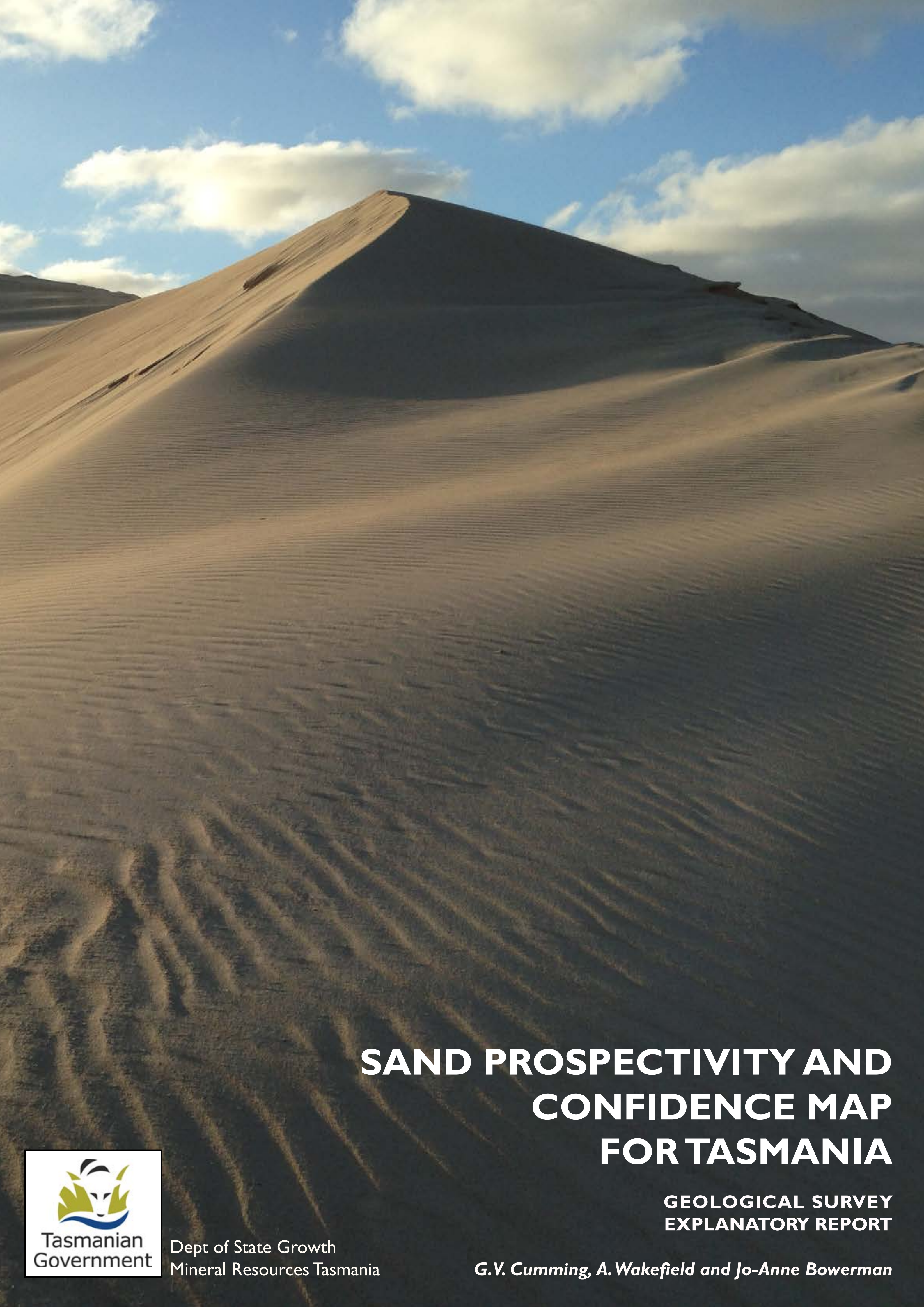

SAND PROSPECTIVITY AND CONFIDENCE MAP FOR TASMANIA

GEOLOGICAL SURVEY EXPLANATORY REPORT

G.V. Cumming, A. Wakefield and Jo-Anne Bowerman

Tasmanian Government
Dept of State Growth
Mineral Resources Tasmania

Mineral Resources Tasmania
Department of State Growth

GEOLOGICAL SURVEY
EXPLANATORY REPORT

Sand Prospectivity and Confidence Map for Tasmania

G.V. Cumming, A. Wakefield and Jo-Anne Bowerman

July 2019

Sand Prospectivity and Confidence Map for Tasmania

Mineral Resources Tasmania
Department of State Growth
Mineral Resources Tasmania PO Box 56 Rosny Park Tasmania 7018
Phone: (03) 6233 8377 l Fax: (03) 6233 8338
Email: info@mrt.tas.gov.au l Internet: www.mrt.tas.gov.au

Cover: Sandy Cape Beach, Tasmaina

Sand Prospectivity and Confidence Maps for Tasmania

1.0 Introduction

This report outlines the method used to define and map the distribution of potential sand resources throughout Tasmania. Prospectivity mapping is based on a limited desktop study utilizing Mineral Resources Tasmania's (MRT) 1:25 000 and 1:250 000 digital geological mapping, Mineral Occurrences database, information about current and past tenements, and background knowledge of sand occurrences in the state. As there are issues related to the disparate scales of geological base data used in the prospectivity mapping, a confidence map was also produced.

Sand is an essential component in the manufacture of concrete and other pavement materials used in the building and construction industries, and may also be used in foundrys and for glass making (Bacon et al., 2008). Sand consumption in the construction industry and for glassmaking and production in Tasmania has varied from 675 000 tonnes in 2010/2011, to 454 000 tonnes in 2015/16, to approximately 525 000 tonnes during 2017/18.

The most recent assessment of sand and gravel resources was completed in 2008 (Bacon et. al., 2008). An analysis of the mineral prospectivity for Tasmania was completed in 2012. "Unconsolidated" construction materials (clay sand and gravel) were included as a mineral deposit model (C44; MRT, 2012) and a tract map was prepared but not included in the final prospectivity analysis (Large and McNeill, 2012). Earlier prospectivity mapping for related materials and mineral categories were:

- In the 1997 Regional Forestry Agreement (RFA) a statewide assessment of sand was included in the prospectivity mapping for "construction materials", and was grouped with stone and gravel (Anon, 1996).
- In the southeast of Tasmania, where urban growth and environmental considerations are impacting the availability of sand resources, a series of reports on options for the long term supply of sand in the Hobart region were prepared (Duncan, 1999; Mills 2000; Grun, 2006).

2.0 Method

Initially, geological units with components of sand were recognised from the geological map series. These are referred to as "User-defined sand units" in Section 2.1. Following on from this (Step 2 and 3 in Section 2.2 and 2.3), sand occurrences in the Mineral Occurrences database were selected and considered. Characteristics of deposits actively being mined were used to filter prospective geological units. This enabled geological units to be ranked according to their relative prospectivity. In Step 4, a series of prospectivity zones were defined using available datasets and local knowledge. A confidence map was also produced to support the further interpretation of the prospectivity zones defined in Step 4.

2.1 Step 1: User-defined sand units

Areas of sand mapped at 1:25 000 scale were initially derived from MRT geological mapping. These "User-defined sand units" were isolated from the seamless geological polygon layers. Some screening of the prospectivity of these units was undertaken based on geological knowledge and previous mapping experience, to provide a more accurate representation. This produced the first-pass map of sand occurrences in the state shown in Figure 1.

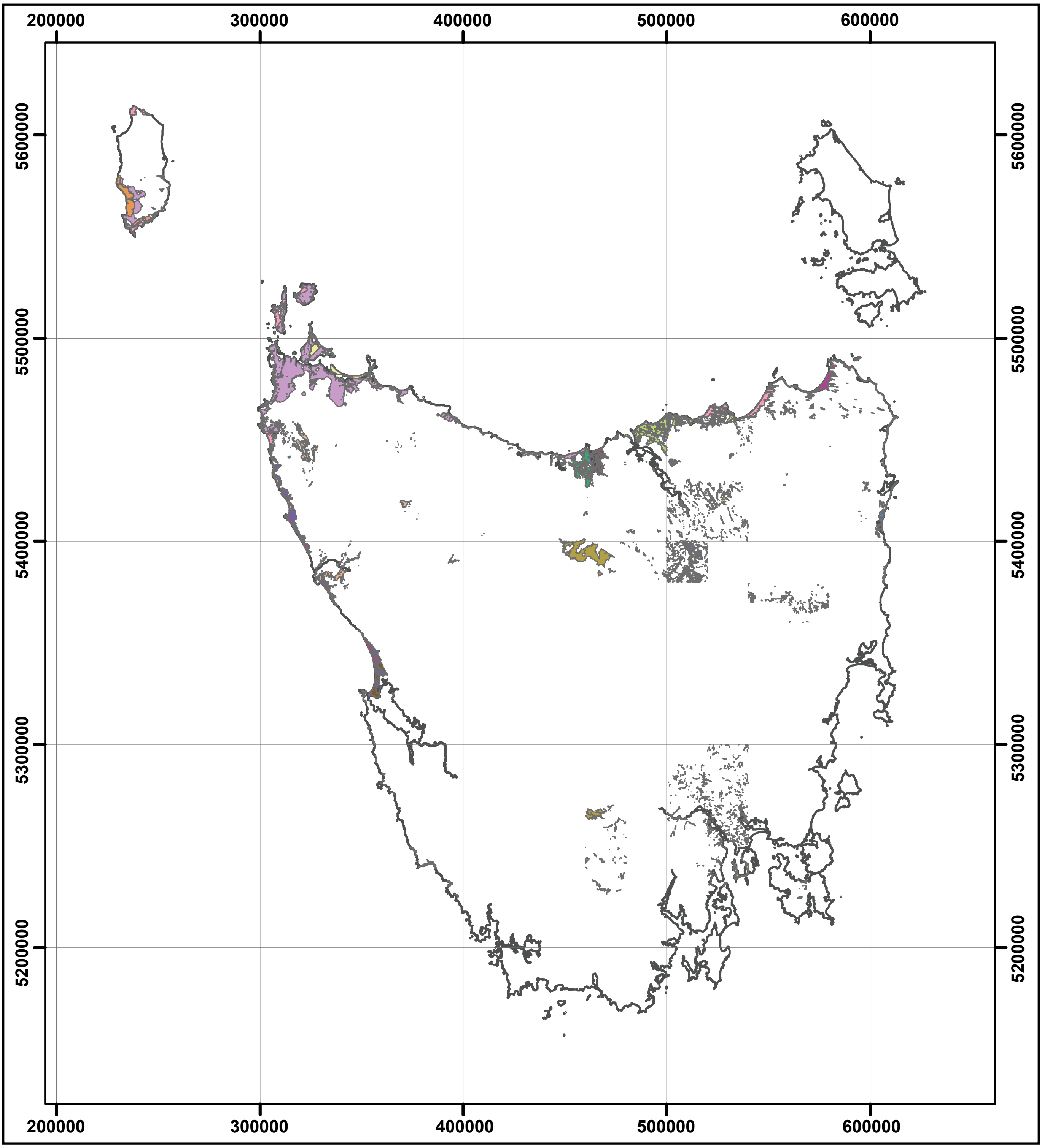

Figure 1. User-defined sand units based on the 1:25 000 geological mapping. It was apparent that some areas of potential were not captured in the initial filter of the seamless geological map layer.

2.2 Step 2: Sand defined by geology and mineral occurrence locations

The Mineral Occurrences database consists of point data showing mineral occurrences of all categories throughout the state. A breakdown of relevant occurrences and their types is included below, plotted with the 1:250 000 and 1:25 000 seamless geology polygons. A total of 379 mineral occurrences contain sand as a commodity and are displayed as different categories (shown in Figure 2).

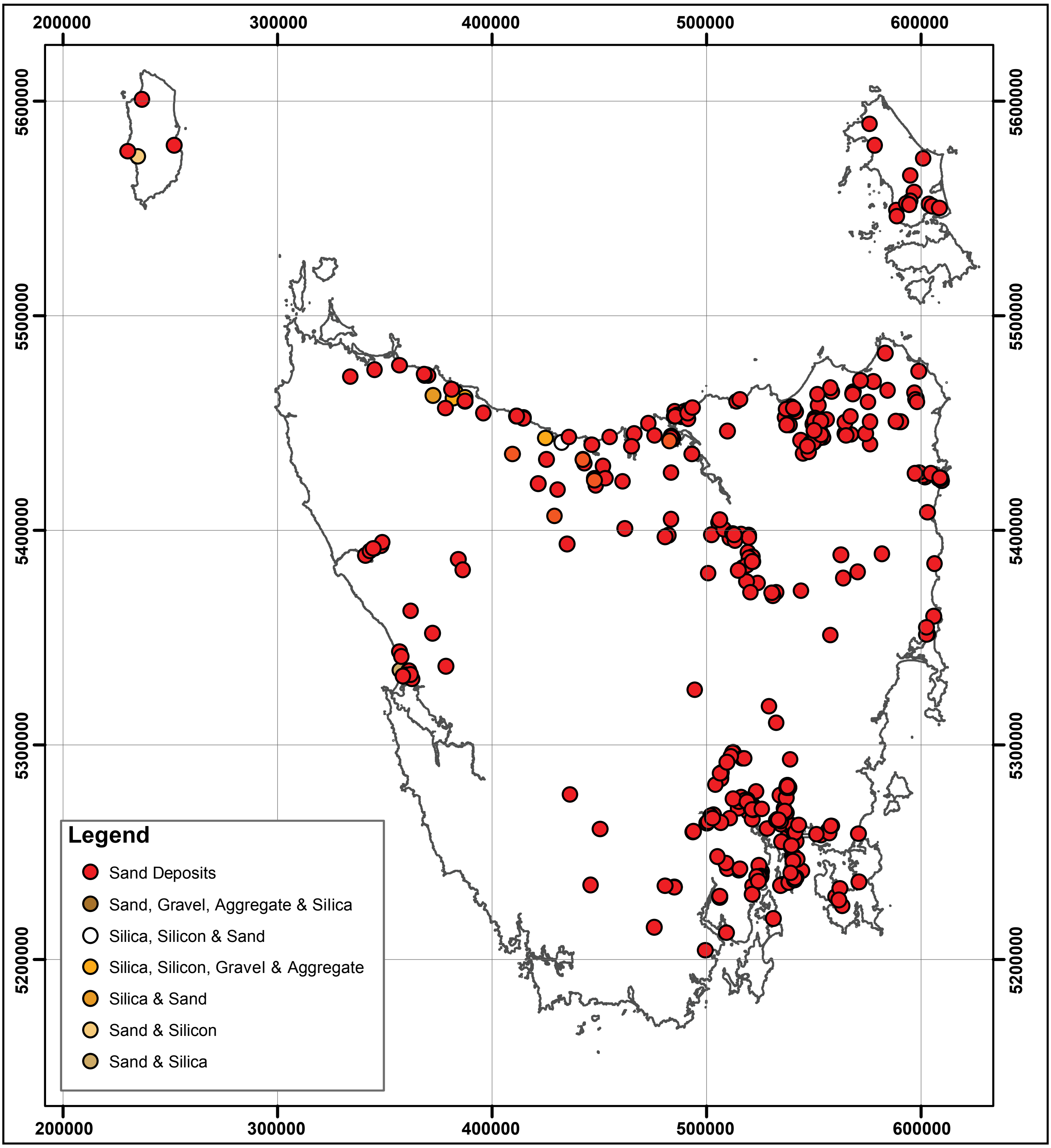

Figure 2. Sand deposits derived from the MRT Mineral Occurrence database. Most relevant entries in the dataset are "Sand deposits" in red.

The different categories were then selected and plotted as separate layers. These categories include:

- Sand, gravel and aggregate (4 occurrences);
- Sand (365 occurrences);
- Silica, silicon and sand (1 occurrence);
- Silica, silicon, gravel and aggregate (3 occurrences);
- Silica and sand (2 occurrences);
- Sand and silicon (1 occurrence);
- Sand and silica (3 occurrences).

All geological polygons (from the 1:25 000 and 1:250 000 digital geological coverage) were plotted. Where the selected mineral occurrence categories intersect, or are contained within a geological polygon, the polygon was selected. These polygons and their attributes were then saved as two shape files. Some filtering of the data was necessary as large areas of the state were captured. Many large polygons not directly related to sand, such as Triassic sandstone, Jurassic dolerite and granodiorite were then individually filtered from the geological polygon layer. A list of lithological units was then captured and maintained within the geological polygon shape file layers. These units were then filtered from the geological polygon layers from the whole of the state. This allowed isolation of geological units which did not have a deposit located directly within or adjacent to a prospective geological unit. The output map is included in Figure 3.

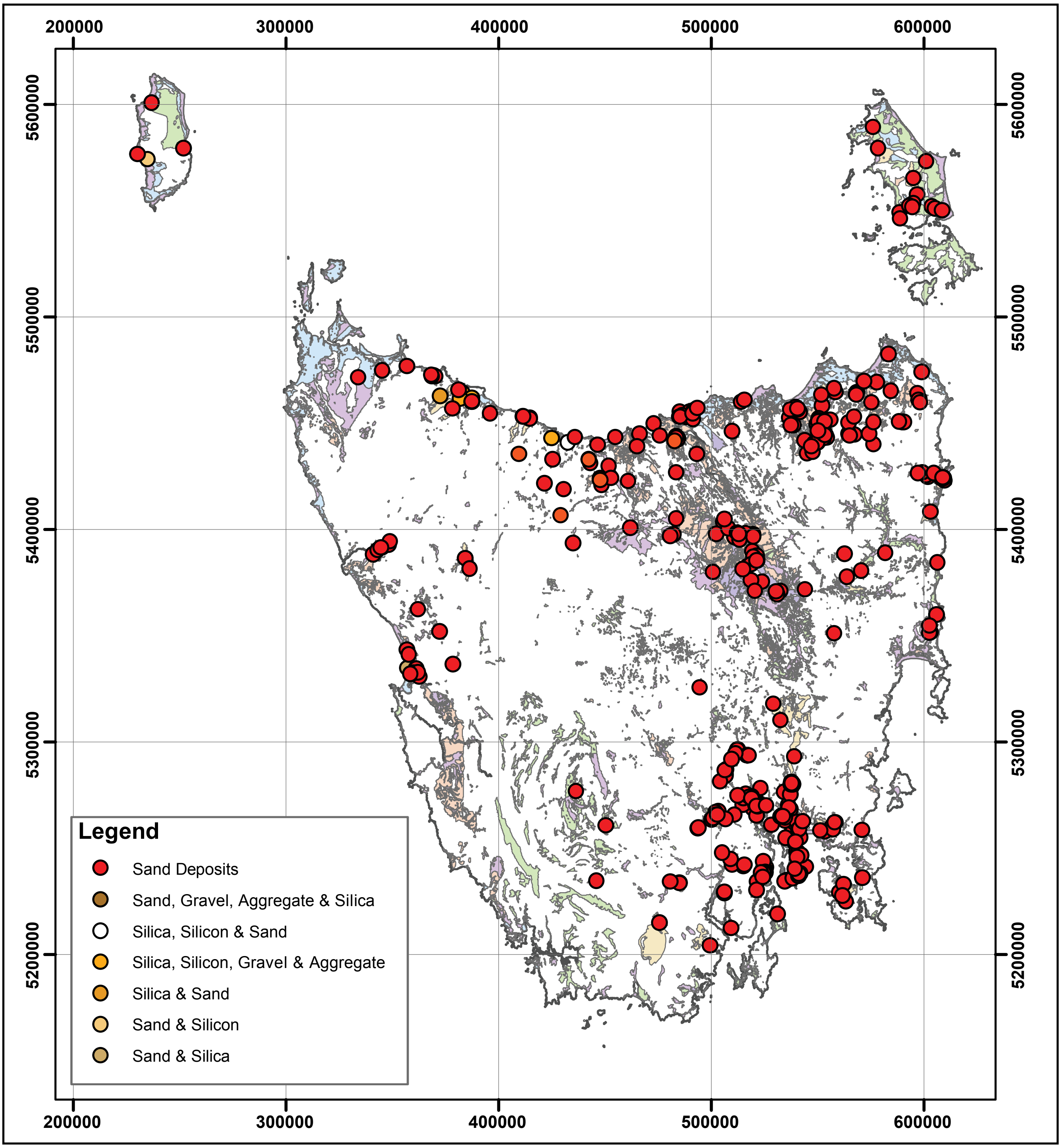

Figure 3. Map of Tasmania showing various sand deposits as derived from the mineral occurrence database. The geological units which host these deposits were extracted from the data, and all geological units (which share the same attributes) were added to the map.

This process did not capture all the areas of Tasmania with potential for sand resources because:

1. There were differences between sand units defined in Step 1 and 2, as units were not mapped consistently at different scales;
2. In some areas where there is current sand mining activity, there is not a mapped sand bearing geological unit (and these are considered in step 3).

2.3 Step 3: Sand Potential based on present mining activities

A review of current mining operations based on extraction types indicated the key materials being mined were:

- Sand;
- Sand and clay;
- Sand and gravel;
- Sand and stone;
- Minerals and sand.

Where the mining leases for the above types intersected or overlapped with geological polygons, the polygons were selected out of the 1:25 000 and 1:250 000 geological map layers. The geological polygons which relate to each mining category were filtered as separate polygon layers.

The procedure detailed in Step 2 was then repeated for all geological units that were being mined for sand, sand and clay, and sand and gravel. The category 'Minerals and sand' could not be filtered as, at the time the analysis was done, the spatial extent of the one licence to which this category applied was not defined (it was an application).

3.0 Prospectivity Analysis

In order to generate the final prospectivity map, an additional map layer showing mining leases (categorised by the types of material being extracted) was created with the 1:25 000 and 1:250 000 geological polygon layers. Where the mining leases intersected or overlapped with geological polygons, these polygons were then selected and identified as "very high" prospectivity layers (Figure 4). The geological polygons which relate to each mining category (sand, sand-gravel-aggregate, sand and clay etc.) were filtered as separate geological polygon layers but the mining category was not ranked in the final prospectivity analysis. An outline of each prospectivity band for sand in the state is outlined below:

1. **Very High prospectivity:** geological units that contain, or are adjacent to, current mining activities or historic mining activities related to sand.
2. **High prospectivity:** geological units which are the same as those being presently mined, but, which are not adjacent to, or do not contain, any current or historic mining leases (for sand).
3. **Medium prospectivity:** geological units which contain sand occurrences (from the MRT database).
4. **Prospective:** geological units which share the same geological polygon codes to those which occur beneath sand deposits located from the deposit database and user-defined Access database, but do not have a recorded sand occurrence or active or historical mining lease located directly on them (effectively all the geological units which may still be overlain by sand, but where sand is not recorded in the Mineral Occurrence database, or in previous mining activities).

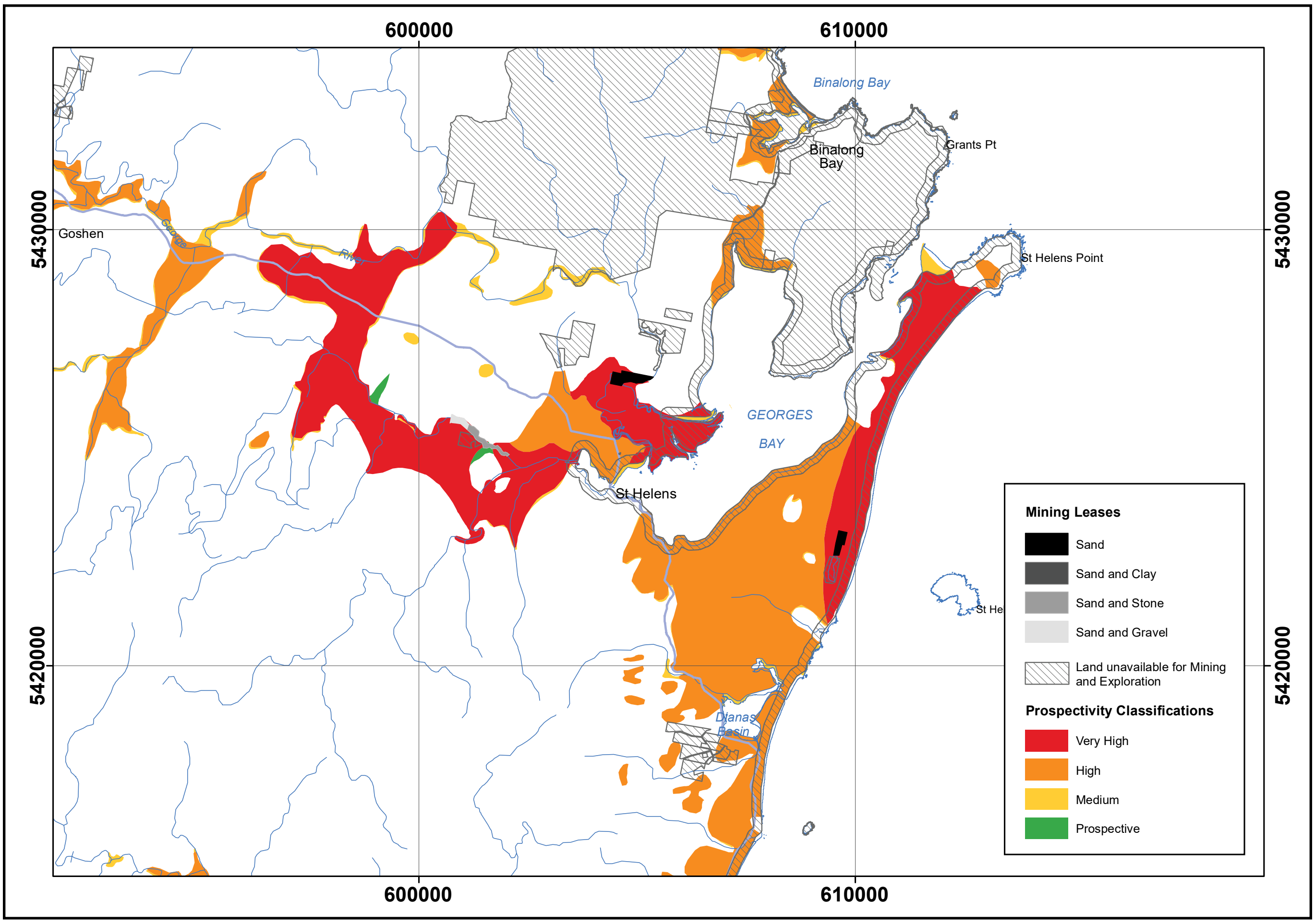

Figure 4. Map showing a mining lease for sand (as black polygon), and mining leases for sand and gravel and sand and stone (pale to mid-grey polygon) sitting over an area of coastal sand and gravel (code Qps); outlined as the red polygon. All units containing current sand mining operations have been grouped in the "very high" prospectivity layer.

The prospectivity definitions are based on a composite of 1:25 000 and 1:250,000 scale geological mapping. Some units have been excluded from the filter process, the reasons for which are discussed in Section 5.0. The final sand prospectivity map is included in Appendix1, Map 1, which includes mining leases and land unavailable for mining.

4.0 Confidence Map

The prospectivity analysis is based on a desktop study. Very little field work or analytical work was carried out specifically for the purpose of understanding sand prospectivity in the state. The level of confidence in the prospectivity of geological polygons is shown in Appendix1, Map 1, and is defined as follows:

1. **High confidence:** Areas which have been mapped at a detailed (1:25 000) scale, and also contain active sand mining operations.
2. **Medium confidence:** Areas which have been mapped at any scale, with potential sand resources defined through the filter process as 'highly prospective', but are not actively mined.
3. **Low confidence:** Areas which have been mapped (at any scale) which have known sand occurrences (from the Mineral Occurrence Database), but these have not necessarily been actively mined.

A detailed map showing confidence layers is included in Figure 5 below. The state-wide confidence map, showing areas geologically mapped at 1:25 000 scale is included in Appendix 1, Map 2.

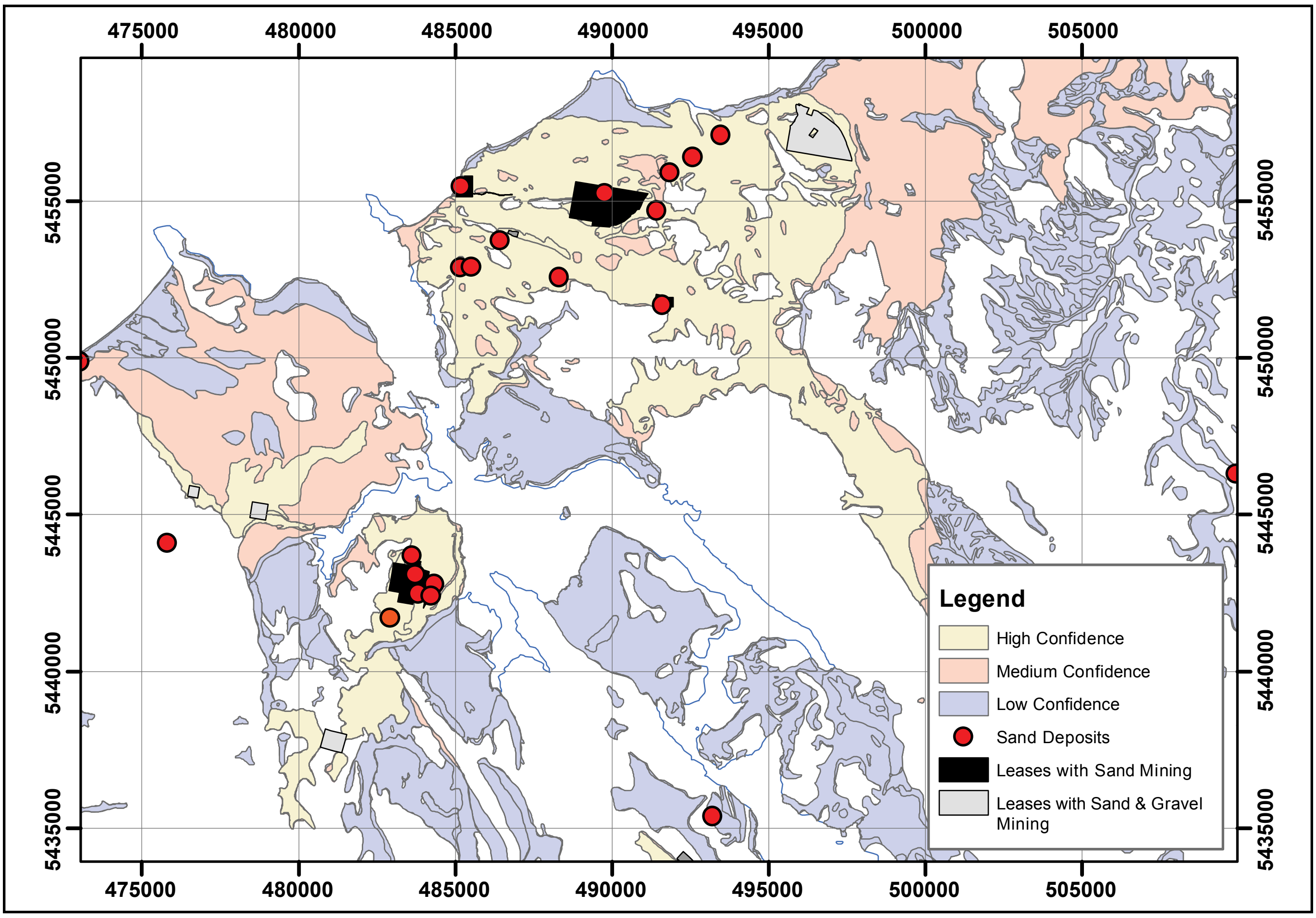

Figure 5. Map showing mining leases, principally for sand and sand and gravel (as black and grey polygons), sitting over areas of high confidence. Sand deposits (from MRT's Mineral Occurrence database) are shown, which overlap on areas of high, medium and low confidence. Some sand occurrences are located on units which are not prospective (see orange arrow), such as Oonah Formation, which is considered "very low" or "not" prospective.

5.0 Considerations

Several factors have not been considered in relation to prospectivity for sand. These include:

- No consideration has been given to potential causes which may reduce the prospectivity of a geological unit. For example, the occurrence of acid sulphate soils or laterite, which would reduce prospectivity.
- Large areas of granitic rocks, Mathinna Group sedimentary rocks, Jurassic dolerite, Parmeener Group sedimentary units and Tertiary (Cainozoic) basalt have been excluded from the filtering process, even though there is a likelihood that some sand deposits will occur above these rock units. This is because some regions have not been mapped at a detailed scale. In some instances (Cainozoic) sand deposits have not been mapped appropriately on some units, so weathering "layers" derived from the underlying rock units are mapped as bedrock rather than a surficial deposit.
- It is difficult to distinguish if there are additional areas of "high" or "very high" sand prospectivity zones related to geological units that have not previously been exploited or do not have any recorded sand deposits located on them. A more detailed and thorough investigation to

systematically assess all sand bearing deposits in our Mineral Occurrence database and to sample all prospectivity zones to understand and compare the characteristics of sand deposits throughout the state is required in order to develop a more detailed prospectivity map.

- The likely end-use of the sand has not been assessed in detail, for instance sand used for cement will have different requirements compared to that used for glassmaking.
- The detailed prospectivity maps are limited to regions where 1:25 000 scale geological mapping has been undertaken. More map sheets are being produced each year, and the prospectivity of an area may change as more detailed maps are completed. For this reason, the prospectivity map needs to be updated regularly.
- Caution must be used when assessing the prospectivity of large areas mapped as Qpsa, which contains a diverse range of features. Consequently, the actual zone of prospectivity associated with this unit might be much smaller than shown as Qpsa includes many different landform and sand features. This is also true for the prospective zone at Macquarie Harbour/Ocean Beach, albeit for different reasons. This area was mapped as coastal sand and gravel "Qps" but may actually include units not specified in the description.

6.0 Conclusions

The majority of highly prospective sand resources occur in the north-east of the state spanning areas east of the Rubicon River (Port Sorell) to the Tamar River and further east at Noland, Andersons and Ringarooma Bay. Great Musselroe Bay, Perrins Dunes and Georges River near St. Helens currently host mining operations, and Golden Fleece Rivulet west of St Helens also shows highly prospective zones. Large areas near Pioneer and Scottsdale are also prospective and have current mining activities.

A large area in NW Tasmania has been mapped as older, stabilised aeolian sand in a predominantly coastal plain setting, with underlying marine sands in places (Qpsa). These areas may show relict landforms including terraces, lunettes, linear or barchan dunes, and beach ridges related to regressive strandlines of the Last Interglacial, and these areas are highly prospective.

A large zone west of Exeter and some riverine zones south of Latrobe are "highly" and "very highl" prospective. A zone north of the Mersey River is being mined for sand and gravel, and is categorized as "very highly" prospective, but the type of material being mined is uncertain.

Unfortunately, and perhaps due to the lack of detailed mapping in the south of the state, there are no large, "very highly" prospective areas in southern Tasmania. South Arm, 7-Mile Beach and Sorell already have very large mining leases over sand units. There are, however, areas of medium prospectivity in this area of the state, along alluvial valleys, and isolated coastal stretches. Many of these "medium" prospectivity zones are already impacted by residential development. Refer to Duncan (1999) and Grun (2006) for a more detailed study of sand resources in southern Tasmania.

As for the east coast and Midlands, a "very high" prospectivity zone occurs east of Moulting Lagoon, and a fairly large, irregular zone occurs between Campbell Town and Perth. Although these areas have been allocated a very high prospectivity, as mining activities occur/have occurred in this region, the quality of the material is poorly known. Cainozoic sediments span the northern part of this zone (dominantly non-marine sequences of gravel, sand, silt, clay and regolith) but the majority of current mining activities are extracting from Quaternary sediments (sand gravel and mud of alluvial, lacustrine and littoral origin).

7.0 Recommendations

The analysis outlined in this report is not comprehensive, but draws upon relationships between the MRT Mineral Occurrence database, the information on current and historic leases, and geological mapping at 1:25 000 and 1:250 000 scale. It represents a preliminary attempt to understand areas that are prospective. The analysis could be improved by:

1. Further field reconnaissance to "rank" the high prospectivity zones and compare them state-wide.
2. Collect sand samples from various regions around the state in order to systematically assess their chemical and physical characteristics.
3. Development of a criteria (such as particle size, composition, sphericity, contaminants etc.) to characterise sand in various locations.

8.0 References

Anon, 1996. Tasmanian-Commonwealth Regional Forest Agreement, Social and economic report Vol. VI, Supplementary appendices to Volume 3, Background Report Part D. Public Land Use Commission, 272p.

Bacon, C. A., Calver, C. R., Pemberton, J., 2008. The Industrial Mineral Deposits of Tasmania. *Record Tasmanian Geological Survey 13*.

Duncan, D. M., 1999. A study of the Sand Resources of Southern Tasmania, *Record Tasmanian Geological Survey* 1999/03.

Grun, W., 2006. A review of concrete sand supplies in the Hobart region, June 2006, *Record Tasmanian Geological Survey* 2006/03.

Large, R.R., and McNeill, A.W., 2012. Minerals prospectivity assessment: proposed reserve areas for independent verification group, 40p. at: https://www.environment.gov.au/system/files/resources/eefde0e6-0f83-486d-b0c3-8b1d25abc497/files/ivgmineralsprospectivity.pdf

Mills, J., 2000. A review of socio-economic and environmental issued relating to the potential extraction of sand in the Hobart region. *Record Tasmanian Geological Survey* 2000/03.

MRT, 2012. Mineral Deposit Models prepared for minerals prospectivity assessment: Proposed reserve areas for Independent Verification Group. *Record Tasmanian Geological Survey* 2012/03.

APPENDIX 1

STATEWIDE SAND PROSPECTIVITY - MAP 1

&

SAND PROSPECTIVITY CONFIDENCE - MAP 2