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# A brief study of land capability in the coastal region of the shire of Harvey

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# **A brief study of Land Capability in the Coastal Region of the Shire of Harvey**

**M. Wells and P. Hesp**

**Resource Management Technical Report No. 14**

## **Disclaimer**

The contents of this report were based on the best available information at the time of publication. It is based in part on various assumptions and predictions. Conditions may change over time and conclusions should be interpreted in the light of the latest information available.

## Preface

The Department of Agriculture, Division of Resource Management is responsible for providing comments to the Town Planning Department and Shire Councils in relation to land rezoning or subdivision proposals within the State. These comments are expected to help planners evaluate the effects of particular development or subdivision proposals on the viability of any agricultural industries concerned. In addition, under its legal responsibilities there is a need for the Department of Agriculture to evaluate the extent of any risk of land degradation associated with development.

In line with this latter responsibility, the Division of Resource Management conducts a survey and 'capability' evaluation of proposed development areas referred to it by either the Town Planning Department or local government bodies. The detail of the survey and evaluation depends on the magnitude of the proposal and the time available, however in general it aims to assist planning by outlining the extent and severity of potential development constraints imposed by the physical nature of the land.

An integral part of this evaluation is an assessment of the risk of soil erosion or land degradation associated with the proposal. By providing this risk assessment to planning authorities, the objective is to guide development into areas of high capability (low risk) areas in preference to areas of lower capability (higher risk). Wherever this can be achieved the effect will be to help minimize future land degradation problems.

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## Maps: Appended

Shire of Harvey, Coastal Zone

Landforms and Soils

- Sheets 1,2,3

Residential Land Capability

- Sheets 1,2,3

Agricultural Land Capability

- Sheets 1,2,3

## **1. Introduction**

In recent years Harvey Shire Council has been under considerable pressure from landowners in the coastal section of the Shire (see Figure 1) wishing to develop tourist and/or recreational facilities. As part of the requirements relating to the review of its District Town Planning Scheme, Council subsequently decided to undertake a survey of the region to determine areas where recreation or holiday settlements might be established.

AS two of the particular objectives of the Planning Scheme relate to areas of Department of Agriculture concern, namely protection of the coastal 'environment, and protection of rural and primary industry. Council approached the Division of Resource Management for assistance. Specifically, the Division was asked to supply whatever information it could on factors, which would place limitations on development within the coastal region (Figure 1).

The response, reported here was to supply a brief capability assessment based upon existing CSIRO land resource mapping.

## **2. Land Resource Mapping**

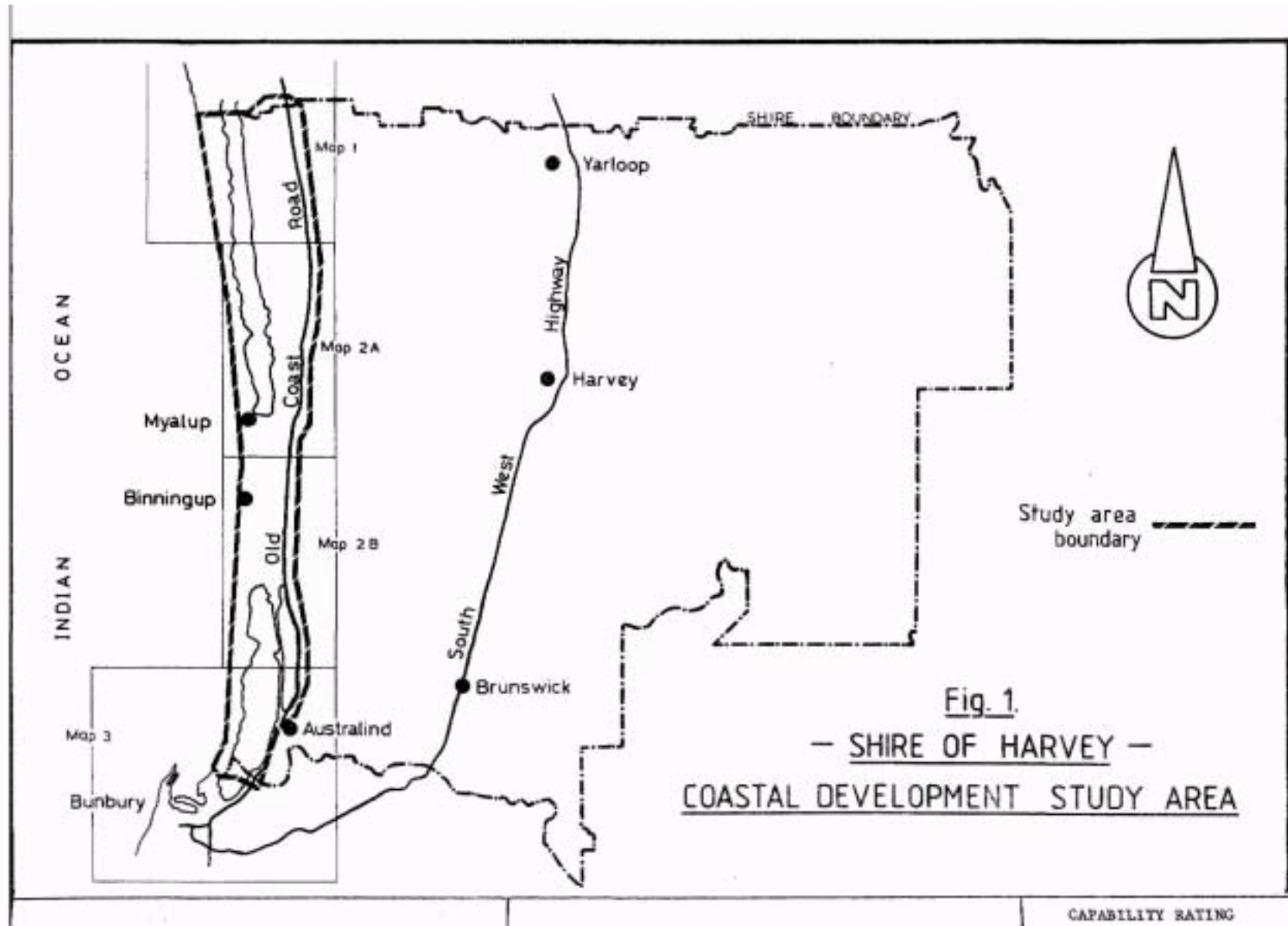
At present the most detailed and comprehensive land resource mapping covering Harvey Shire's coastal strip, which can be effectively used as an aid to assessing development proposals, is the work conducted by W.M. McArthur and G. Bartle of CSIRO in 1980.

The three soil/landform map sheets presented with this report are reproduced from that CSIRO work. Minor alterations have been made to this mapping within areas of the recent dune systems where the Department of Agriculture's fieldwork has indicated that the land could more clearly be described by the delineation of an additional map unit or else by the relocation of an existing boundary.

Within McArthur and Bartle's report, the coastal region is described in terms of three major geomorphic elements - Spearwood Dunes, Yoongarillup Plain and the Quindalup Dunes. These have been further divided on soils and relief to form mapping units, which are delineated on the base maps accompanying this report. A brief description of these geomorphic elements and their component map units, based on both CSIRO and Department of Agriculture Survey data, is given in Table 1. This table should act as a legend to the land resource base maps.

Further discussion of the nature of the region's land resources including geology, vegetation, climate and land use, may be found in McArthur and Bartle (1980)





**Table 1**

Description	Limitations For Development And Current Land Use	Capability Rating Refer Table 2	
		Agriculture	Residential Development
<p>Spearwood Dune System: - Low hilly to undulating terrain; a core of sandy limestone, with a mapping of secondary calcite, overlain by siliceous sand.</p> <p>y-Karrakatta sand (yellow phase). Low hilly landscape with moderately deep to deep brownish sands. These are excessively well drained with grey brown sandy surfaces over yellow to yellow, brown sandy subsoils. Limestone may occur within a metre in some areas.</p> <p>g-Karrakatta sand (grey phase). Undulating landscape with deep siliceous sands. These are excessively well drained. Grey sandy surfaces over a very light grey subsoil may grade into pale yellow sand within a metre. Limestone occurs at depth.</p> <p>Is - Hilly and irregular terrain with much exposed outcrop between areas of very shallow brown sand.</p>	<p>Marginal agricultural land with groundwater of good quality but doubtful quantity; currently used for low intensity grazing.</p> <p>Sandy soils with low water holding capacity; subject to erosion if surface vegetative cover lost, particularly in steeper areas, soils sometimes shallow.</p> <p>Sandy loose soils with low water holding capacity, subject to erosion if surface vegetative cover lost.</p> <p>Severe rock outcrop, very shallow loose sandy soils; erodible on slopes.</p>	<p>-</p> <p>3</p> <p>3</p> <p>4</p>	<p>-</p> <p>3</p> <p>2</p> <p>4</p>
<p>Quindalup Dune System: - Complex parabolic dunes consisting of calcareous sand with minimal soil profile development.</p> <p>Qo - Flat to slightly undulating Aeolian sand plains behind major dune complex with moderately deep to deep, excessively well-drained calcareous sands.</p>	<p>Inherently fragile ecosystem subject to wind erosion particularly on steeper slopes and exposed areas. Contains little good quality water, which is often saline. Unsuitable for agriculture and under increasing pressure for residential development.</p> <p>Although light grazing is possible, proximity to fragile dunes rules out this use. Residential development is possible in areas of Qo not adjacent to dunes classified as Qu, Q3 and Q4. Whilst the erosion risk of Qo is relatively low, the erosion risk of the surrounding dune terrain is high. Access routes, road design and clearing over the latter must be carefully planned and controlled.</p>	<p>-</p> <p>4</p>	<p>-</p> <p>3/5</p>

Description	Limitations For Development And Current Land Use	Capability Rating Refer Table 2	
<p>Q1 - Chiefly parabolic dunes. Discrete U-shaped ridges enclosing deflation basins (Qp); deep, excessively well drained calcareous sands.</p>	<p>Sandy soils with low water holding capacity; susceptible to erosion if vegetative cover disturbed. Dunes commonly display incipient cementation.</p>	5	4
<p>Q2, Q3 - Nested blowout complex, characterised by steep arcuate ridges and hollows; deep excessively well-drained calcareous sands.</p>	<p>As for Q1, but less stable due to lesser degree of sand compaction and cementation, steeper slopes and commonly less vegetative cover.</p>	5	4
<p>Q4 - Partially vegetated foredune complex and most recent blowout complex. The latter are commonly steep, nested, irregular dunes. Soils are deep, excessively well drained calcareous sands.</p>	<p>As for Q2, Q3 but very high potential instability.</p>	5	5
<p>Qu - Partially vegetated to unvegetated foredunes, blowouts and transgressive dune sheets with presently unstable, deep excessively well drained calcareous sands.</p>	<p>Severe erosion hazard areas, unstable for residential development or grazing.</p>	5	5
<p>Qp - Flat to undulating deflation basin enclosed by dune ridge. Soils commonly moderately deep to deep, but limestone may be encountered at shallow depths in some areas.</p>	<p>Minor soil depth problems in some areas and moderate erosion hazard. Unsuitable for grazing due to proximity to fragile dunes. Unsuitable for residential development where areas are limited in size, or where adjacent to Qu, Q4 and Q3.</p>	4	3/5
<p>Yoongarillup Plain: - Flat terrain with minor ridges and swales; depressions with swamps or lakes; marine fossiliferous limestone, with a capping of secondary calcite, overlain by siliceous sand.</p> <p>s - Flat to gently undulating sandplain with generally deep well drained brownish sands. These soils have a grey to light grey surface and a yellowish brown subsoil overlying limestone at variable depths. Limestone 'floaters' may be encountered close to the surface in limited areas. Soils generally have a neutral reaction trend.</p> <p>Is - Undulating low rocky hills and areas with very shallow sands overlying limestone. Considerable exposed rock pavement.</p>	<p>Contains areas currently used for dryland agriculture and irrigated cropping. Water is of suitable quality for irrigation although reserves are reasonably shallow and overpumping can occur,</p> <p>Minor areas with shallow soils; subject to wind erosion if excessively cleared or overgrazed. There is probably insufficient groundwater for any significant extension of irrigated areas.</p> <p>Very severe rock outcrop with shallow loose sandy soils, erodible on steeper slopes.</p>	-	-
		2	2
		4	4

Description	Limitations For Development And Current Land Use	Capability Rating Refer Table 2	
<p>3 - Broad depressions and former estuarine basins within Ys with deep mixed alluvial deposits. Soils usually have very dark grey to black, loam to clay 3am surfaces overlying variable subsoils which re poorly drained and highly alkaline.</p>	<p>Poor site and soil drainage adversely affecting residential development and on-site effluent disposal; however provides valuable summer pasture when farmed in conjunction with Ys</p>	3	4
<p>sp - Stoney plains and depressions with shallow ark grey to black, sandy loam or loams overlying limestone. Outcropping 'pavement' and loose rocks re common. Soils are strongly alkaline.</p>	<p>Severe rock outcrop in places, generally poor site drainage and shallow soils adversely affecting residential use but providing some additional summer pasture areas when farmed with Ys.</p>	3	3
<p>I – Gently undulating higher level terrace associated with lagoon system between the Quindalup Dunes and the Yoongarillup Plain proper. These areas have generally deep, moderately well rained grey sandy alkaline soils, which may contain fossiliferous limestone or shell fragments at variable depths.</p>	<p>Soil either shallow or somewhat poorly drained in minor areas. Useful summer pasture areas although use is not encouraged in areas close to fragile dunes. Adverse affects on adjacent dunes may result if residential development is not carefully planned and controlled.</p>	3	3
<p>3 - Generally flat lower level terraces associated with the lagoon system, these areas have dark grey jam to clay loam surface soils overlying ariable sand, clay or shell bed deposits. These soils are poorly drained and alkaline.</p>	<p>Poor to very poor site and soil drainage. Not suitable for either agriculture or residential development due to likely adverse affects on adjacent water bodies and associated vegetation,</p>	4	5

### 3. Land Capability Evaluation

In view of Council's concern over future recreation and holiday settlement development, and also the need to protect rural and primary industry in the region, the basic land resource mapping was interpreted to show areas of varying residential and agricultural capabilities. The capability of land for a particular use may be defined as the ability of the land to sustain that use with minimal risk of attendant land degradation problems such as erosion, flooding, and severe waterlogging.

The method of evaluating the capability of each of the map units has been to consider the number and severity of physical characteristics of the land in question, which can be considered to impose some sort of limitation to future development of that land, or which will predispose it to some form of degradation, usually erosion, as a result of changed use. Relevant physical characteristics of the land which are assessed include, soil depth and texture, rockiness, slope of landform features, degree of exposure to prevailing winds, proximity to the high spring tide line, and susceptibility to waterlogging.

The capability of land is expressed by a class, or ranking, from 1 to 5, reflecting varying degrees of limitation or risk of land degradation, imposed by the nature of its soil and landform characteristics. The capability classes are described more fully in Table 2.

**Table 2**

Land Class	Degree Of Limitation	General Description
1	None to very slight	Areas with high capability for the proposed use. Limitations of long term instability, engineering difficulties or land degradation hazard are nil to very slight.
2	Slight	Areas capable of sustaining the proposed use with only slight limitations in the form of engineering difficulties or land degradation hazard.
3	Moderate	Areas with fair capability for the proposed use. Moderate engineering and/or high land degradation hazard exists during construction or development phase.
4	High	Areas with poor capability for the proposed use. There are considerable engineering difficulties during development and/or a high land degradation hazard exists during and after the construction or development phase.
5	Very severe	Areas with very poor capability for the proposed use. Limitations, long term instability hazards, land degradation or engineering difficulties cannot be easily overcome with current technology. Severe deterioration of the environment will occur if the land use is attempted.

### 3.1 Residential Capability

In coastal dune areas 'Residential Capability' assessment involves a consideration of the physical ability of land to sustain the pressures imposed by future holiday or recreational settlements. Further inland this type of assessment relates to the effects and requirements of hobby farming or rural retreats. For any residential development such things as the suitability of land for construction purposes, for on-site effluent disposal, and the hazard of soil erosion resulting from decreased vegetative cover and increased vehicular and people traffic, must be considered.

A summary of the land capability ratings for residential uses is given in Table 3.

**Table 3**

Capability Rating For Residential Use	Map Unit (After Mcarthur And Bartle, 1980)	Coastal Dunes	Comments Inland
1	-	-	-
2	Kg Ys	-	Capable of being used for rural retreat purposes, however often not suitable due to 'competition' with commercial intensive agricultural interests (Horticulture).
3	Ky, Ysp, Pg, Qo, Qp	Fair capability for residential development where land unit is not adjacent to Qu, Q3 & Q4. Where Qp is a narrow linear unit, development provides a potential erosion hazard due to the likelihood of increased access by off-road vehicles.	Fair capability for rural retreat use; mainly grazing country likely to be affected.
4	Kls, Yls, Yb, Q1, Q2, Q3	Low capability for residential use. Risk of land degradation is high where slopes are modified or vegetation cover removed.	Low capability for rural retreat use; grazing country only will be affected,
5	Ps, Qo, Q4, Qu, Qp	Qo & Qp are not capable of sustaining residential development where adjacent to Qu, Q3 & Q4 units, or where unit size is limited. Q4 & Qu are not suitable for development due to instability of surface, steep slopes & high exposure.	PS not capable of sustaining rural retreat use without severe adverse affects on adjacent waterbodies.

### 3.2 Agricultural Capability

In this report the agricultural capability ranking is based on the physical land requirements for irrigated horticulture. The report recognizes however, that land physically capable of such use is also quite capable, but probably less suitable, for grazing uses. The capability ranking is largely based on a risk of erosion assessment, and although availability of underground water supplies will strongly influence the future of irrigated horticulture, this factor has not been explicitly considered in this report.

As the study area is located within a gazetted groundwater control area where Public Works Department permission must be granted for extraction of any water, then the responsibility for specific comments on the effect of this constraint to future land use rests with that Department. In general terms however, it is understood that for the major part of the coastal area underground water supplies are already substantially committed to existing users. This is indicated by dotted line boundaries on the agricultural capability maps.

A summary of the land capability ratings for agricultural uses is given in Table 4.

**Table 4**

Capability Rating For Agriculture	Map Unit (After Mcarthur And Bartle, 1980)	Comments
1	-	-
2	Ys	Areas capable of being used for horticulture (subject to water availability) and grazing.
3	Yb, Ysp, Pg, Kg, K	Areas capable of being used for grazing; minor areas suitable for more intensive, horticultural uses.
4	Kls, Yls, Qp, QO, PS	Areas capable of rough grazing use, however due to risk of land degradation in adjacent land units from straying stock, this use is not recommended.
5	Qu, Q1, Q2, Q3, 04	Areas considered not capable of supporting any agricultural uses without incurring severe land degradation. Agriculture not recommended.

## 4. Discussion

Land within the Shire of Harvey's coastal strip is described in this report in terms of three major soil/landform associations, the Spearwood Dunes, the Quindalup Dunes and the Yoongarillup Plain.

Within what has been mapped in this report as Spearwood Dunes, map unit differences are due to variations in topography, rock outcrop and soil depth due to degree of wind erosion. The sandy soils have limited water holding capacity and are generally susceptible to erosion on all but the most gentle slopes. Because the soil and topographic conditions within the older dunes are generally unfavourable for irrigation these areas are regarded as marginal or poor quality horticultural land. At present there appears to be little pressure on these areas for residential development.

Within the more recently formed Quindalup Dunes a number of phases of dune development of varying degrees of instability are represented in a complex, narrow zone approximately 1 km wide adjacent to the present beach. Dune instability is the greatest limiting factor for holiday or residential development. Within these dunes only the lower, relatively protected slopes of certain older dunes can be developed safely for residential purposes and in all areas there is a need to carefully control beach access routes. The limitations of severe erosion hazard and lack of good quality water generally preclude these dunes from any future intensive agricultural uses. In addition, any grazing of stock within the Quindalup system is likely to accelerate erosion and should therefore also be excluded.

The Yoongarillup Plain, inland of the Quindalup Dunes, is currently a productive agricultural area although it is subject to increasing pressure for subdivision to create lot sizes suitable for rural retreat or hobby farm purposes. Current land uses include grazing of cattle and sheep, and more intensive operations such as growing irrigated Lucerne, or market gardening. The sandy plains are farmed successfully, particularly where depression areas have been cleared and artificially drained and where good quality groundwater supplies have been obtained for irrigation.

In the areas suited for irrigated agriculture the bulk of the water used for irrigation is obtained from relatively shallow underground aquifers. As virtually all of this water has been committed to existing users, it appears that unless deeper aquifers can be made more widely available for irrigation purposes then prospects for future expansion of horticulture are extremely limited.

## 5. Recommendations

1. Development within areas of low to very low capability (Class 4 and 5) is considered likely to incur significant land degradation effects and is therefore not recommended.
2. Wherever possible, intensive development should be guided into those areas of higher capability with fewer associated limitations or hazards i.e. into class 1 or 2 and failing that, class 3. Wherever this can be achieved the effect will be to help minimize future land degradation problems.



3. The prospect for future expansion of irrigated horticulture within the coastal region is probably limited by the water availability constraint. It may therefore be appropriate in the future for the inland region to be zoned for a mixture of both rural residential and intensive agricultural pursuits depending on the outcome of P.W.D. studies of the area. If such a mixed zoning were adopted, intensive agriculture should be concentrated where both existing production and agricultural capability ratings are high, in the remaining areas, demand for residential development should be guided preferentially into those of higher residential capability before lower ranked, more hazardous land is used.

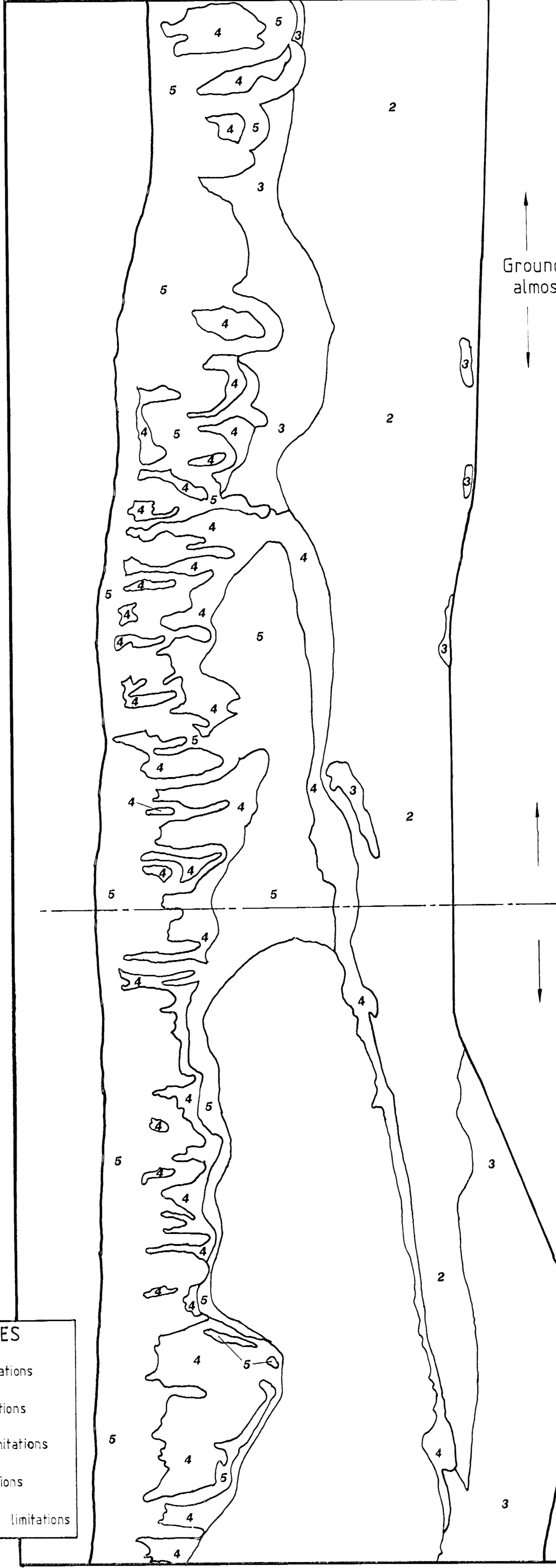
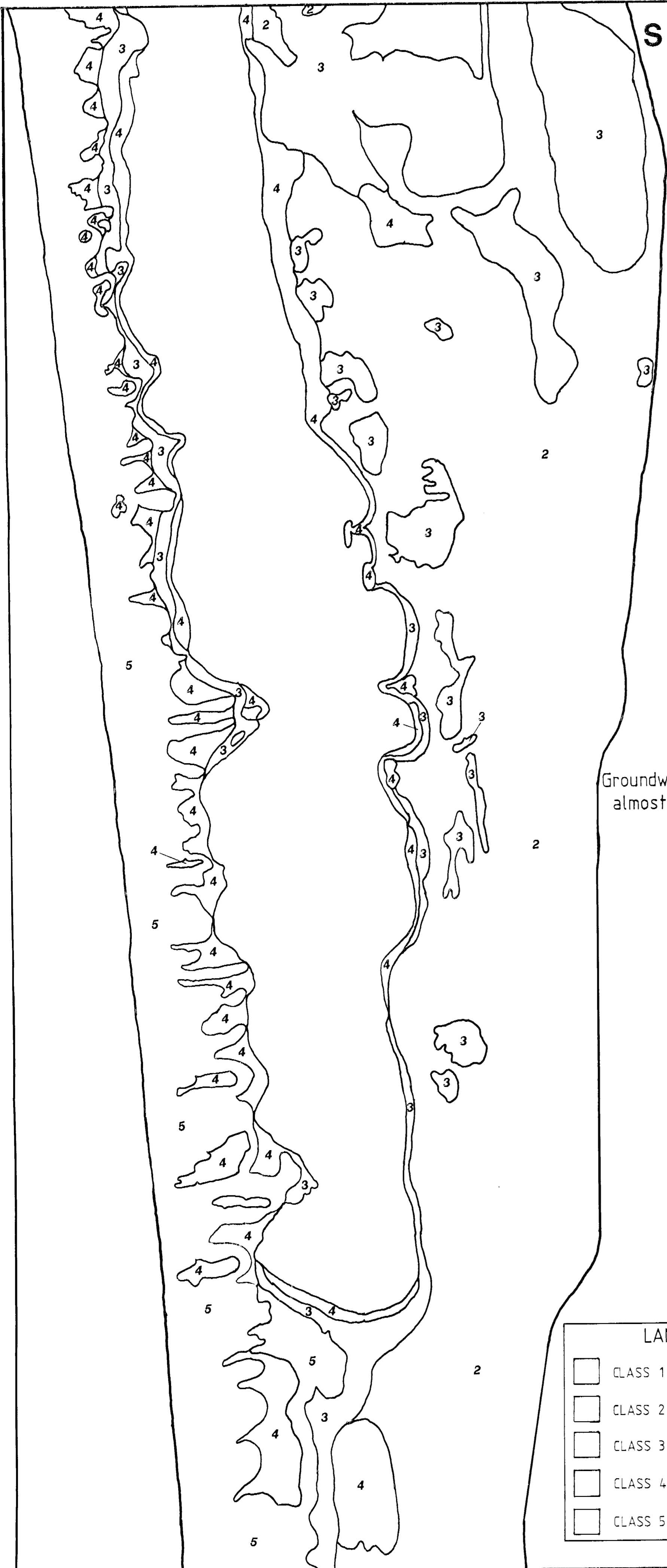
## **6. Reference**

W.M. McArthur and G.A. Bartle (1980) "Soils and Land Use Planning in the Mandurah-Bunbury Coastal Zone, Western Australia" C.S.I.R.O. Land Resources Management Series No. 6

# SHIRE OF HARVEY, COASTAL REGION: AGRICULTURAL CAPABILITY

SHEET 2A

SHEET 2B



**LAND CAPABILITY CLASSES**

□	CLASS 1	Very high capability: no limitations
□	CLASS 2	High capability: slight limitations
□	CLASS 3	Fair capability: moderate limitations
□	CLASS 4	Poor capability: high limitations
□	CLASS 5	Very poor capability: severe limitations

Groundwater reserves almost fully committed

Groundwater reserves almost fully committed

Groundwater reserves partially committed



PLAN N° 311

Note: Site specific approval required in ALL areas from P.W.D.

MAY 83

# SHIRE OF HARVEY, COASTAL REGION AGRICULTURAL CAPABILITY SHEET 3



↑  
Groundwater reserves  
partially committed  
↓

## LAND CAPABILITY CLASSES

- CLASS 1 Very high capability: no limitations
- CLASS 2 High capability: slight limitations
- CLASS 3 Fair capability: moderate limitations
- CLASS 4 Poor capability: high limitations
- CLASS 5 Very poor capability: severe limitations

PLAN N<sup>o</sup> 313

Note: Site specific approval required in ALL areas from P.W.D.

*6/7*  
MAY 83

# MAP 3 LANDFORMS AND SOILS of the HARVEY SHIRE COASTAL ZONE



SCALE 1:25,000

W.M. McARTHUR & G.A. BARTLE.  
C.S.I.R.O. Division of Land Resources Management.  
with modifications by  
Division of Resource Management  
West. Aust. Department of Agriculture.

## ABBREVIATED LEGEND \*

### SPEARWOOD DUNE SYSTEM

- Ky Low, hilly landscape; Karrakatta sand. (Yellow phase.)
- Kg Undulating landscape; Karrakatta sand. (Grey phase.)
- Kls Hilly terrain; Bare limestone and shallow brown sand.

### QUINDALUP DUNE SYSTEM

- Qo Aeolian sand plain; Flat to undulating.
- Q1 Parabolic ridges; Commonly discrete.
- Q2 Complex parabolic dunes and nested blowouts.
- Q3 Complex, steep parabolic dunes and nested blowouts.
- Q4 Foredune and blowout/parabolic dune complex.
- Qu Unstable foredunes, blowouts and transgressive dunes.
- Qp Deflation plain.

### YOONGARILLUP PLAIN

- Ys Flat to gently undulating sandplain.
- Yls Bare limestone.
- Yb Swamps in depressions.
- Ysp Stony plains in depressions.
- Pg Upper terrace fringing lakes.
- Ps Lower terrace fringing lakes.

\* For map units outside study area see  
McArthur and Bartle publication.

Study area boundary

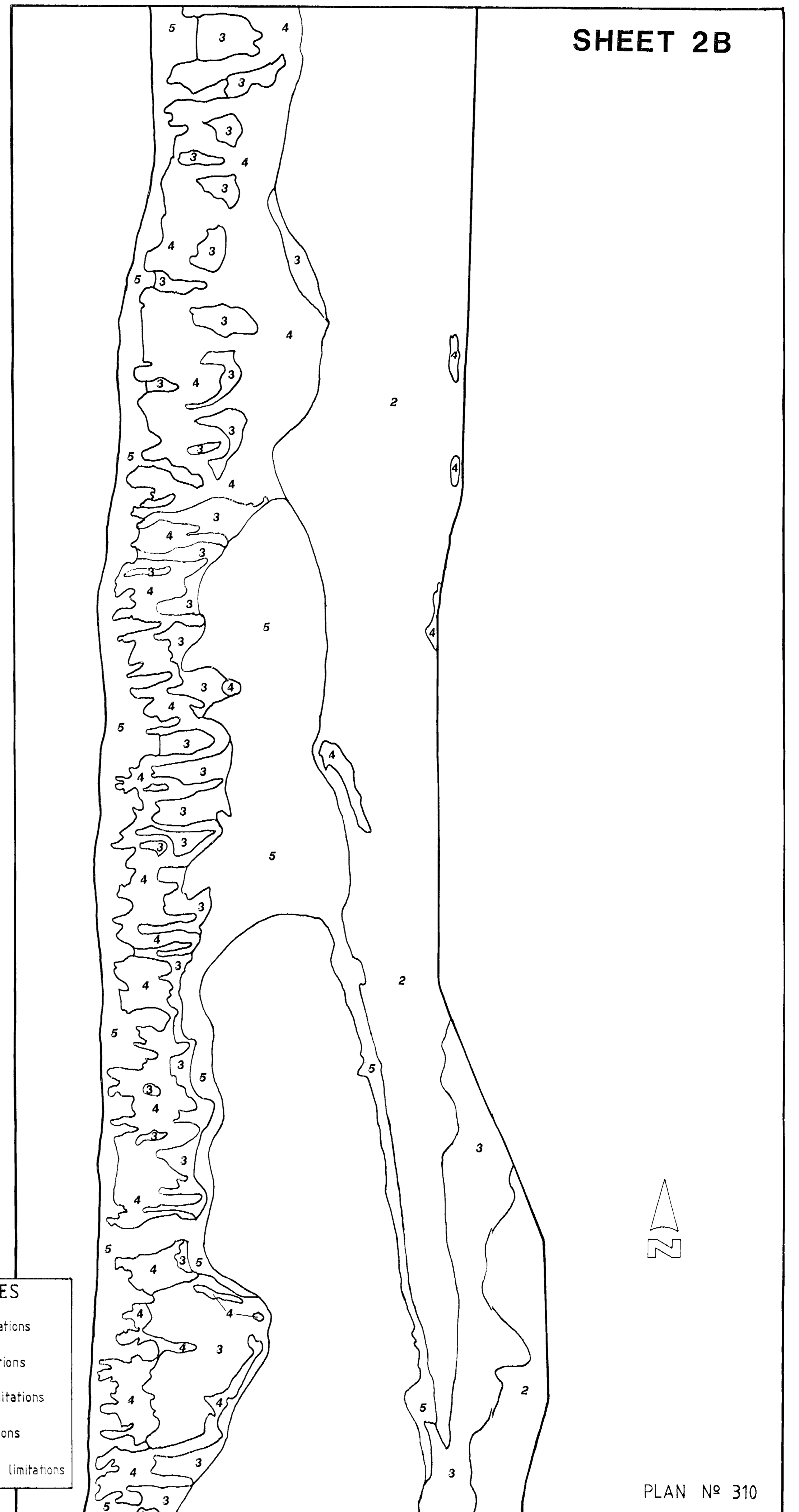
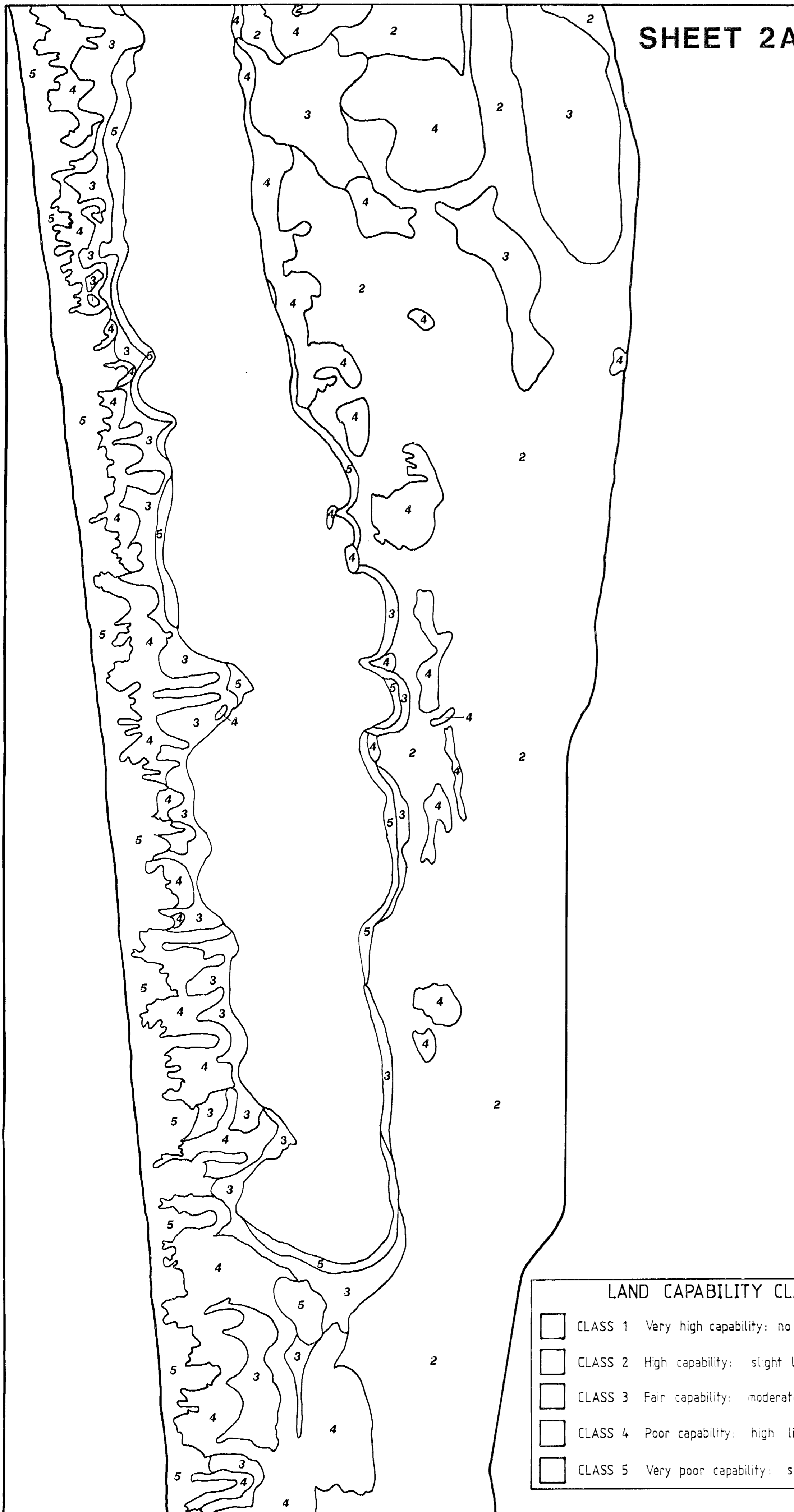


PLAN N° 307

# SHIRE OF HARVEY, COASTAL REGION: RESIDENTIAL CAPABILITY.

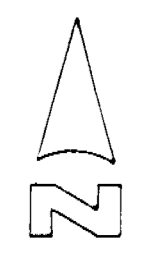
SHEET 2A

SHEET 2B



**LAND CAPABILITY CLASSES**

□	CLASS 1	Very high capability: no limitations
□	CLASS 2	High capability: slight limitations
□	CLASS 3	Fair capability: moderate limitations
□	CLASS 4	Poor capability: high limitations
□	CLASS 5	Very poor capability: severe limitations



PLAN No 310

1/4 May 83