

Naturally occurring asbestos within immediate vicinity of the township of Port Macquarie, NSW

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Introduction

The term Naturally Occurring Asbestos (NOA) is used to describe asbestos that occurs in nature and is not commercially mined or used but may be disturbed by human activity. It is most commonly found *in situ* within three rock types: serpentinites, altered ultramafic rocks, and some mafic rocks at varying levels. NOA fibres can be released into the air from soil and rock by human activities (e.g. digging, driving) and natural weathering (wind and rain) (Culley *et al.*, 2010). The inhalation of elevated levels of asbestos fibres is known to have a detrimental impact on human health, including diseases such as asbestosis, mesothelioma, lung cancer and other malignant pleural and tumour diseases (Greillier and Astoul, 2008). In Australia, every state contains NOA in a variety of geographical environments (The Australian Geologist (TAG), 2006). In NSW there are a number of serpentine regions known as the Peel Fault (near Orange), the great Serpentine Belt (near Barraba), the Gordonbrook Serpentine Belt (near Baryugil), and the Coolac Serpentine Belt (near Gundagai) (Resources and Energy, Trade and Investment, 2015).

There has been substantial research undertaken in the USA on the health effects of NOA and airborne levels of asbestos around NOA areas (Start, 2005; U.S EPA, 2008). In California, in particular, there are very significant outcrops of NOA in some populated areas (Start, 2005). It should also be noted that in the United States background asbestos levels in ambient air average between 0.00001 to 0.0004 fibres/mL and concentrations tend to be much lower in rural areas (USEPA, 2013).

This study focuses on Port Macquarie Serpentine as it is exposed along the coastal strip from Town Beach down to Tacking Point and is within immediate vicinity of the growing township of Port Macquarie. Other areas to the west of the Port Macquarie coast but still within residential/commercial areas of the town were also assessed. Eight masses of serpentine have been reported along the coast of Port Macquarie to Tacking Point (Och *et al.*, 2007). The presence of this serpentine belt is now widely recognised and contemporary land use planning and work practices give consideration of this material. The aim of this study was to verify the presence, type and location of NOA in various locations within the township of Port Macquarie, NSW. Air monitoring was undertaken to provide indicative exposure data associated with passive recreational activity (signposted coastal walk) in the vicinity of NOA outcrops.

Methodology

Determining potential NOA sites

NSW WorkCover, Port Macquarie, raised awareness of a number of potential locations of rocks containing NOA within the township of Port Macquarie. See Appendix 1 for a detailed map of NOA sampling locations.

Rock Sample Collection

Rock samples were “cherry picked” according to their visual characteristics. A rock was selected if it displayed any of the following visual characteristics:

- flakiness/crumbliness
- green/brown colouring
- white crystalline covering the rock surface/sides
- small fibrous white veins within the rock

These selective samples were collected from nine (9) sites around Port Macquarie. They were placed in clean and labelled sample bags. See Appendix 1 map with collection points 1-9 for location details.

Asbestos Air Monitoring

On the 22nd October 2014, two personnel were fitted with personal air samplers and on 10th April 2015, an additional three personnel were fitted with personal air samplers using SKC Universal PCXR4 pumps at 2 L/min for the duration of the Port Macquarie coastal walk between Town Beach (Spot 4, Appendix 1 map) to Tacking Point Lighthouse, a distance of approximately 8 kms (Spot 9, Appendix 1). Two static samples were additionally used as controls.

Laboratory Analysis

On the 22nd October 2014, rock samples exhibiting asbestos rock type characteristics, were “cherry picked” onsite and sent to the OEH Forensics and Analytical Science Laboratory to determine the presence/absence of asbestos. These samples were contracted to a NATA accredited laboratory, Envirolab Services, Chatswood, NSW and analysed using a qualitative identification of asbestos in bulk samples using Polarised Light Microscopy and Dispersion Staining Techniques including Synthetic Mineral Fiber and Organic Fibre as per Australian Standard AS4964-2004.

Air filters (Preloaded cassette, MCE, Best Chek, 0.8um, 25mm, pre-banded, SKC, USA) collected (n=7) were also sent to the OEH laboratory and contracted to, Envirolab Services, Chatswood, NSW. An additional blank filter was included as a control. The filters were examined in accordance with NOHSC:3003 (April 2005) *Guidance Note on the Membrane Filter Method for Estimating Airborne Asbestos Fibres* and Envirolab in-house method ASB-002. Less than 10 fibres/100 graticule areas is the minimum detection level for this recognised method and equates to <0.01 fibres/mL (NOHSC: 3003 (April 2005)). SEM was performed at Envirolab Services Pty Limited on two filters, a control static air sample and a personal air sample.

Results

Rocks collected from nine sampling locations all exhibited similar visual characteristics as described above. In Figure 1 and 6, rocks collected from Town Beach and a construction zone (see “Spot 4” and “Spot 1” in Appendix 1, respectively) showed white, green and/or brown colours and thin impure veinlets. Some rocks were easily broken and crumbled when handled. A description of each sampled rock can be seen in Table 1. Importantly, chrysotile asbestos was detected in all samples collected from the nine locations within Port Macquarie. Numerous outcrops were seen along the coast of Port Macquarie to Tacking Point (see Figure 5). In Figure 2, 3 and 4 a large outcrop is found along the edge of a carpark, adjacent to a popular Port Macquarie beach known as Town Beach. This NOA outcrop is accessible to the general public with evidence of foot traffic, crumbling rock surfaces and the presence of loose rocks (see Figure 4). Chrysotile asbestos was detected in rock samples collected from this outcrop (see Table 1, “Spot 4”).

Table 1. Description and asbestos identification of rock collected from nine different locations in Port Macquarie (refer to Appendix 1 for location details).

Location	Land/Soil Description	Sample Description	Asbestos ID in materials
"Spot 1 on map" Port Macquarie, Charles Sturt Construction site (See Figure 6,7,8)	Excavated material presumed to contain NOA, segregated under workplace controls. Approximately 50% of soil stockpile consisting of broken NOA rock.	Brown-green rocks and ore	Chrysotile asbestos detected

"Spot 2 on map" Port Macquarie, Ruin's Way Construction Zone/Area	NOA rock fragments (1-5cm in diameter) were sporadic (approx. 1-2 fragments per 100m ²) within the soil.	Brown rocks with crystal coating	Chrysotile asbestos detected
"Spot 3 on map" Port Macquarie, Ruin's Way New Home Estate (See Figure 9 and 10).	NOA rock fragments (1-10cm in diameter) were sporadic (approx. 1-2 fragments per 100m ²) within the soil.	Assorted brown-green rocks and ore	Chrysotile asbestos detected
"Spot 4 on map" Port Macquarie, Town Beach	Large NOA rock outcrop, with crumbled rock pieces (1-30cm in diameter) present on and around the outcrop (See Figure 1,2,3,4)	Green asbestiform rocks and ore	Chrysotile asbestos detected
"Spot 5 on map" Port Macquarie, Coastal Walk	Large NOA rock outcrops (see Figure 5)	Green asbestiform rocks and ore	Chrysotile asbestos detected
"Spot 6 on map" Port Macquarie, Coastal Walk	Predominately large NOA rock outcrops	Green asbestiform rocks and ore	Chrysotile asbestos detected
"Spot 7 on map" Port Macquarie, Coastal Walk	Predominately large NOA rock outcrops	Green asbestiform rocks and ore	Chrysotile asbestos detected
"Spot 8 on map" Port Macquarie, Coastal Walk	Predominately large NOA rock outcrops	Green asbestiform rocks and ore	Chrysotile asbestos detected
"Spot 9 on map" Port Macquarie, Coastal Walk	Predominately large NOA rock outcrops	Assorted brown-green rocks and ore	Chrysotile asbestos detected



Figure 1. Chrysotile asbestiform rock identified at Town Beach, Port Macquarie. Refer to "Spot 4" for location on map in Appendix 1.



Figure 2. Large NOA outcrop containing chrysotile asbestos identified at Town Beach, Port Macquarie. Refer to “Spot 4” for location on map in Appendix 1.

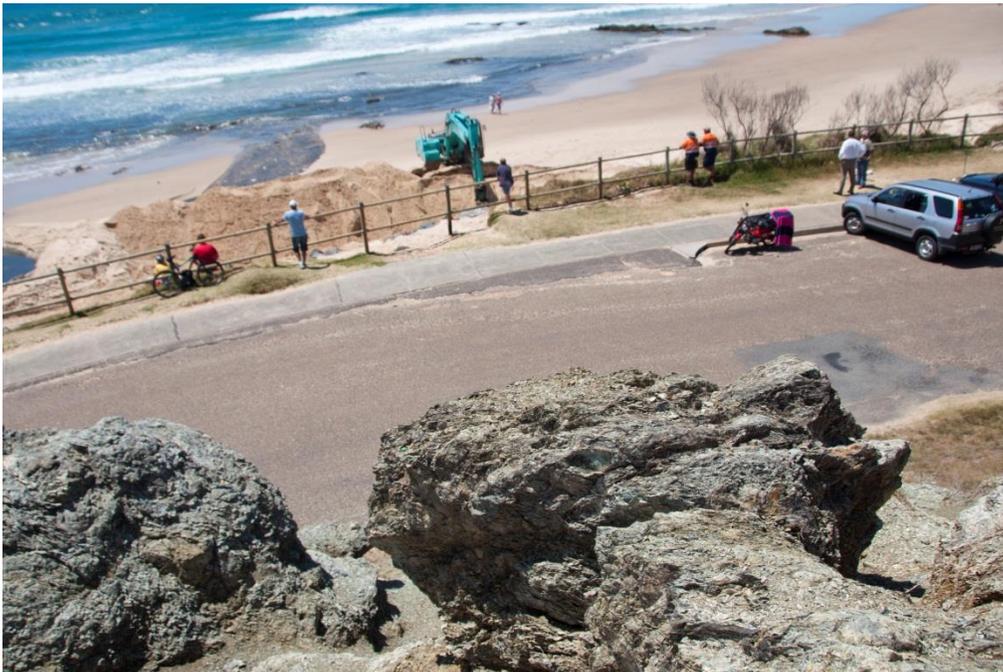


Figure 3. View of large NOA outcrop containing chrysotile asbestos in the vicinity of the popular Town Beach at Port Macquarie. Refer to “Spot 4” for location on map in Appendix 1.



Figure 4. Large NOA outcrop containing chrysotile asbestos with evidence of public access and foot traffic areas identified at Town Beach, Port Macquarie. Refer to “Spot 4” for location on map in Appendix 1.



Figure 5. Chrysotile asbestiform rock identified at Rocky Beach, Port Macquarie. Refer to “Spot 5” for location on map in Appendix 1.



Figure 6. Chrysotile asbestiform rock identified at a construction zone near Ruin's Way, Port Macquarie. Refer to "Spot 1" for location on map in Appendix 1.



Figure 7. Chrysotile asbestiform rock identified on a construction site (Ruin's Way, Port Macquarie) and covered in tarpaulin to control segregated material. Refer to "Spot 1" for location on map in Appendix 1.



Figure 8. Chrysotile asbestiform rock identified and segregated on a construction site (Ruin's Way, Port Macquarie) and covered in tarpaulin to control segregated material. Refer to "Spot 1" for location on map in Appendix 1.



Figure 9. Chrysotile asbestiform rock fragments, 1-5cm in diameter, found in sporadic distribution at a residential construction zone. Ruin's Way New Home Estate, Port Macquarie. Refer to "Spot 3" for location on map in Appendix 1.



Figure 10. Chrysotile asbestiform rock fragments, 1-5cm in diameter, found in very sparse amounts at a residential construction zone. Ruin's Way New Home Estate, Port Macquarie. Refer to "Spot 3" for location on map in Appendix 1.

The NSW EPA inspected a construction site for Charles Sturt University, (see Figure 7 and 8) on Ruin's Way, Port Macquarie. The work practices adopted for this development factored in the potential for NOA and outcrops were identified. These suspected NOA materials were segregated and appropriate controls applied. The asbestos containing rock distributed throughout the soil was covered in tarpaulin and sprayed with water to reduce the risk of liberating asbestos fibres into the air. The segregated rock found under the tarpaulin was analysed by Envirolab Services laboratories and shown to contain chrysotile asbestos (Figure 6 and Table 1, "Spot 1").

Sporadic/isolated samples of rocks collected from residential construction site adjacent to newly built residential homes (see Figure 9 and 10) were brown-green in appearance with the presence of a white-green crust. Chrysotile asbestos was again detected in these rock samples by Envirolab Services laboratories (Table 1). The NOA isolated stockpile was transported to an appropriate landfill for disposal.

Table 2. Asbestos personal air monitoring data (fibres/mL) (refer to Appendix 1 for location details).

Sample type	Date/ Location	Weather	Sample Volume (L)	Results (fibres/field)	Fibre count	Exceed > 0.1 f/ml
Personal Air sample	22/10/2014 - Port Macquarie Coastal Walk (Town Beach to Tacking-point), person 1	Wind SE 11 knots, clear skies	320	1/100	<0.01 fibres/mL	No
Personal Air sample	22/10/2014 - Port Macquarie Coastal Walk (Town Beach to Tacking-point), person 2	Wind SE 11 knots, clear skies	430	2/100	<0.01 fibres/mL	No
Personal Air sample	10/04/2015 - Port Macquarie Coastal Walk (Town Beach to Tacking-point), person 1	Wind SW 12 knots, clear skies	456	0/100	<0.01 fibres/mL	No
Personal Air sample	10/04/2015 - Port Macquarie Coastal Walk (Town Beach to Tacking-point), person 2	Wind SW 12 knots, clear skies	426	1/100	<0.01 fibres/mL	No
Personal Air sample	10/04/2015 - Port Macquarie Coastal Walk (Town Beach to Tacking-point), person 3	Wind SW 12 knots, clear skies	408	1*/100	<0.01 fibres/mL	No
Static Air sample	10/04/2015 – placed at Town Beach	Wind SW 12 knots, clear skies	456	0/100	<0.01 fibres/mL	No
Static Air sample	10/04/2015 – placed at Town Beach	Wind SW 12 knots, clear skies	394	2/100	<0.01 fibres/mL	No
Blank	22/10/14	-	-	0/100	-	-
Blank	10/04/15	-	-	0/100	-	-

*Fibre type was determined by Scanning Electron Microscopy as calcite and halite material.

A total of five people equipped with personal air monitoring filters and devices on two separate days of the year participated in the signposted recreational coastal walk from the popular Town Beach to Tacking Point (approximately 8kms). Much of this activity was on formed unsealed trails, whilst perhaps 10% was scrambling/rock hopping over NOA outcrops.

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The sequence of walkers changed periodically to represent the lead and following exposure patterns. The route and activity undertaken was selected to represent a potential exposure scenario reflecting a vigorous 8 km walk over an area with a substantial component of NOA. Filters resulted in fibre counts less than the minimum detection limit for airborne concentration of asbestos which is set at 0.01 fibres/mL of air (2nd edition, NOHSC:2002 (2005)). In Australia the occupational exposure limit is 0.1 fibres/ml for a 40 hour working week. Notification to SafeWork NSW is required if workplace levels exceed 0.02 fibres/ml.

Discussion

Chrysotile asbestos is found in the Port Macquarie Serpentine coastal outcrops located along the coastal walk from the Town Beach to Tacking-Point. In this study, air monitoring during the coastal walk returned results less than the detection limit of the contemporary method for measurement of airborne asbestos exposure and as such did not indicate an elevated human health risk from the inhalation of airborne asbestos. One of the most prominent outcrops is the Town Beach NOA outcrop located adjacent to the car park and within close vicinity to a populated beach. There is evidence of outcrop weathering i.e. foot traffic paths and loose crumbing rocks within and around the outcrop. There is no signage to indicate to members of the general public that this is a chrysotile asbestos NOA outcrop. Installation of a simple barrier at this location may be an effective control without causing undue concern.

In context of the simulated recreational activities, this study found there was no detectable asbestos exposure associated with the presence of NOA outcrops along the coast strip of Port Macquarie. Within the scope of the activities that were simulated, these indicative results suggest that tourists and locals walking/jogging the coastal public paths are not at an increased risk from the inhalation of asbestos fibres. However, if the NOA rocks and outcrops are disturbed in way such as digging, scrapping, using machinery such as excavators etc., an increase in the risk of asbestos fibres being liberated into the air is likely to occur. Path construction and maintenance activities should factor the presence of NOA in developing safe work practices.

NSW has established the Heads of Asbestos Coordination Authorities (HACA) (2013) to improve the management, monitoring and response to asbestos related issues in NSW by developing coordinated prevention programs. These programs include a *state-wide plan for asbestos*, a *model asbestos policy for local councils* and a public awareness campaign to promote the safe handling of asbestos and help minimise exposure to asbestos in the NSW community. There is a map displaying the probable locations of NOA across NSW in the HACA "Asbestos Blueprint (2011): A guide to roles and responsibilities for operation staff of state and local government". This information has been provided to local councils. Additional supporting material, including higher resolution mapping and information sheets outlining prudent control strategies are currently available on the SafeWork NSW website.

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Appendix 1. Port Macquarie map showing all rock sample collection points (1 to 9). **1)** Construction zone, Cnr Oxley Hwy and The Ruins Way. **2)** Ruins Way Construction Zone Area. **3)** Ruins Way New Home Estate. **4)** Town Beach. **5)** The rocks around Flag staff lookout **6)** Oxley Beach. **7)** Windmill Hill Lookout. **8)** Point between Shelly Beach and Miners Beach. **9)** The base of Tacking Point Lighthouse.



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