Quarry Registration System

QRS3: Preparing a Quarry Assessment Report for a natural sand and/or natural gravel quarry

October 2024

Copyright

Licence

CC BY licence summary statement

In essence, you are free to copy, communicate and adapt this work, as long as you attribute the work to the State of Queensland (Department of Transport and Main Roads). To view a copy of this licence, visit: https://creativecommons.org/licenses/by/4.0/

Translating and interpreting assistance

The Queensland Government is committed to providing accessible services to Queenslanders from all cultural and linguistic backgrounds. If you have difficulty understanding this publication and need a translator, please call the Translating and Interpreting Service (TIS National) on 13 14 50 and ask them to telephone the Queensland Department of Transport and Main Roads on 13 74 68.

Disclaimer

While every care has been taken in preparing this publication, the State of Queensland accepts no responsibility for decisions or actions taken as a result of any data, information, statement or advice, expressed or implied, contained within. To the best of our knowledge, the content was correct at the time of publishing.

Feedback

Please send your feedback regarding this document to: tmr.techdocs@tmr.qld.gov.au

Contents

1 Introduction

QRS3 is part of the Quarry Registration System. It describes the content required in a Quarry Assessment Report (QAR) for a natural sand and/or natural gravel quarry. The QAR must be supplied by the Applicant in his or her submission as part of the department's Quarry Registration System requirements.

2 Authorship and confidentiality of the Quarry Assessment Report

The QAR for the registration of new quarries must be prepared in accordance with QRS1, QRS2, QRS3 and QRS4 by a suitable qualified person, with at least 10 years' experience working as an engineering geologist / geologist registered at Australasian Institute of Mining and Metallurgy or Australian Institute of Geoscientists or Institute of Engineers Australia.

This person must also be independent of the Applicant's business, in order to provide an unbiased view of any potential issues the quarry is encountering.

The QAR for the reregistration of quarries must be prepared in accordance with QRS1, QRS2, QRS3 and QRS4 by a suitable qualified person, such as at least five years' experience working in quarry materials.

The submitted QAR is regarded as a confidential document and will not be released to external organisations, or persons without the permission of the Applicant.

3 Quarry Assessment Report content

The QAR content will be dependent on whether it is for a new quarry registration or a reregistration.

3.1 Quarry Assessment Report for new quarry registration

The QAR for a new quarry registration should contain the following information:

- site details
- regional and site geology
- quarry development, operational and production practice
- source material description, product quality and compliance testing requirements, and
- quality management including material quality management plan (MQMP).

The degree of detail provided will depend on the size of the site, the stage of development and the products that the Applicant intends to provide.

For greenfield sites, all of the following requirements may not be appropriate; however, sufficient investigations should be reported to enable an assessment of source material quality, variability and reserves.

Site details

The site details should include:

- site name
- location and access (provide maps and layout plans)
- real property description (Parish, County, Registered Property Nos)

- local government authority (Council and Shire)
- ownership and tenure
- quarry manager and contact details, and
- other key management personnel and contact details.

This information shall also be included in the *Quarry registration application form*.

Regional and site geology

The QAR should provide the following geological information:

- **source material origin** (for example, alluvial / fluvial, dune, marine, aeolian, colluvial, residual)
- **description of deposit** including area and depth, current topography including any elevated terraces, natural slope angles of residual and colluvial deposits
- Description of the source rock and its 'Material Group' classification which must be supported with interpretative petrographic analysis reports; petrographic reports (conforming to ASTM C295) shall be carried out by an experienced petrographer specialised in thin section petrology, describing the sand composition and mineralogy, grain coatings, particle size and shape, weak and nondurable particles, free silica content (Transport and Main Roads *Test Method Q188*), potential for alkali silica reactivity (Test Method AS1141.60.1)
- percentage, size and composition of any gravel silt and clay components, and
- other considerations (for example, environmental constraints).

Quarry development and production

The following information is required in this section of the QAR:

- current or proposed source development and available reserves
- current or proposed extraction methods (end loader, excavator, dragline, suction dredge, and so on)
- processing methods (screens, cyclones, crushing and screening operations if employed).

Source material and product quality

The following information is required in this section of the QAR:

- List of 'nominated products' for which Transport and Main Roads registration is required.
  - Natural sand and/or crushed rock or crushed gravel particles are predominantly sources for fine asphalt and concrete aggregates (<4.75 mm in size). Departmental specifications MRTS39, MRTS40, MRTS70 and Australian Standard AS2758.1 are relevant for concrete and MRTS30 and MRTS31 for asphalt.
  - If the gravel component is significant and larger in size it can also be crushed and used as a source for coarse aggregate (>4.75 mm) in unbound paving material, concrete and asphalt mixes, and cover aggregate. The abovementioned concrete and asphalt Technical Specifications, plus MRTS05 for paving material and MRTS22 for cover aggregate, are relevant.

- Test results showing the sand and/or gravel conforms with departmental Technical Specification requirements.
    - For natural sand deposits to be used as a source for fine concrete aggregates the following tests are required for initial quarry registration:
        - AS1141.6.1 *Particle density and water absorption of fine aggregate*
        - AS1141.11.1 *Particle size distribution – Sieving method*
        - AS1141.12 *Materials finer than 75 µm in aggregates (by washing)*
        - AS1141.13 *Material finer than 2 µm*

        (If percent finer than 2 µm is greater than specification test limit X-ray diffraction (XRD) may be necessary to determine mineralogical composition of fines. A quantitative XRD report describing the type and composition of moisture sensitive and reactive clay minerals (such as montmorillonite / smectite, sericite, illite) using X-ray diffraction techniques may additionally be required.)

        - AS1141.24 *Aggregate soundness – Evaluation by exposure to sodium sulphate solution*
        - ASTM D7428 *Micro-deval abrasion loss*
        - AS1141.31 *Light particles*

        (particularly relevant for residual sand and some young alluvial deposits)

        - AS1141.34 *Organic impurities (other than Sugar)*

        (particularly relevant for alluvial / fluvial deposits)

        - AS1141.35 *Sugar*

        (relevant for sand deposits in sugar cane areas; sugar acts as a setting retarder)

        - AS1012.20.1 *Determination of chloride and sulphate in hardened concrete and concrete aggregates*

        (particularly relevant for sand from marine and estuarine environments; halite and gypsum are the most common sources of soluble salts which affect concrete)

        - Q188 *Quartz content of fine aggregate*
        - *AS1141.60.1 *Potential alkali-silica reactivity – Accelerated mortar bar method*

            * These tests are usually carried out on source materials from specific environments. If results from the initial testing are negative they need not be continued on a regular basis.

        Tables in Appendices A1 to C2 list relevant departmental pavement and structural concrete Technical Specifications and relevant tests / Test Methods applicable to the use of natural sand as a fine concrete aggregate.

- For natural sand deposits to be used as fine asphalt aggregate, the Technical Specifications require:
  - the sand be clean and quartzitic
  - AS1141.5 *Water absorption*.
- For crushed gravel used to produce fine and coarse aggregates the relevant tests and test methods applicable are the same as those for crushed rock from a hard rock quarry. These are listed for reference for each specification in Tables of Appendices A to C2 in associated QRS2.

Quality management

Should the Applicant have a 'Third Party Certified' Quality Management System which complies with International and Australian Standard AS/NZS ISO 9001, then evidence of such certification should be attached as an Appendix to the QAR. Any Quality System procedural documentation relevant to achievement and maintenance of product quality should also be included as appendices to the QAR.

For those quarries which do not have a 'Third Party Certified' Quality Management System as described previously, details should be provided of the type of Quality Management System in operation and how it is certified; for example, the system may be based on relevant elements of AS/NZS 9001 only. If the system is independently certified (by a registered auditor) or 'Second Party Certified', written evidence of this shall be attached in an Appendix to the QAR as well as the quality system procedural documentation relevant to the achievement and maintenance of product quality.

For those quarries that may only have a rudimentary Quality Management System in place, the written procedures and instructions (MQMP) used to achieve and maintain product quality shall be attached as an Appendix to the QAR including a statement on whether the system is audited.

3.2 Quarry Assessment Report for quarry reregistration

The QAR for a quarry reregistration need only be an abbreviated version of the report required for the initial quarry registration. It should contain the following information with respect to the basic report elements:

Site details

- Any changes to the quarry name, ownership, management or tenure.

Site geology

- Any changes or additions to the geological site description.

Quarry development and production

- Details of any changes to the quarry and its operations including materials, systems, equipment and key staff.

Source material and product quality

- All product test results relevant to departmental products for the last two years (NATA-endorsed tests carried out by a quarry's clients as part of the normal business are also acceptable, for example, if a quarry sells to a major concrete supplier which does its own compliance testing)
- a list of departmental projects supplied by the quarry over the last two years, including the 'nominated products' and tonnages
- An annual total quarry production summary for the last two years that includes all customers
- details of any additions or deletions to the department’s 'nominated product' list, and
- petrographic reports and test results for the last two years; these should include NATA-endorsed individual test reports and Excel™ spreadsheets where appropriate.

Quality management

List any changes made to the Quality System which affect product quality. These changes could be in procedures, methodologies or programs used to control production and material quality.

Appendix A1

Source rock and product compliance tests for coarse aggregate for:

MRTS39 Lean Mix Concrete Sub-base in Pavements

MRTS40 Concrete Pavement Base – compliance testing

Relevant quarry 'nominated product' – concrete aggregate (coarse) – natural gravel deposit

Can be produced from natural gravel sources.

Table A1.1 – Source material tests

Source material test property	Test Method
Petrographic analysis	ASTM C295
Wet strength[1]	AS1141.22
Wet / Dry strength variation[1]	AS1141.22
Degradation factor	Q208B
Water absorption	AS1141.6.1
Particle density – dry	AS1141.6.1
Weak particles	AS1141.32

Note:

1. The test shall be carried out on the fraction from AS 13.2 mm to AS 9.5 mm.

Table A1.2 – Product tests [5]

Product test property	Test Method
Flakiness index	AS1141.15
Light particles[1]	AS1141.31
Crushed particles[2]	AS1141.18
Particle size distribution[3]	AS1141.11.1
Material finer than 75 µm[4]	AS1141.12

Notes:

1. Limits in MRTS39 and MRTS40 apply to the total coarse aggregates in the mix.
2. Indicated tests are not always required (refer to MRTS39 and MRTS40 for details) and not applicable to MRTS39.
3. Requirement is waived for aggregate which has been extracted from mineral rock quarries by drilling and blasting.
4. Not required if coarse aggregate is to be from multiple sources.
5. Product tests are compulsory for new quarry registration or upon request by the Quarry Registration System for reregistration.

Appendix A2

Source rock and product compliance tests for fine aggregate for:

MRTS39 Lean Mix Concrete Sub-base in Pavements

MRTS40 Concrete Pavement Base

Relevant quarry 'nominated product' – concrete aggregate (fine) – natural sand deposit

Table A2.1 – Source material tests

Source material test property	Test Method
Petrographic analysis	ASTM C295
Micro-deval abrasion loss[1,2]	ASTM D7428
Water absorption	AS1141.5
Particle density – dry	AS1141.5
Soundness (sodium sulfate)	AS1141.24
Organic impurities[2] (other than sugar)	AS1141.34, and if required AS 1289.4.1.1
Sugar presence[2]	AS1141.35
Particle size distribution	AS1141.11.1
Material finer than 75 µm	AS1141.12
Material finer than 2 µm[2]	AS1141.13
Methylene Blue Value (MBV)[1]	AS1141.66
Light particles[1,2]	AS1141.31

Notes:

1. Indicated tests are not always required (refer to MRTS39 and MRTS40 for details) and not applicable to MRTS39.
2. Limits in MRTS39 and MRTS40 apply to the total fine aggregate in the mix.

Table A2.2 – Product tests [5]

Product test property	Test Method
Compacted bulk density	AS1141.4
Acid insoluble residue[3]	Tex-612-J
Flow cone time[1]	RMS T279
Alkali silica reactivity	AS1141.60.1
Alkali carbonate reaction[1,4]	ASTM C1105
Deleterious Fines Index (DFI) [1,2,3]	AS1141.11.1 (by washing) and AS1141.66

Notes:

1. Indicated test are not always required (refer to MRTS39 and MRTS40 for details)
2. DFI is the product of MBV and the percentage of material passing the 75 µm sieve.
3. Limits in MRTS39 and MRTS40 apply to the total fine aggregate in the mix.
4. Applies to dolomitic and argillaceous limestones and other carbonate rocks
5. Product tests are compulsory for new quarry registration or upon request by the Quarry Registration System for reregistration.

Appendix B1

Source rock and product compliance tests for coarse aggregate for:

MRTS30 Asphalt Pavement

MRTS32 High Modulus Asphalt (EME2)

MRTS101 Aggregates for Asphalt

Relevant quarry 'nominated product' –aggregate for asphalts (coarse) – natural gravel deposit

Coarse aggregates that are crushed and/or produced from natural gravel and/or hard rock quarry sources.

Slag aggregate is not permitted.

Table B1.1 – Source material tests

Source material test property	Test Method
Petrographic analysis	ASTM C295
Wet strength[1]	AS1141.22
Wet / Dry strength variation[1]	AS1141.22
Degradation factor	Q208B
Water absorption	AS1141.6.1
Particle density – dry	AS1141.6.1
Polished Aggregate Friction Value (PAFV)	Q203

Note:

1. The test shall be carried out on the fraction from AS 13.2 mm to AS 9.5mm.

Table B1.2 – Product tests[4]

Product test property	Test Method
Flakiness index	AS1141.15
Fractured faces[1] (two or more)	AS1141.18
Particle size distribution[2,3]	AS1141.11.1
Material finer than 75 µm	AS1141.12

Notes:

1. Requirement is waived for aggregate which has been extracted from mineral rock quarries by drilling and blasting
2. Not required if coarse aggregate is to be from multiple sources.
3. Required if the test is carried out on dry sample.
4. Product tests are compulsory for new quarry registration or upon request by the Quarry Registration System for reregistration.

Appendix B2

Source rock and product compliance tests for fine aggregate for:

MRTS30 Asphalt Pavement

MRTS32 High Modulus Asphalt (EME2)

MRTS101 Aggregates for Asphalt

Relevant quarry 'nominated product' – aggregates for asphalts (fine) – natural sand deposit

Aggregates are sourced from a fine natural gravel source.

Table B2.1 – Source materials tests

Source material test property	Test Method
Petrographic analysis	ASTM C295
Particle density (dry basis)	AS1141.5
Water absorption[1]	AS1141.5
Weighted percent loss for mix aggregates	ASTM 1141.24

Note:

1. Testing shall be completed on material passing the 47.5 mm sieve and retained on 75 µm sieve.

Table B2.2 – Product tests[1]

Product test property	Test Method
Particle size distribution	AS1141.11.1
Materials finer than 75 µm	AS1141.12

Note:

1. Product tests are compulsory for new quarry registration or upon request by the Quarry Registration System for reregistration.

Appendix C1

Source rock and product compliance tests for coarse aggregate for:

MRTS70 Concrete

Relevant quarry 'nominated product' – concrete aggregate (coarse) – natural gravel deposit

Table C1.1 – Source material tests

Source material test property	Test Method
Petrographic analysis	ASTM C295
Wet strength[1]	AS1141.22
Wet / dry strength variation[1]	AS1141.22
Degradation factor	Q208B
Water absorption	AS1141.6.1
Particle density – dry	AS1141.6.1
Weighted percent loss	AS1141.24
Weak particles	AS1141.32
Sulfate content	AS1012.20.1
Chloride content	AS1012.20.1

Note:

1. The test shall be carried out on the fraction from AS 13.2 mm to AS 9.5 mm.

Table C1.2 – Product tests[4]

Product test property	Test Method
Flakiness index	AS1141.15
Particle size Distribution[1]	AS1141.11.1
Material finer than 75 µm	AS1141.12
Alkali silica reactivity[3]	AS1141.60.1
Alkali carbonate reaction[2,3]	ASTM C1105

Notes:

1. Not required if coarse aggregate is to be from multiple sources.
2. Applies to dolomitic and argillaceous limestones and other carbonate rocks.
3. Applies to combined aggregates of concrete mix design.
4. Product tests are compulsory for new quarry registration or upon request by the Quarry Registration System for reregistration.

Appendix C2

Source rock and product compliance tests for fine aggregate for:

MRTS70 Concrete

Relevant quarry 'nominated product' – concrete aggregate (fine) – natural sand deposit

Table C2.1 – Source rocks tests

Source material test property	Test Method
Petrographic analysis	ASTM C295
Water absorption	AS1141.6.1
Particle density – dry	AS1141.6.1
Micro-deval abrasion loss	ASTM D7428
Weighted percent loss for mixed aggregates	AS1141.24
Chloride content	AS1012.20.1
Sulfate content	AS1012.20.1
Organic impurities	AS11.41.34, and if required AS1289.4.1.1
Sugar content	AS1141.35
Light particles	AS1141.31
Particle size distribution	AS1141.11.1
Material finer than 75 µm	AS1141.12
Material finer than 2 µm	AS1141.13

Table C.2.2 – Product tests [4]

Product test property	Test Method
Alkali silica reactivity[1,3]	AS1141.60.1
Alkali carbonate reactivity[1,2,3]	ASTM C1105

Notes:

1. Indicated tests are not always required (refer to MRTS40 for details.
2. Applies to dolomitic and argillaceous limestones and other carbonate rocks.
3. Applies to combined aggregates of concrete mix design.
4. Product tests are compulsory for new quarry registration or upon request by the Quarry Registration System for reregistration.