
Roads	161 km
Power lines	165 km
Wyndham port	
Raw-sugar store	180,000 t
Molasses store	75,000 t

* *Areas rounded to the nearest '000 ha.*

** *Includes some 2,000 ha that would otherwise be suitable for farming.*

3.1.2 Relationship to other developments

The Project would essentially be independent of other irrigation developments in the region.

The Project would abut the easternmost extremity of ORIA Stage 1 on the Ivanhoe Plain in the vicinity of Cave Spring Gap. ORIA Stage 1 is served by the M1 Channel, and the proposed M2 Channel would be developed in a parallel alignment to the M1 Channel for the first 23 km of its length from the off-take at Lake Kununurra. It is envisaged that the M2 Channel would have a stand-alone management and operation system.

It is possible that some farmers in ORIA Stage 1 may wish to expand their current operations into the Project Area. Even under these circumstances any farm operations in the Project Area would need to be consistent with the environmental commitments made in this ERMP/draft EIS and the environmental conditions imposed on the proposed development.

Government is also considering the development by others of other components of ORIA Stage 2, described in Section 1.1.3, for agricultural purposes. This land is located as follows:

- Mantinea Plain;

- west bank of the Ord River;
- Carlton Plain.

All of the above developments, if they proceed, would share the same source of water derived from releases from Lake Argyle; however, they would be independent of the Project, and would require separate environmental assessment prior to proceeding.

3.1.3 Programme

The development schedule (Figure 3.1) would be staged to maximise the delivery of cane to the sugar mill in the early years, so as to underpin the economics of the Project. It is envisaged that farm development would be substantially complete in 2003 and the first cane would be harvested for processing by the mill in the same year, coinciding with the completion of mill construction. It is envisaged that full cane production would be achieved in the dry season of 2005.

Construction of the sugar mill would continue during both the dry and wet seasons. Other construction would occur predominately during the dry season as ground conditions during the wet season would prohibit significant land development activities. Cane-planting requires ‘seed cane’ harvested from the previous season’s growth. On an indicative basis, one hectare of cane would produce sufficient seed cane to plant a further 10 ha. The development schedule allows for the progressive development of seed cane stocks from an initial nursery of 1,000 ha, which would probably be developed on the Weaber Plain in 2001.

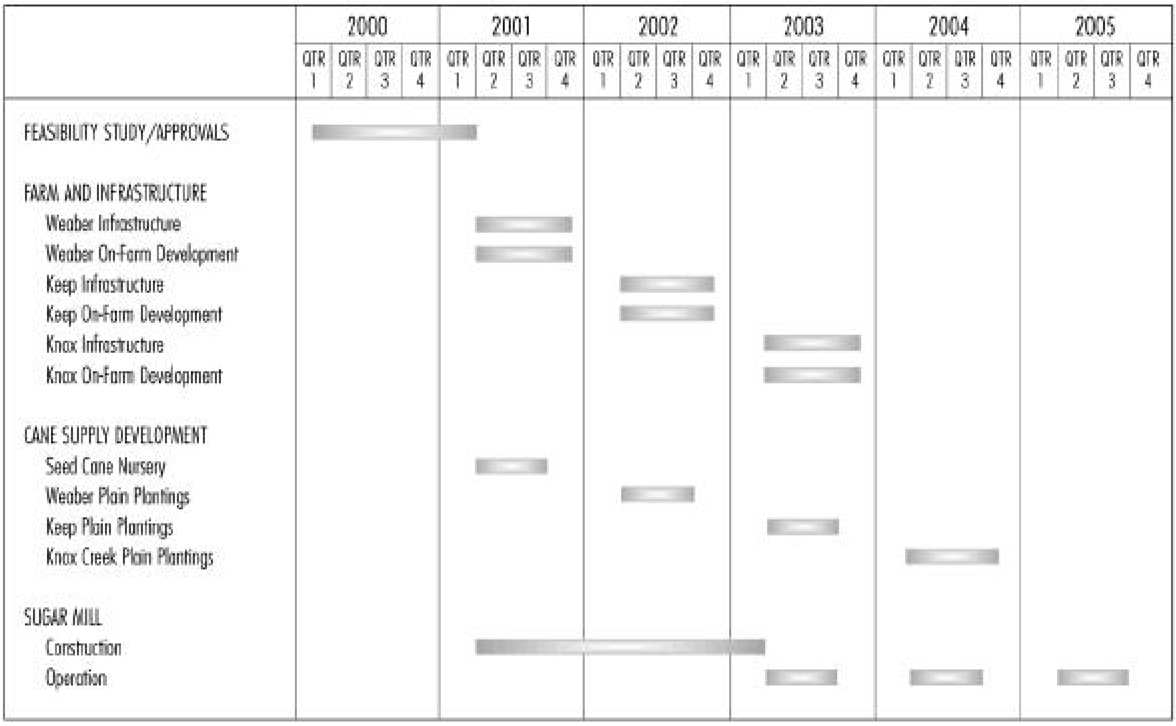


Figure 3.1 Indicative Development Schedule

3.2 FARM DEVELOPMENT AND OPERATION

3.2.1 Farm development

The agricultural component of the Project is based upon the development of a series of farm units of, notionally, 400 ha each for both the Wesfarmers–Maurbeni corporate farm and farms that would be owned by independent farmers. The farm units would be linked by the infrastructure described in Sections 3.5 and 3.6 and predominantly provide sugarcane for a raw-sugar mill described in Section 3.7.

The farm development (on-farm irrigation and potable water supply, power and telecommunications, and access roads) has been designed so as to readily enable subdivision and sale of the farmland at some point in the future.

The farm unit layout is governed to a large extent by the desire to achieve uniform water application to the crop. This necessitates that farm units (or blocks within a unit) have:

- uniform soils
- uniform slopes
- uniform row/furrow lengths.

Farms would be designed to facilitate the operation of large-scale farm equipment to optimise economies of scale. The width of farm blocks, or bay length, would be approximately 500–800 m, whilst the length of blocks would be maximised subject to the geometry of the three plains. The limiting factor with respect to row length would be the potential for accumulation of trash in the furrows. The naturally flatter Aquitaine soils of the Weaber Plain may therefore demand shorter row lengths.

The farm unit layout outlined in Figure 3.2 has been developed using the above principles, although it is recognised that some adjustment to the farm units may be made at the detailed design phase as further data are gathered.

Farm development would initially consist of the clearing of vegetation by burning to remove any grass cover. This would be followed by bulldozing to remove the generally sparse tree cover that occurs on the black-soil plains. The felled trees would be chipped to provide mulch for use in rehabilitation or pushed up into windrows and burnt. Removal of vegetation would also include the removal of roots and stumps by a combination of grubbing by bulldozers and mechanised pinwheel rakes, followed by hand-picking if necessary. The farm area would then be ploughed using heavy disc ploughs, and minor surface irregularities would be removed by towing a float board over the surface. On completion of the above activities, the land would be surveyed for level on a maximum interval spacing of 50 m. The level information would then be used by designers to optimise the datum and gradient of the farm units to optimise the soil cut-and-fill balance.

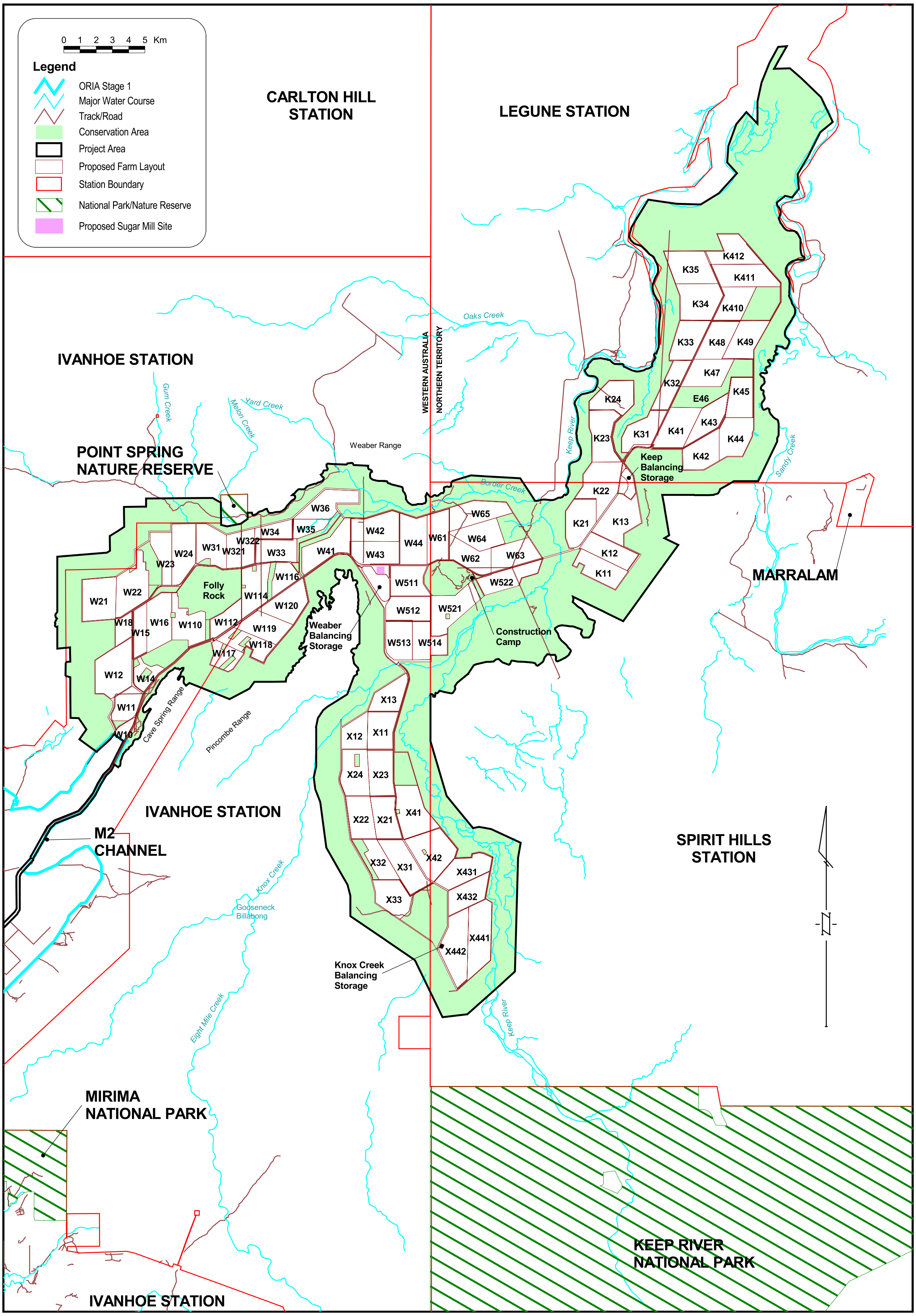


Figure 3.2 Farm Unit Layout

Land-levelling activities would follow shortly after design, using box scrapers towed behind large tractors and possibly with some final trimming using graders. As accuracy is an important feature of land-levelling activities, the levelling equipment would be guided by field laser. Farm development would then proceed with the construction of access roads, head ditches, tailwater return systems and stormwater drainage outlets. The water management components of the on-farm infrastructure are described further in Section 3.3. The standard proposed for the Wesfarmers–Marubeni corporate farm is for roads to be formed from the *in situ* black soil. Whilst access on these roads would be restricted during the wet season, the need for vehicle access around the farm during the wet season is expected to be minimal.

3.2.2 Ground preparation and planting

Ground preparation prior to planting would generally involve spraying with a herbicide such as glyphosate for the control of weeds, followed by cultivation to achieve an appropriate seed bed depth and tilth suitable for planting.

Sugarcane is grown from seed cane derived from the previous season's crop. This seed cane may be in the form of entire stalks or stalks chopped into smaller sections called billets. The seed cane is buried in rows and germination of the new plants occurs at the 'eyes' located at the nodes along the stalk.

It is envisaged that the Project would utilise modern planting machines that would combine the several required operations in one pass, including furrow-forming, fertiliser application, placement of the billets or stalks in the furrow, closing of the furrow and pressing of the soil on to the cane 'set'.

Section 3.4 describes the likely fertiliser and farm chemical requirements of the crop.

Planting of new sugarcane crops would depend on the cropping strategy adopted, but it is envisaged that replanting would be required every three to four years in the proposed development. In the intervening years, ratoon crops would be grown from the regrowth from the plant rootstock remaining following harvesting. Cultivation requirements for the ratoon crops would be kept to a minimum, and where necessary involve:

- cultivation of the inter-row;
- fertiliser application;
- weed control using a contact herbicide such as paraquat, or a pre-emergence herbicide, or by mechanical cultivation.

3.2.3 Sugarcane harvesting

Sugarcane harvesting operations would be similar to the methods being utilised in ORIA Stage 1. All cane-harvesting operations would take place during the dry season (April to November) and be scheduled to provide a continuous supply of cane to the raw-sugar mill.

Sugarcane harvesting would involve the following operations:

- cessation of irrigation to allow the farm block to dry out sufficiently to allow access by harvesting equipment;

- burning of the crop immediately prior to harvest. Burning operations would generally be undertaken at night. Burning is required to reduce the amount of trash associated with the cane at harvest, and it also confers other benefits such as the destruction of pests;
- harvesting of the cane using mechanised harvesters that remove the tops and remaining trash and cut the cane stalks into billets. The harvesters would load the billets directly into haulout vehicles;
- transfer of the sugarcane billets from haulout vehicles into road trailers for transport to the mill (Section 3.7);
- tagging of all loads to allow the mill to assess the quantity and quality of cane and the sugar content of each load.

It is generally believed that green-cane harvesting, which avoids the need to burn the crop prior to harvesting, would not be suitable for the ORIA. Currently some 60% of the sugarcane crop in Queensland and New South Wales is harvested using green-cane techniques and the proportion has been increasing steadily over recent years. However, in the Burdekin District of Queensland, which has similar cane yields and irrigation systems to Ord Stage 1, less then 5% of the crop in 1997 was harvested using green-cane techniques (Bureau of Sugar Experiment Stations 1998). As for the Burdekin District, the main reason preventing adoption of green-cane harvesting in Ord Stage 1 is that the sugarcane has particularly high trash levels and the residual trash blanket would interfere with the efficiency of the flood irrigation system. Green-cane harvesting is also slower and more costly than harvesting of burnt cane and results in higher trash levels being delivered to the mill.

3.2.4 Farm management

Certain management constraints would apply to farms within the Project Area. These would include the timing of the harvest to maintain continuous sugar production at the sugar mill, and the honouring of environmental commitments made in this ERMP/draft EIS, and any Ministerial Conditions that may apply to the Project. Wesfarmers–Marubeni and the Water Corporation would prepare an EMP for the Project upon receipt of environmental approval. The EMP would incorporate all the requirements of the commitments and conditions that apply to the Project and be prepared in consultation with the DEP, the DLPE and other relevant regulatory authorities.

Compliance with the EMP would be mandatory for all landowners and occupiers within the Project Area.

3.2.5 Sugarcane research and development

To maximise long-term sugar yields, a fully resourced and funded research and development programme would be established by Wesfarmers–Marubeni.

Core research programmes would include:

- the introduction/evaluation of new cane varieties
- plant nutrition
- pest and disease control

- weed control
- farming systems related to soil and water conservation.

Small-scale plot trials may be performed at the existing research station at the Frank Wise Institute, given the existing investment in equipment and irrigation facilities for small-scale plot trials at that facility. Trials conducted at the research station may include variety testing, and pest and weed control.

Larger scale trials would also be conducted on the Wesfarmers–Marubeni corporate farm, to more accurately reflect the soil conditions of the Project Area. An area of approximately 80 ha would be set aside for this purpose.

Relevant results from the research and development programme would be incorporated into updates of the EMP.

3.3 ON-FARM WATER MANAGEMENT

3.3.1 Crop water requirements

Estimates of the in-field water requirements for the major crops likely to be grown on the black soil areas of the ORIA are set out in Table 3.2.

Table 3.2 Estimated in-field water requirements for irrigated crops in the ORIA

	Monthly water requirement (ML/ha)						
Month	Cotton (furrow)*	Sugarcane (furrow)*	Leucaena (furrow)*	Forage maize (furrow)*H	Hybrid seed sorghum (furrow)*	Hybrid seed sunflower (furrow)*	Chick pea (furrow)*
January	–	0.29	1.00	–	–	–	–
February	–	–	0	–	–	–	–
March	–	0.67	1.00	–	–	–	–
April	0.94	1.43	2.00	1.00	1.50	1.50	1.50
May	1.41	1.96	2.00	0.75	1.10	1.10	1.00
June	1.41	1.72	1.00	2.25	1.20	1.60	1.40
July	1.88	1.80	1.50	2.25	1.95	2.00	1.40
August	2.82	2.32	1.50	0.75	1.30	0.50	1.40
September	2.82	2.57	2.00	–	–	–	–
October	–	2.24	2.00	–	–	–	–
November	–	1.88	2.00	–	–	–	–
December	–	1.21	2.00	–	–	–	–
Total	**11.28**	**18.09**	**18.00**	**7.00**	**7.05**	**6.70**	**6.70**

* *Seventy-five per cent application efficiency, typical of flood irrigation in the ORIA, assumed.*

H *Established leucaena undersown with pasture.*

Source: Sherrard 1994

Cotton has the highest monthly water requirement of 2.82 ML/ha in August and September, closely followed by sugarcane, which has a requirement of 2.57 ML/ha in September. The peak demand for both crops therefore occurs late in the dry season when significant rainfall is rare. Sugarcane has the highest estimated annual water requirement of 18.09 ML/ha, closely followed by established leucaena undersown with pasture.

The 1-in-5-year recurrence interval monthly evaporation is approximately 10% above the average evaporation rate, and during these times the peak water requirements could be 10% above those shown in Table 3.2. For cotton this peak monthly water requirement is therefore about 3.10 ML/ha.

Precision farm water management techniques would be developed for the Project Area and their adoption would be required under the proposed Environmental Management Plan. It is anticipated that these techniques would be based upon measurement of actual crop water use in the soil profile to determine the timing and magnitude of irrigation applications. For example, current planning assumes an application of about 90 mm of irrigation water following an estimated evapotranspiration loss of the same value in the crop.

3.3.2 Tailwater management systems

All farms in the Project Area would be developed with irrigation tailwater management systems. Irrigation tailwater is the water that would leave the bottom of the furrows during watering. Irrigation tailwater is unavoidable if uniform water application to the crop is desired.

A conceptual tailwater management system proposed for use in the Project Area is outlined in Figure 3.3 and would consist of the following elements:

- a tailwater ditch that would collect tailwater from the furrows and deliver tailwater to a tailwater dam;
- tailwater dams. The volume of these dams would be optimised during detail design with the objective being to minimise off-farm discharges of irrigation tailwater during the dry season. As a minimum, the tailwater dam capacity would be sufficient to provide the specified first-flush stormwater retention capacity (Section 5.5.2 refers) for the Project—12 mm of rainfall runoff for sugarcane farms and 25 mm of rainfall runoff from other farms;
- tailwater return pumps and pipelines that would return irrigation tailwater to the farm head ditch or to other intermediate points in the farm irrigation system for application to the crop. The tailwater return pumps would be configured to operate at partial filling of the dam, thereby reducing the volume of tailwater requiring storage.

Observations indicate that some 25–50% of the applied water in ORIA Stage 1 is discharged to the drainage system as tailwater. The farms on ORIA Stage 1 were not developed with tailwater return systems as the merits of tailwater return systems were not widely known at the time of development.

3.3.3 Crop drainage requirements

Drainage requirements would be largely dependent upon the crops grown, as different crops have different tolerance levels to flooding. Sugarcane is a crop that is tolerant to flooding:

research in Queensland has shown that sugar yields are not depressed by up to 72 hours' inundation and that yield depressions by longer periods of inundation is insufficient to justify significant expenditure on drainage.

For crops other than sugarcane it is usually sufficient to adopt a design criterion that aims to remove water from the 'design storm' in 48 hours. The design storm is generally a storm in duration of 48 hours and a recurrence interval of five years. In Kununurra this equates to a storm with a rainfall intensity of 3.7 mm/h.

3.3.4 Collection and discharge of stormwater

A portion of water from any rainfall event would infiltrate into the soil profile, with the magnitude of this proportion dependent upon the intensity and duration of the rainfall event and the moisture content of the soil immediately prior to the rainfall event. Thus, low-intensity or short-duration rainfall events may produce little or no runoff from farm areas that are not saturated. The converse is also true, with a high proportion of runoff expected from high-intensity or long-duration storms, particularly from farm areas that were either irrigated or subject to a rainfall event immediately prior to the storm occurring.

Rainfall runoff from the cropped areas would be collected by the irrigation furrows and the tailwater collection system. As discussed in Section 3.3.2, the tailwater storage dams would be designed to act as first-flush collection systems for stormwater. First-flush stormwater is likely to contain higher concentrations of sediment, organic matter, fertiliser and other farm chemicals than stormwater arising later in the rainfall event or subsequent rainfall events. Runoff would be retained in the tailwater management system for subsequent use as irrigation water. The remainder would discharge to the drainage infrastructure system (described in Section 3.5.2) and then either to the Keep River or to Sandy Creek.

3.4 FARM FERTILISERS, CHEMICALS AND THEIR USE

The predominant crop to be grown on the Project Area would be sugarcane. Experience with this crop in ORIA Stage 1 has shown that it has a low requirement for pesticides , in relation to other crops to grow successfully. The following sections describe the likely farm chemical and fertiliser use for sugarcane and other crops that may potentially be grown within the Project Area.

3.4.1 Sugarcane

The likely requirements for fertiliser for sugarcane grown within the Project Area, are as follows:

- *urea*; applied at an indicative rate of 400 hg/ha/a to provide a source of nitrogen
- *diammonium phosphate (DAP)*; applied at an indicative rate of 200 kg/ha/a to provide a source of nitrogen and phosphorus.

Fertilisers would be applied at planting and at some three to four weeks after planting. Ratoon crops would also be fertilised following the previous harvest.

Weed control would also be required for sugarcane and this would be provided by the application of herbicides such as glyphosate.

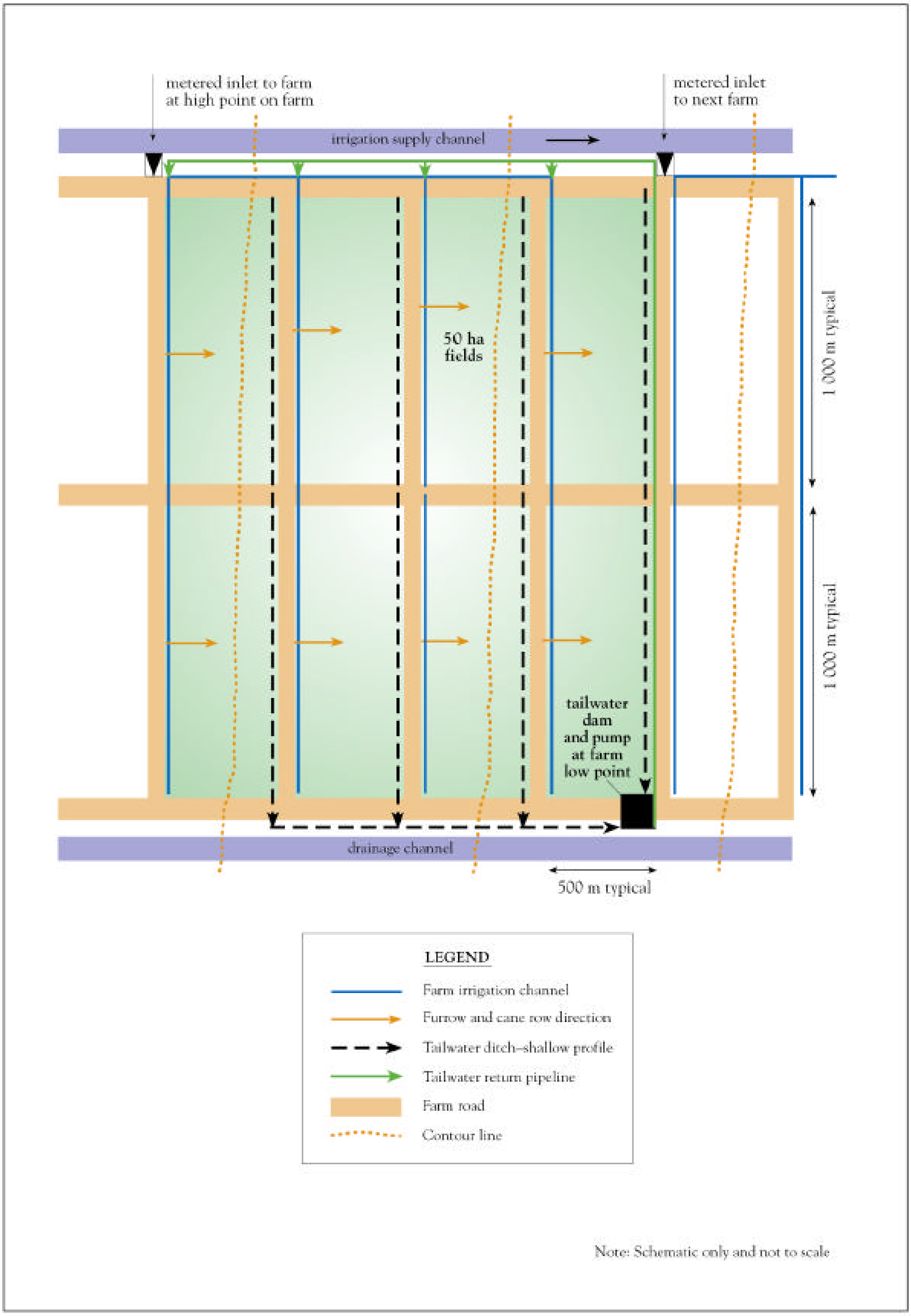


Figure 3.3 Conceptual tailwater return system

The primary means of managing diseases in sugarcane, such as the fungus Sugarcane Smut which was recently discovered in ORIA Stage 1, is to plant with varieties known to be naturally resistant to such diseases. Hence, as confirmed by experience with ORIA Stage 1, it is likely that minimal usage of pesticides or fungicides would be required by the sugarcane. Usage may involve the occasional application of a fungicide, such as Prochloraz, at the time of planting the seed cane.

3.4.2 Other crops

Farm chemical and fertiliser requirements for crops other than sugarcane would depend upon the actual crops under cultivation. Section 2.4.1 outlines the agricultural chemicals currently used in ORIA Stage 1. It is anticipated that a similar range of chemicals would be used on the land farmed by independent farmers within the Project Area.

In accordance with current practice in ORIA Stage 1, application of farm fertilisers and chemicals would involve direct application of fertiliser to the crop root zone and tractor-drawn boom-spraying and aerial-spraying in the case of herbicides and pesticides. Regimes of chemical and fertilizer usage in terms of type, timing and method of application, would be incorporated into the EMP to be developed for the Project Area (Section 3.2.4). These restrictions would as a minimum include:

- pesticide application in accordance with the annual spray calendar prepared for the ORIA;
- the use only of chemicals that are approved by the Governments of Western Australia and the Northern Territory;
- the successful completion of training for farm staff required to spray chemicals;
- commercial spray operators being required to be fully accredited under a national standards system;
- a ban on the use of endosulfan during the wet season (November to March) and at other times when the crop areas have free-standing water in either the furrows or tail drains;
- application of endosulfan to comply with the NRA review recommendations (Section 2.3.1 refers), and substitution of more benign insecticides for endosulfan wherever possible.

3.5 IRRIGATION, DRAINAGE AND FLOOD PROTECTION INFRASTRUCTURE

The Water Corporation would be responsible for provision of the entire off-farm irrigation, drainage and flood protection infrastructure required by the proposed development. The following sections describe the works proposed.

3.5.1 Irrigation infrastructure

The water supply and storage system for the Project are illustrated in Figures 3.4 to 3.6.

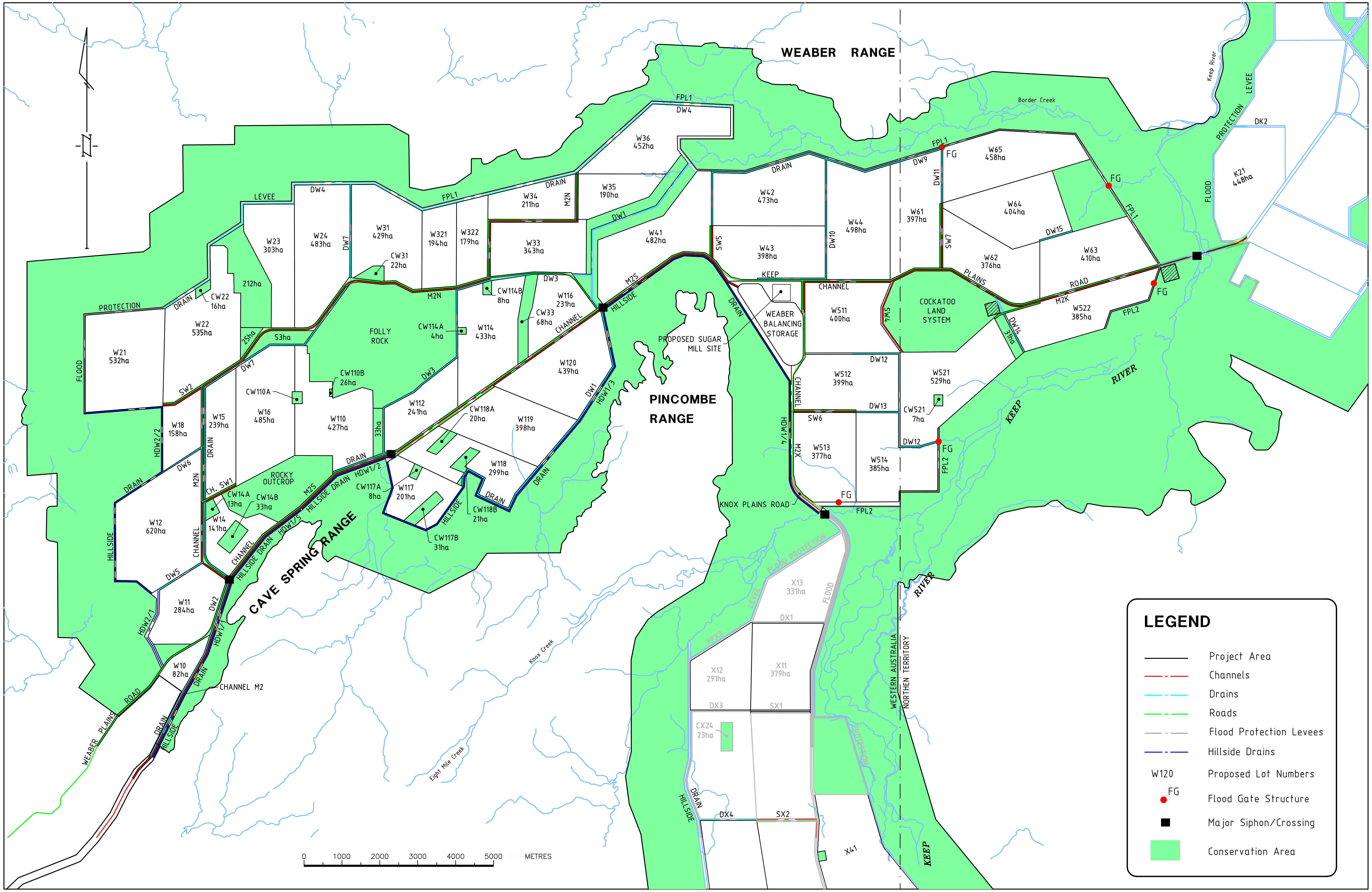


Figure 3.4 Infrastructure - Weaber Plain

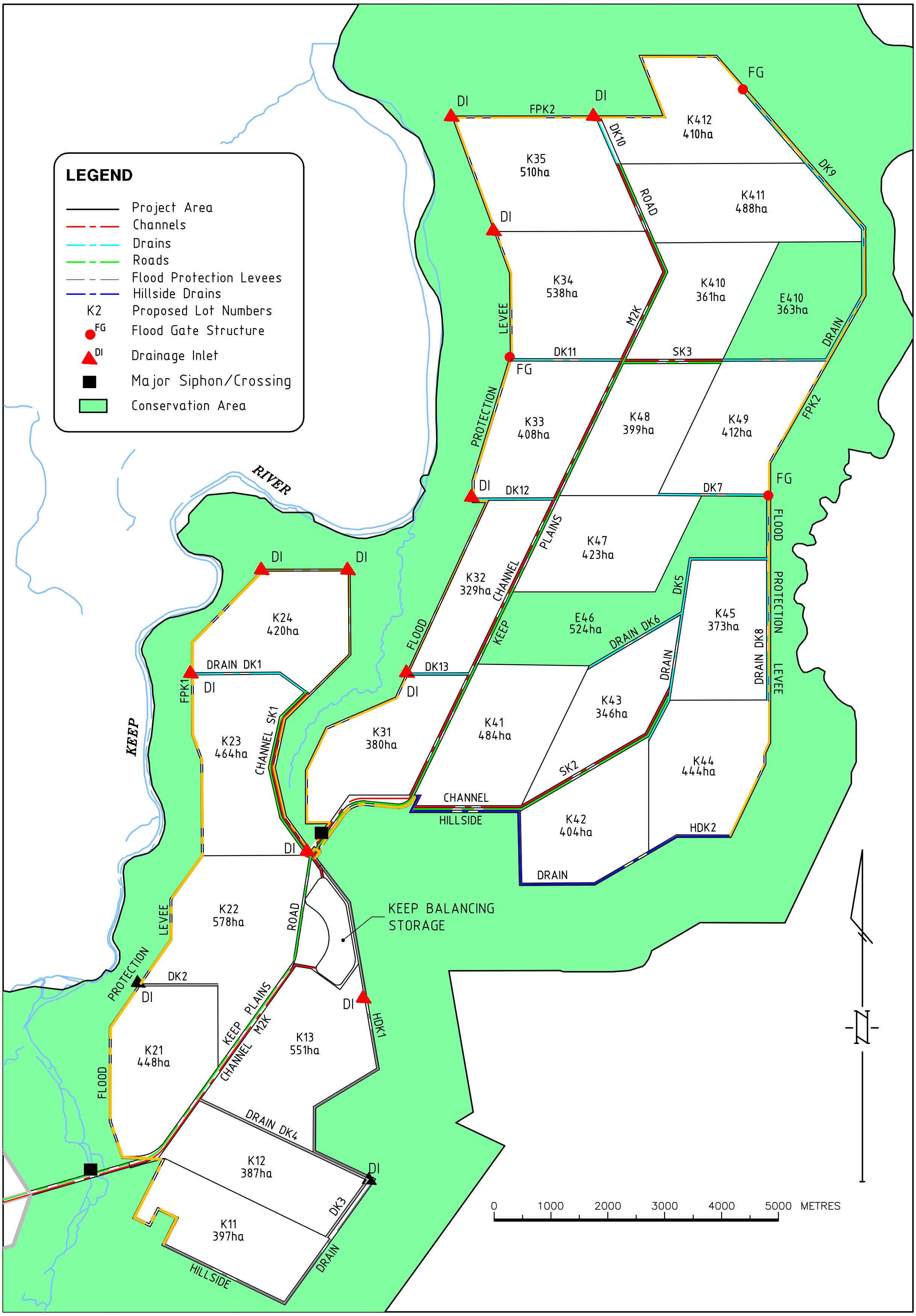


Figure 3.5 Infrastructure - Keep River Plain

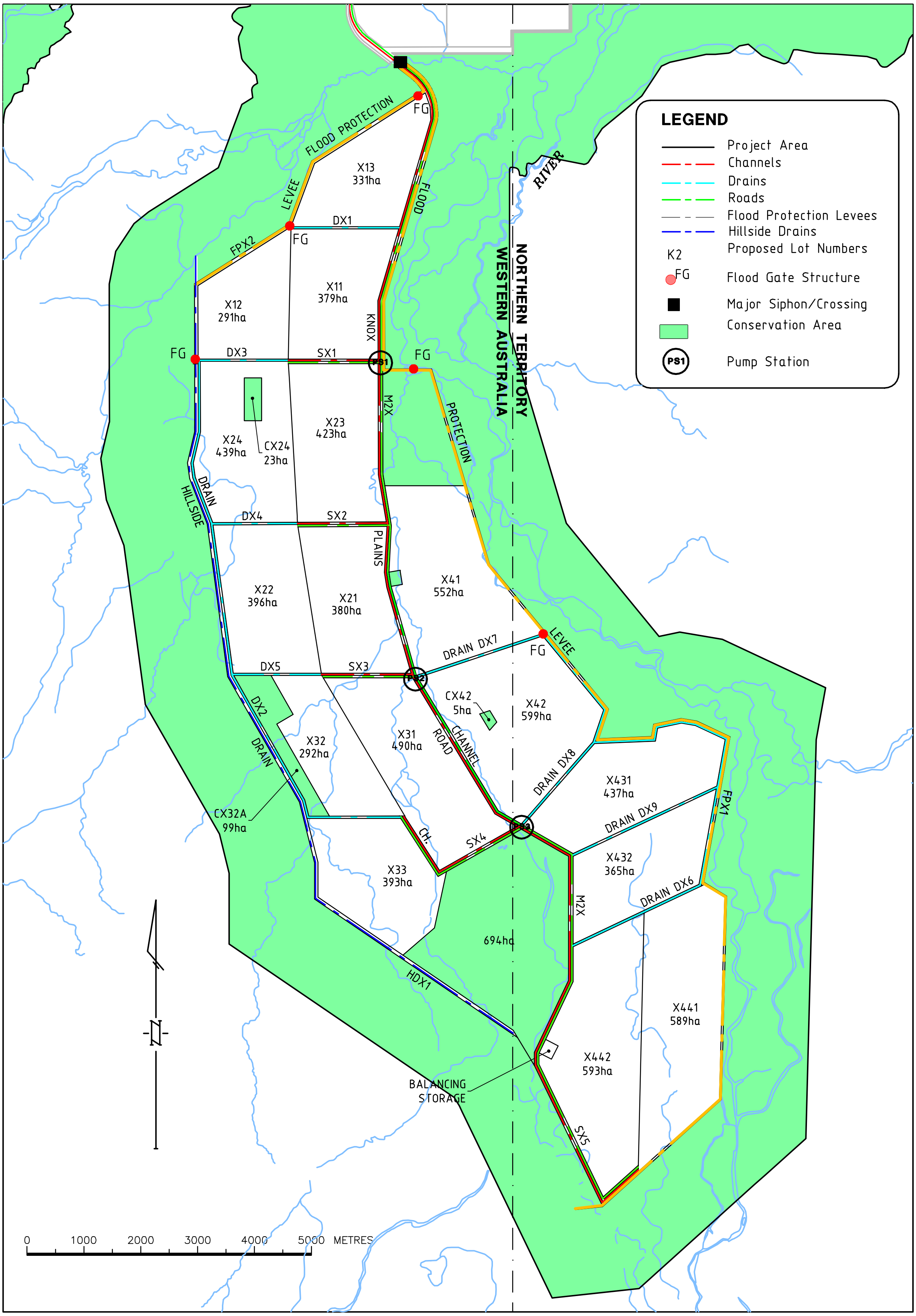


Figure 3.6 Infrastructure - Knox Creek Plain

Main supply channels

Irrigation water supply for the Weaber Plain, Knox Creek Plain and Keep River Plain would be sourced from Lake Argyle via the Ord River and Lake Kununurra. Irrigation water would be gravity fed from Lake Kununurra to the Project Area via a purpose-built channel, known as the M2 Channel.

The M2 Channel intake would be located adjacent to the existing M1 Channel intake structure on the north bank of Lake Kununurra. The proposed M2 Channel would be aligned parallel and east of the M1 Channel for some 24 km, to the point where the M1 channel terminates at the southern end of Cave Spring Gap.

Through Cave Spring Gap, the M2 channel alignment would be along the base of Cave Spring Range. On the Weaber Plain, the M2 channel would bifurcate to form the M2N Channel and the M2S Channel. The former would service the northern portion of the Weaber plain and terminate at the supply point to farm block W36, and the latter would service the southern portion, and terminate at the Weaber Balancing Storage.

From the Weaber Balancing Storage, main supply channels would be constructed to supply the Keep River Plain, including the eastern portion of the Weaber Plain, and the Knox Creek Plain. The former would be known as the M2K Channel, and the latter as the M2X Channel.

The supply channels would be open excavations with sloping sides (Figure 3.7). The soil from the excavation would be used to form compacted banks on each side of the channels, and the banks would be around 4–5 m wide at their crest. Typically, the channel water levels would be above natural surface level. At some locations, however, the water level would be below the natural surface water. Bed widths (the channel bases) would be between 4 m and 14 m. Compacted clay channel lining would be provided in locations where the channel would be constructed in more permeable soils, and in these locations. The channel lining would be at least 0.5 m thick over the bed and the lower 1–2 m of the channel batters.

Surplus water in the M1 Channel currently discharges via a drain onto the Weaber Plain. This practice would be discontinued if the proposed development were to proceed and any surplus water would remain within the ORIA Stage 1 water system.

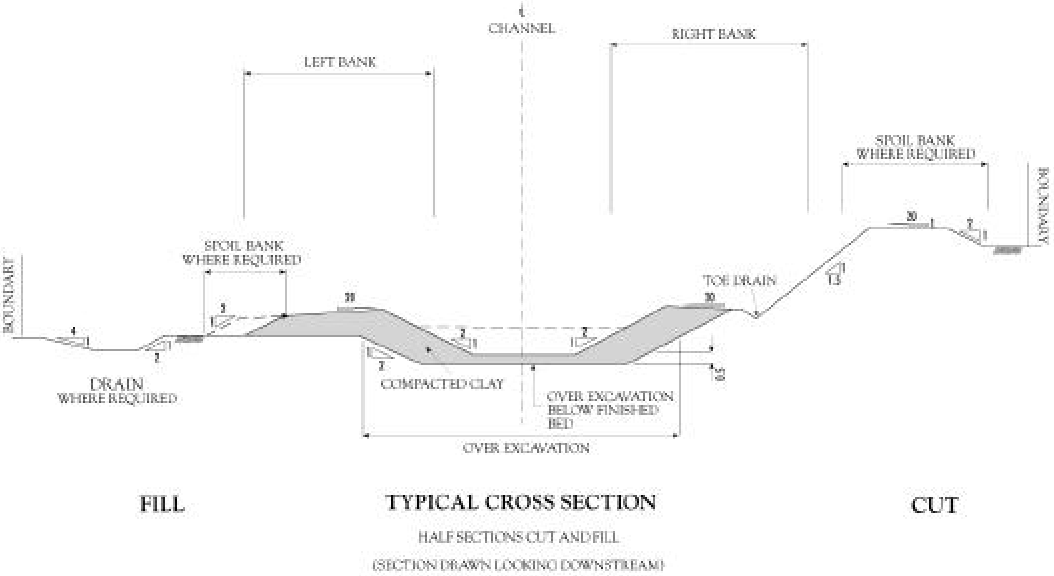
Secondary supply channels

Secondary supply channels would be required in the Weaber Plain to service farming units that cannot be supplied directly from the main supply channels. The channel profiles of these laterals would be similar to those of the main supply channels yet smaller, due to the lower volumes of water to be conveyed.

Balancing storage dams

Three balancing storage dams are proposed:

- the Weaber Plain Balancing Storage Dam—a dam with a surface area of 185 ha and an operating volume of 4.07 GL, located on the Weaber Plain at the intersection of the M2S Channel, M2K Channel and M2X Channel;
- the Keep River Plain Balancing Storage Dam—a dam of 85 ha surface area and an operating volume of 1.5 GL, located on the Keep River Plain;



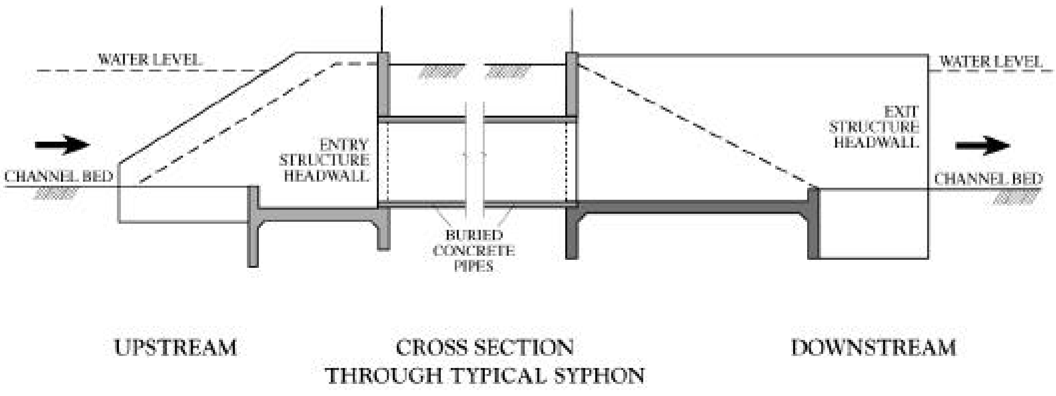


Figure 3.7 Typical supply channel cross section and siphon structure

- the Knox Creek Plain Balancing Storage Dam—a dam with a surface area of 6 ha and an operating volume of 16 ML, located at the southern extremity of the Knox Creek Plain.

The balancing storage dams would facilitate operation of the irrigation supply system, particularly in meeting peak demands or in providing buffer storage at times other than normal operating conditions. In doing so they would reduce significantly the requirement to discharge water to the drainage system from the supply channels, as is currently the case in ORIA Stage 1.

The balancing storage dams would consist of a clay-lined perimeter embankment with an internal lining of stone riprap to prevent erosion from wave action. They would also include entry and exit structures with remote controlled gates.

Control System

The control system for the irrigation infrastructure in ORIA Stage 1 relies upon manual operation of control gates. This is in contrast to the system proposed for the Project, which would be based upon a modern remote control system designed to maximise efficiency of water distribution while minimising operating costs. The control system would utilise Supervisory, Control and Data Acquisition (SCADA) technology to provide a radio link between activators on control structures and sensors monitoring flow conditions in the channels, with a centralised control facility. The SCADA system would allow one operator to concurrently control a number of different parts of the system, with consequent productivity improvements over a manual system.

Other significant irrigation infrastructure items

Typical structures on irrigation channels would include:

- channel-flow regulating and measuring structures
- lateral channel off-take structures
- channel overflow and drainage facilities
- pumping stations
- channel siphons
- channel bridge and culvert road crossings.

There are seventeen major inverted siphon structures proposed for the entire Project. The siphons (Figure 3.7 refers) consist of multiple buried pipes to convey water beneath natural features such as riverbeds or constructed features such as roads or drains. They have significant intake and outlet structures, but are generally preferred to bridges or other options on economic grounds. Significant siphon structures include:

- the Knox Creek Siphon on the M2X Channel. This is proposed as a twin, 1,800 mm diameter pipe structure some 120 m long. It would provide a facility for the M2X Channel to cross underneath the Knox Creek between the Weaber Plain and Knox Creek Plain areas;
- the Keep River Siphon on the M2K Channel. This is proposed as a twin-barrel, 1,800 mm diameter pipe structure some 500 m long. It would have a similar design to the

Knox Creek Siphon and would provide a facility for the M2K Channel to cross underneath the Keep River between the Weaber Plain and the Keep River Plain;

- the Keep River Re-entrant Siphon on the M2K Channel (downstream of the Keep River Plain Balancing Storage Dam). This smaller structure, proposed as a twin-barrel, 1,800 mm diameter pipe structure some 120 m long, would convey the M2K Channel flows across and underneath a Keep River re-entrant creek.

3.5.2 Drainage infrastructure

The drainage system for the Project is shown in Figures 3.4 to 3.6. The system comprises a variety of open, excavated drains that would collect stormwater runoff from developed farming areas and local drainage from outside the farming areas. These open drains would be located along low points in such a way that they service each farm unit. Drains have been designed to exit the farming areas at the perimeter of the development via floodgates in the flood protection levees and discharge into natural drainage features.

Current planning is based upon the use of wider, shallower drains than were built in ORIA Stage 1. This approach would minimise seepage to groundwater by locating the channel inverts in the less permeable surface soils. Where deeper drains are required, the excavated surface of the drain would be compacted to minimise seepage. The drains would be constructed to a trapezoidal cross-section with the design flow level kept at or slightly below the natural surface.

The proposed destination of the greater part of the stormwater from the Weaber Plain is Border Creek, to the north, which in turn drains to the Keep River. The Knox Creek Plain would be drained to the Keep River, while the Keep River Plain would be drained to the Keep River and to Sandy Creek.

The Project has been designed so that drainage channels would only convey water during the wet season following rainfall events. At all other times the channels should be dry, and provide access corridors for native fauna within the Project Area.

Chapter 5 outlines surface water issues in relation to the proposed development, and Chapter 10 outlines the conservation corridors within the Project Area.

3.5.3 Flood protection infrastructure

Hillside drains would be developed at the perimeters of developed farmland to divert stormwater runoff from adjacent catchments (Figures 3.4 to 3.6). These structures would be embankments less than 3 m in height, combined with limited excavation to ensure continuous longitudinal drainage.

Farmland adjacent to significant waterways would be protected from flooding by levees (Figures 3.4 to 3.6). Intense rainfall in the region, and the fact that much of the proposed farmland would be flooded regularly under natural conditions, implies that a levee system would be essential for farm protection. Economic considerations indicate that levees could not be designed to protect against all flood events. The preliminary design has adopted a 4% annual probability of exceedence as a reasonable design criterion.

Flood protection levees would be earth embankments generally 1–3 m in height, with 2:1 side slopes and a 4 m crest width. Earth for the flood protection levees would generally be obtained from excavations associated with construction of the drainage infrastructure and hillside drains. Borrow pits located alongside the flood protection levees may be required in some locations.

The flood protection levees would incorporate flood gate and drainage inlet structures that would allow the discharge of stormwater run-off from the developed area to be collected by the perimeter drainage channels.

3.6 OTHER INFRASTRUCTURE

3.6.1 Roads

The road system proposed for the development of the Weaber, Knox Creek and Keep River plains (Figures 3.4 to 3.6) would comprise:

- the Weaber Plain Road from the end of ORIA Stage 1 across the Weaber Plain to the Weaber Balancing Storage Dam;
- the Keep Plain Road from the Weaber Balancing Storage Dam eastwards across the Keep River and northwards through the central portion of the Keep Plain;
- the Knox Plain Road from Weaber Balancing Storage Dam, southwards across Knox Creek and through the centre of the Knox Creek Plain;
- roads in the northern Weaber Plain

Two significant waterway crossings would be required with this road system:

- a Knox Creek crossing—a low-level culvert crossing (embankment)
- a Keep River crossing—a low-level bridge or culvert crossing.

These stream crossings would provide access under all but peak flood conditions.

Public roads in the system would be two-way, and would have a total carriageway width of 6–7 m. They would have a sealed or gravelled surface, depending on traffic density. In addition, they would be provided with a wide, sealed shoulder where they are constructed over black-soil areas to reduce road maintenance.

Secondary roads, where required for access to the corporate farm, would be formed from black soil only and not sealed or surfaced with gravel. Accordingly, these roads would have limited use during the wet season.

The design and construction of roads within the Project Area would be to a standard suitable for use by large transport vehicles, including B-double semi-trailers and road trains.

3.6.2 Power

Power requirements within the Project Area during the processing season would be supplied predominately by the sugar mill, utilising bagasse (cane fibre) as fuel. During the non-processing season the power requirements of the mill, irrigation infrastructure, and on-farm purposes, would be supplied either by Western Power or local generating capacity. A power distribution system, using overhead transmission lines, would be developed for the Project.

Small power requirements throughout the proposed farm area may be provided by diesel motors or generating sets where it is not economical to extend the power distribution system.

3.6.3 Telecommunications

Telecommunication requirements for the Project would be provided by a combination of:

- extension of the digital mobile phone network from Kununurra to cover the Project Area;
- extension of the optical fibre network from Kununurra to the mill site;
- establishment of a two-way radio network for use by the corporate farm and by transport and harvesting contractors;
- establishment of a SCADA system for the remote control of irrigation infrastructure.

3.7 SUGAR-MILLING

3.7.1 Scope

The proposed Wesfarmers–Marubeni sugar mill has been sized, to have a crushing capacity of approximately 750 t of cane per hour, enabling a steady state annual sugarcane crush of approximately 3.2 Mt.

The preferred mill location (Figure 3.2) has been selected adjacent to the Weaber Balancing Storage Dam, and at the centroid of the proposed plantation development.

Based upon local sugarcane characteristics and the projected mill efficiency, approximately 1 t of raw sugar would be produced for every 8 t of sugarcane processed, and 1 t of molasses would be produced for every 20 t of sugarcane processed.

A natural production ramp-up in the start-up phase would be provided by the planned development of the corporate farm as outlined in Table 3.3. Peak production of 3.3 Mt would occur in 2005 but that production would stabilise at approximately 3.2 Mt in the steady state.

Table 3.3 Sugar-mill crushing volume

	Year			
Rate	**2003**	**2004**	**2005**	**Steady state**
Cane supplied to mill (Mt)	1.3	2.5	3.3	3.2

The mill would be designed for 24-hour operation and would be provided with a high level of automation in order to maximise efficiency.

3.7.2 Process description

The function of the sugar mill is to recover from sugarcane the maximum practicable quantity of sucrose, and process the sucrose into raw sugar of a specified quality. The mill would operate during a cane-harvesting season of approximately seven months' duration. During the non-processing season, the processing plant would be overhauled in preparation for the following crushing season.

The milling process described further below is illustrated in the simplified flow diagram in Figure 3.8.

Sugarcane would be delivered to the mill by road transport and, after weighing of the loaded vehicles, the cane would be tipped into a cane-carrier. The empty vehicle would then be weighed to determine the weight of sugarcane delivered.

The cane-carrier would deliver the sugarcane to a cane conveyor which feeds a shredder. The function of the shredder is to rupture a high percentage of the cane-stalk cells, thereby liberating the stored sugar. The shredded cane would then be fed to the first crushing mill.

In the crushing mills, the shredded cane would be squeezed between mill rollers to extract the cane juice. The milling train would consist of successive mills, each comprising pressure feed rollers and juice extraction rollers. Between successive mills, the crushed cane would be immersed in water to dilute the juice remaining in the cane fibre. The cane fibre would then be allowed to drain before passing into the following mill for further juice extraction.

Cane fibre from the final crushing mill, which is called bagasse, would be conveyed to storage and thence to the boiler to be burned as fuel for the generation of steam. High-pressure steam would be used in the various turbines that drive process equipment and in the electricity generators in the mill's power station. The low-pressure steam issuing from the turbines would provide the heat energy for process heating requirements.

Processing of the juice collected from the crushing mills would involve heating, followed by addition of lime and synthetic flocculant, and then clarification. In the clarifiers the mud solids and lime precipitates would settle out and be collected for further treatment by vacuum mud filtration. The filtrate (sweet water) would be returned to the process.

The clear juice from the clarifier would be passed through evaporators where it would be concentrated to about 65% soluble solids by evaporation of water. The syrup thus produced would then pass to vacuum pans. Each vacuum pan would boil the syrup under a vacuum in the presence of a slurry of seed crystals. After a period of crystal growth, the resulting 'massecuite' would be discharged from the pan into a receiving vessel. The 'mother syrup' (molasses) would be separated from the raw-sugar crystals by centrifuging and recycled to the vacuum pans station for further recovery of sugar. The raw-sugar crystals would pass to the sugar drier and would then be cooled in a counter current flow of air. The dried raw sugar would then be conveyed through a weigher to the mill storage and truck loading facility.

The syrup from which it is uneconomic to extract further sugar is 'final molasses', which would be weighed, cooled and pumped to the mill storage tanks.

All power requirements for the mill during normal operations would be provided from burning the bagasse remaining after processing of the cane. At other times, such as during annual start-up and in the off season, power would be obtained either from local generating capacity or from Western Power.

Apart from sugarcane, the major process inputs would be lime and small volumes of caustic and specialty chemicals, such as synthetic flocculants. Lime would be used to precipitate impurities from cane juice and the synthetic flocculents (usually food-grade polyacrylamides) would be used to assist in the clarification of heated, limed cane juice. Caustic soda solution would be used for cleaning heating surfaces in mill evaporators.

An additional, but relatively minor, chemical input would be that associated with pretreatment of boiler make-up water. Typical chemicals used for feedwater treatment are carbonates, sulphates and sulphites of sodium, polyphosphates and an anti-foam preparation. These chemicals would be discharged from the boilers in blow-down water.

3.7.3 Effluents and emissions

Atmospheric emissions would consist of water vapour from the process equipment and the normal products of combustion from the bagasse and fuel-oil-fired boiler.

The boiler would operate continuously for about seven months of each year. Emissions from the boiler would be passed through a scrubber to achieve a maximum particulate discharge of 32 kg/h from the 40 m high chimney. The total gas volume discharged via the chimney would be 420 m^3/h at 45°C with a density of 0.832 kg/m^3. This equates to a particulate emission level of less than 0.12 g/Nm^3. Bagasse firing would be a complete combustion process with excess oxygen available at all times. Carbon monoxide levels would therefore be extremely low.

The use of fuel oil would be necessary during boiler start-up conditions. The fuel oil would typically contain 0.7% sulphur, and the discharge gases are expected to contain 300 ppm of sulphur dioxide, 200 ppm of oxides of nitrogen and less than 200 mg/Nm^3 of carbon monoxide.

Water vapour would be given off by process cooling towers. This vapour would have no contamination and would be pure water. Steam at temperatures ranging from 120°C to 400°C would also be emitted to the atmosphere on occasions.

A diesel generator would be provided at the mill to operate during the milling season on a stand-by basis only. When this generator is operational, exhaust gas would be emitted to the atmosphere at a rate of 95 m^3/h, and contain 37 g/Nm^3 of oxides of nitrogen, 11 g/Nm^3 of carbon monoxide and 1.25 g/Nm^3 of hydrocarbons.

Liquid discharges from the mill would predominantly consist of cooling water and small quantities of process effluent treated as described below.

Cooling water sourced from the irrigation infrastructure would be used at a rate of approximately 12,000 m^3/h to condense the vapour generated in the vacuum pans. The cooling water would be discharged into the irrigation infrastructure, downstream of the intake point. The discharged cooling water would have no additional contamination, and would be approximately 3°C warmer than the intake water.

Process effluent would arise at a flow rate of about 200 m^3/h and at a biological oxygen demand (BOD) level of 1,500 mg/L (mainly due to sucrose). The process effluent would be treated in a biological treatment plant combining activated sludge and anaerobic processes. The treated effluent, with a BOD level of less than 20 mg/L, may be used as irrigation water directly on to canefields near to the mill.

Blow-down water from the boiler would produce an effluent stream of about 6 L/s during mill operations. This water would have negligible BOD, but would contain total dissolved solids (TDS) up to a concentration of 200 mg/L. The dissolved solids would arise from naturally occurring salts in the boiler make-up water and from the boiler feedwater chemicals collected from the boiler combustion chambers and from the boiler flue gases by an emission-cleaning system. The boiler blow-down would be combined with the process effluent for disposal.

Ash from the boiler would comprise the unburned residue of bagasse, generally about 90% inorganic matter and 10% carbon. The levels of the ash in bagasse would be variable and depend largely on the amount of field soil entering the mill with the cane. About 20 t/h of ash (with a 50% moisture content) would be produced by the boiler, with the major constituents expected to be silica, alumina, iron oxide, potash and lime. Silica should represent 90% of the solid mass, and the percentage of lime would be expected to be about 1%.

Disposal of the ash would be effected by spreading on to canefields. The ash mixture would act both as a soil conditioner and as a fertiliser and should be beneficial to the soils of the Project Area. All that would be returned to the soil by spreading the mill mud and ash would be the minerals extracted by the cane from the soil and soil itself.

3.8 PROCESSING OF OTHER CROPS

Crops other than sugarcane may be propagated on the land farmed by independent farmers within the Project Area. It is anticipated that any further processing of these crops would occur at existing facilities located within ORIA Stage 1.

3.9 MATERIALS HANDLING AND TRANSPORT

3.9.1 Sugarcane transport

Transport of cane would be carried out using purpose-designed road transport vehicles with a payload of approximately 100 t. In the steady state, sugarcane supply to the mill would be 3.2 Mt/a, and approximately eight trucks would arrive at the mill every hour over a 24-hour period, seven days a week for seven months of the year. The following measures would be adopted with respect to cane haulage:

- Trucks would be operated and maintained to meet the requirements of relevant noise abatement legislation.
- Public roads would be designed to the appropriate national road design standards in order to provide an acceptable level of safety for the cane transport operations and any other road users.

3.9.2 Farm requirements

Bulk farm inputs would predominantly comprise fertilisers including urea and DAP. Fertilisers would be transported in bulk form in semi-trailers to dedicated storage facilities, established in each of the three plains. Fertilizers would then be transferred by closed screw conveyors directly into field distribution vehicles.

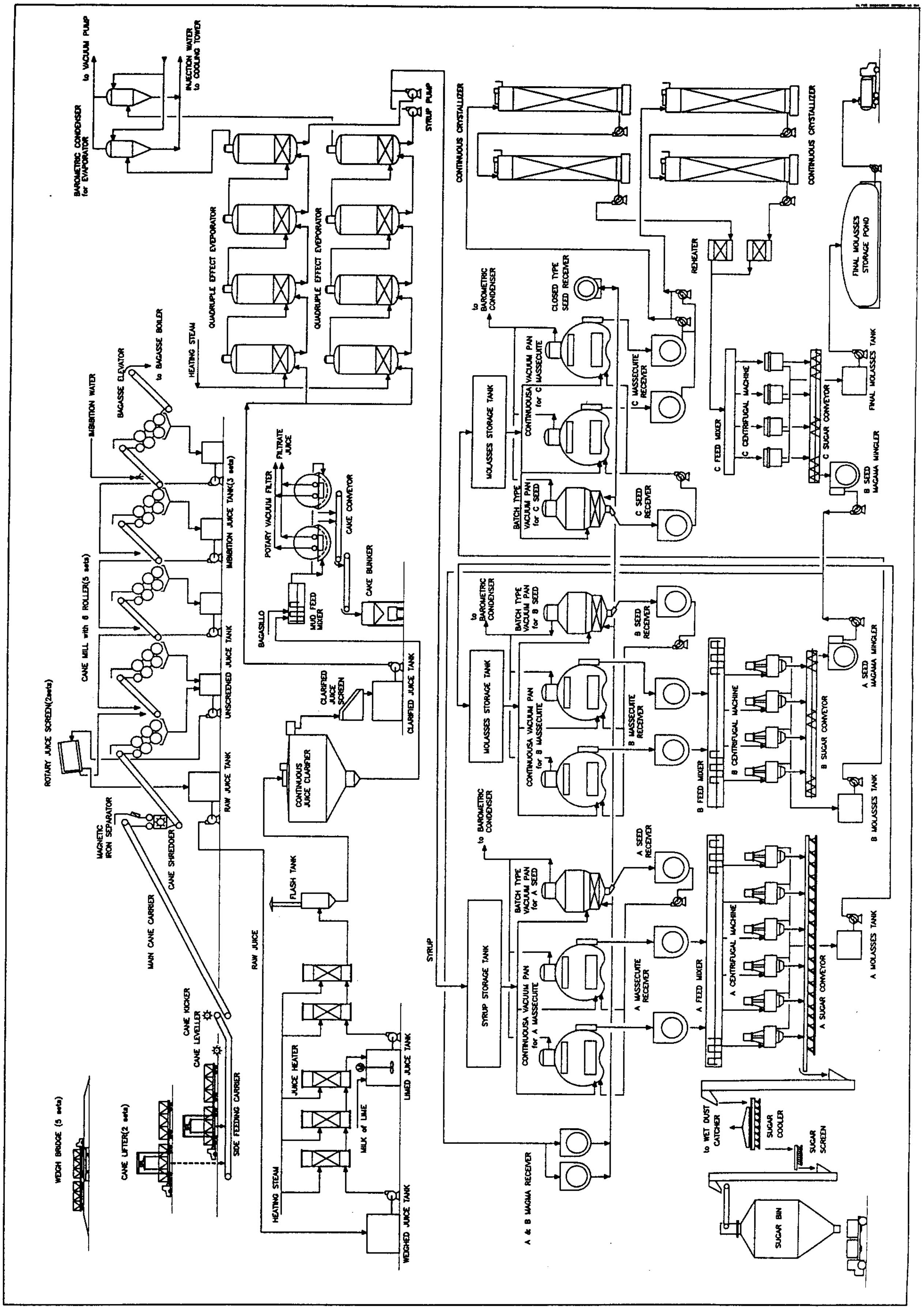


Figure 3.8 Raw sugar milling process

Other farm requirements would include:

- diesel fuel for agricultural machinery and generators
- herbicides for use over the whole Project Area
- other pesticides for use on farms not dedicated to sugarcane.

All of the above farm requirements would be transported and stored in accordance with regulatory requirements, including impervious bunding of storage areas where appropriate.

3.9.3 Products

Raw-sugar and molasses transport from the mill to the port of Wyndham would be carried out over the processing season in purpose-built road transport vehicles with a payload of approximately 90 t. On this basis, approximately thirty vehicle movements per day are anticipated for product transport from the Project Area. At this stage, it has been assumed that transport from the Project Area to Wyndham would be via the existing Kununurra–Wyndham road.

The main product storage facilities in relation to the proposed development would be developed adjacent to the Wyndham wharf (Figure 3.9), with a nominal capacity of 180,000 t for raw sugar and 75,000 t for molasses. Development of these storage facilities would require the reclamation of a portion of unvegetated mud flat adjacent to the southern section of the Wyndham wharf access road.

Figure 3.9 New storage facilities within the Wyndham Port

A conveyor system would be developed to move raw sugar from the storage shed to the existing shiploader. A pressurised pipe would take molasses from the storage tank to the wharf.

Shipment sizes from the port of Wyndham would typically be in 20,000 t vessels. On this basis, in the steady state, twenty-eight shipments would be required annually, implying shipments from Wyndham every thirteen days.

3.10 CONSTRUCTION ISSUES

The current construction schedule for the irrigation infrastructure, sugar mill, port facilities and other infrastructure allows for staged development occurring over three years (Figure 3.1 refers). With the exception of the sugar mill, all earthworks and major construction would take place during dry seasons and be planned in such a way that all necessary flood protection levees and drainage systems would be in place prior to the onset of the wet seasons. The phased development would commence on the Weaber Plain, then proceed on the Keep River Plain and finally the Knox Creek Plain. The mill would be constructed over a period of two years and receive the first cane for processing in 2003.

Prior to the construction of the irrigation infrastructure, the land corridors for these facilities would be cleared of any existing vegetation and grubbed to remove roots. In areas where corridor widths are significantly greater than those required for construction, only the sections necessary for construction and future maintenance purposes would be cleared. The uncleared sections of the corridors would be managed as part of the conservation reserve system for the Project.

Construction of roads and the irrigation infrastructure would require access to local sources of suitable clay, sand and gravel material. Borrow pits would be selected in accordance with Aboriginal cultural and heritage considerations of the land and operated as far as practicable with a view to minimising erosion, damage to surrounding vegetation and visual impact. Once construction is completed, areas no longer required would be rehabilitated by a combination of contouring, slope stabilisation, topsoil spreading and seeding.

Is has been estimated that the total combined workforce for the construction phase would peak at 650. A construction camp would be established within the Project Area adjacent to the existing homestead of Spirit Hills Station in the Northern Territory (Figure 3.2 refers). Upon completion of the construction period, the construction camp may be modified to accommodate seasonal workers.

Potable water would be provided for the construction camp from purpose-drilled bores. The bores would be approved by either the Water and Rivers Commission of Western Australia or the Department of Lands, Planning & Environment, depending upon their location.

Sewage and refuse from the camp would be treated and disposed of in a manner approved by the relevant public health authorities of the Northern Territory.

Few construction-related environmental issues are envisaged due to the remoteness of the Project Area from residential areas. An exception relates to the proximity of a section of the proposed M2 Channel, which in some areas is within 300 m of residences. The following measures would be employed at these locations to minimise nuisance from construction equipment:

- Construction activities would be restricted to daylight hours.

- Prior to use, all equipment would be checked to ensure that silencing equipment had been fitted and was in good working order.

Local residents would be advised of the nature of the activities to be undertaken and of their duration, particularly if blasting were required to remove rock.

3.11 ENVIRONMENTAL MANAGEMENT AND MONITORING SYSTEM

A comprehensive environmental management and monitoring system would be developed and implemented as part of the Project. In summary this comprises:

- the retention of areas of existing vegetation in conservation areas and linkages (corridors) between these areas where this is appropriate (Chapter 10 refers). Monitoring within the conservation areas would include indicator species of environmental health and possible impacts from the Project such as the presence of weeds;
- a surface-water monitoring system designed to gather data on possible impact from the Project (Chapter 5 refers). This monitoring would include water quality measurement, including nutrients and pesticides, flow measurements and monitoring of aquatic flora and fauna species selected to be indicators of environmental health;
- groundwater monitoring for both level and quality via a network of monitoring bores located within the Project Area. The possibility of the need for future groundwater management is recognised and this may take the form of abstraction bores and a collector pipework system. Collected groundwater would either be used as irrigation water or discharged to the estuarine portion of the Keep River and Sandy Creek, depending upon the water quality. This system is described further in Chapter 6.

An important issue for environmental management is the allocation of responsibilities for the various activities identified in this ERMP/draft EIS and any unforeseen measures that may be required in future. An environmental management framework has been developed as part of the Project to address this issue, and this framework is described in Chapter 16.

3.12 ALTERNATIVE DEVELOPMENT SCENARIOS

Various alternative development scenarios were considered by Wesfarmers/Marubeni in the development of the Project proposal outlined in this ERMP/draft EIS, and detailed in this chapter. The alternative development scenarios centered around two generic options:

- development of the Project Area for the purposes of irrigated agriculture
  - with crops other than sugarcane
  - with a mix of sugarcane and other crops
- development of only a portion of the Project Area for the purposes of irrigated agriculture, with the balance of the Project Area left undeveloped.

Discussion of each of the alternatives follows.

3.12.1 Alternative crops

In preparation of this proposal, Wesfarmers–Marubeni considered in detail a number of broadacre cropping alternatives for the Project Area. Of the alternative broadacre crops, sugarcane was considered by Wesfarmers–Marubeni to be the most attractive option for the Project Area on the following grounds:

- there are considered to be solid long term market opportunities for raw sugar, both in the Asian region and other world markets;
- there are excellent local conditions for the growing of sugarcane in the ORIA, relative to other regions in Australia and overseas;
- the commercial production of sugarcane in Ord Stage 1 in recent years has had a successful track record, which has validated the results of decades of scientific sugarcane trials performed in the East Kimberley;
- sugarcane grown in the Project Area would have a minimal requirement for on-farm chemicals, particularly in relation to the alternative broadacre cropping alternatives considered.

Various alternatives were considered with respect to development of the Project Area with a mix of broadacre crops. The alternatives were centered around having sugarcane as the 'base' crop, and also having land within the Project Area dedicated to the growing of alternative broadacre crops. The conclusion drawn from detailed analyses of these options was that economies of scale are significant with respect to the growing of sugarcane, and the subsequent processing to produce raw sugar. Furthermore, that dedication of any significant portion of the Project Area to an alternative broadacre crop in parallel with development of a sugar industry may marginalise the economics of the sugar industry.

Horticultural cropping options were also considered for the Project Area, but these options were discounted due to the soil types within the Project Area, and the economic imperative that the Project Area is developed rapidly. It is the view of Wesfarmers–Marubeni that horticultural crops would be well-suited to the proposed Ord Stage 2 Riverside Developments (Section 1.1.3 refers).

3.12.2 Partial development of the Project Area

The proposed development is to occur on the Weaber, Keep River and Knox Creek plains. Alternative development scenarios were considered based upon:

- development of the Weaber plain *only*;
- development of the Weaber and Keep River plains but *not* the Knox Creek plain;
- development of the Weaber and Knox Creek plains but *not* the Keep River plain;
- development of the Weaber plain in accordance with the Project programme (Section 3.1.3 refers), but *postponing* development of the Keep River and Knox Creek plains beyond the proposed development schedule.

The conclusions drawn from analyses of the aforementioned development scenarios were as follows:

- Any significant reduction in the scale of the proposed sugar industry for the Project Area would lead to a reduction in the economies of scale. In turn, this would decrease the cost competitiveness of the proposed export industry in relation to other sugar production regions of the world, and potentially jeopordise the long term economic viability of the proposed development.

- Any significant reduction in the Project Area would lead to increased unit costs associated with the provision of infrastructure from Kununurra. A significant portion of the infrastructure investment required to service the Project Area for irrigation and drainage, roads, power and communications would be expended to service the Weaber plain only, and development of the Keep River and Knox Creek plains would involve only incremental investment in infrastructure. Development of the entire Project Area would mean that the total infrastructure cost could be spread more evenly over the Project Area as a whole, thereby reducing the unit investment cost, and unit fixed operating costs. The net result would be a proposed development with a greater chance of long term economic viability.
- Postponement of development of the Keep River and Knox Creek plains to some unspecified point in the future would lead to a transition period within which the disadvantages of a reduced scale of development would prevail. In the transition period, significant uncertainty would prevail with respect to the future of the industry, and sub optimal economics would prevail.
- A decrease in the scale of the proposed development may actually lead to a decreased expansion of the conservation estate in Western Australia and the Northern Territory (Chapter 10 refers).

3.12.3 Conclusion

It is the view of Wesfarmers–Marubeni that the proposed development scenario is the most robust of all the options considered, from an agronomic, economic, community and environmental perspective.