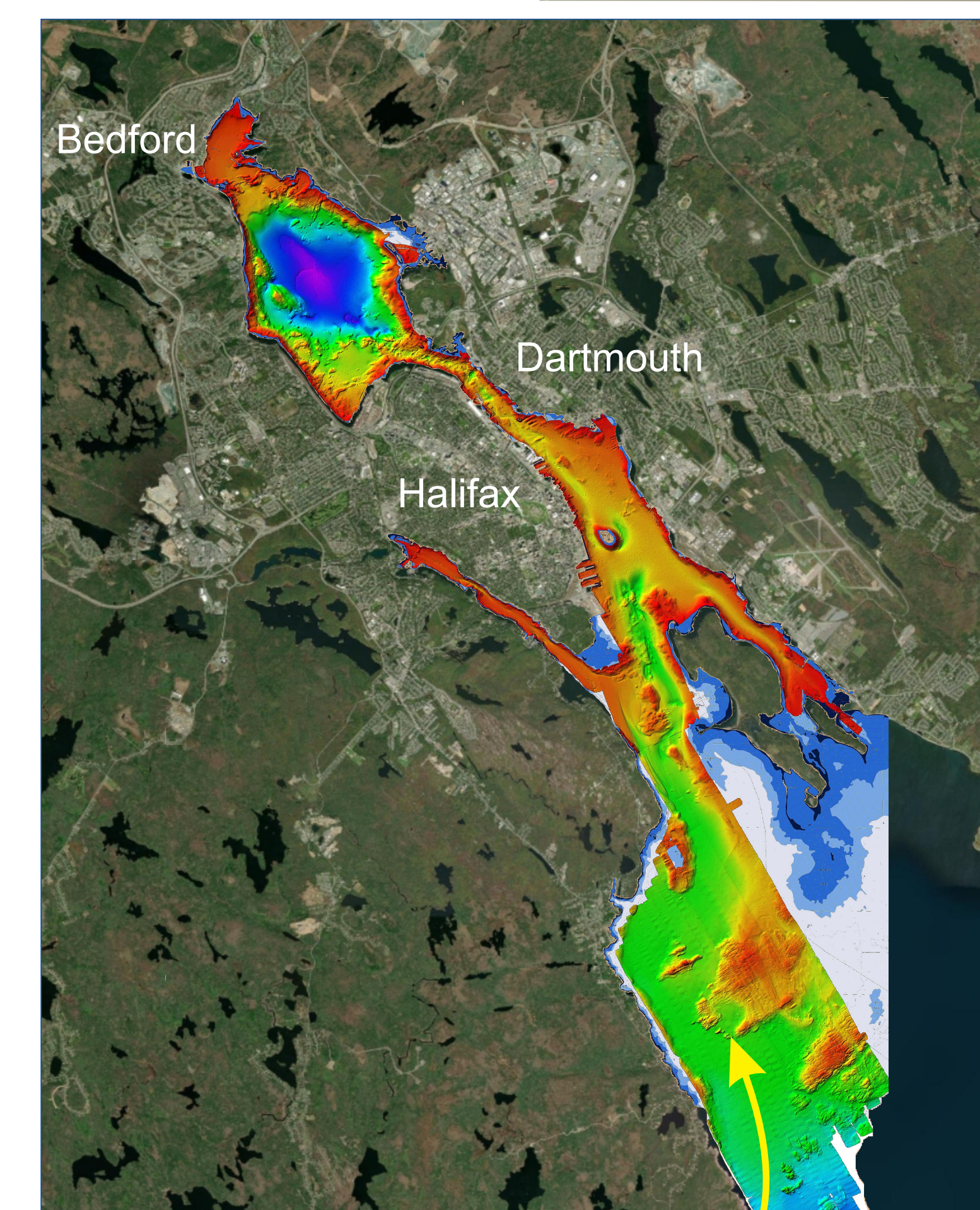
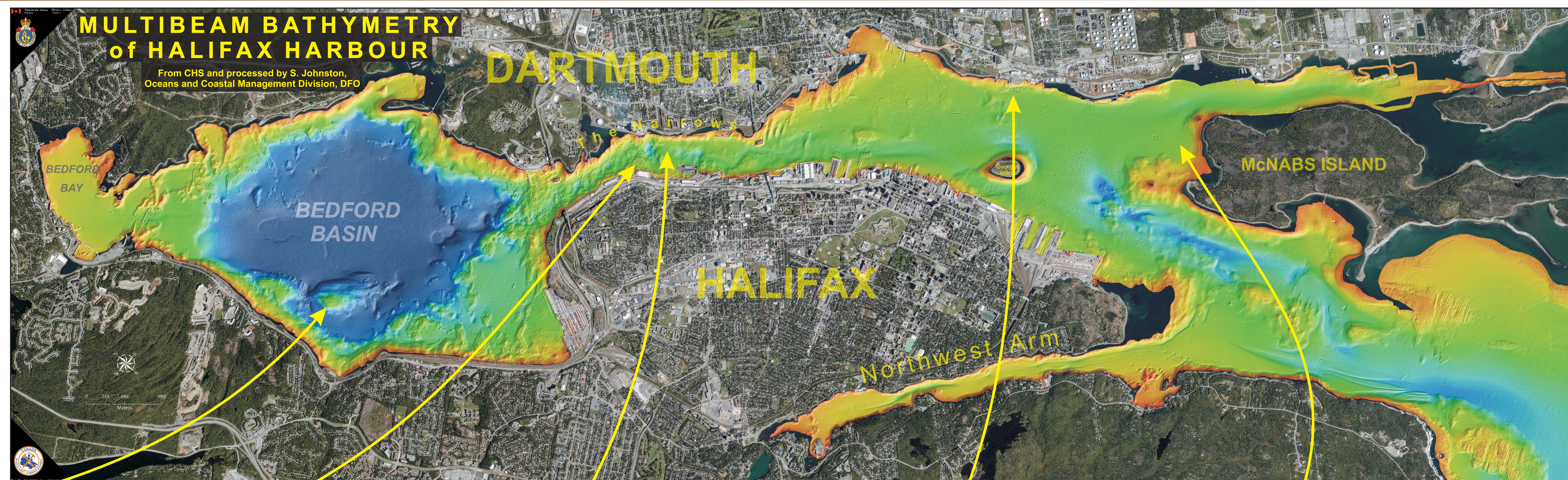


INTRODUCTION

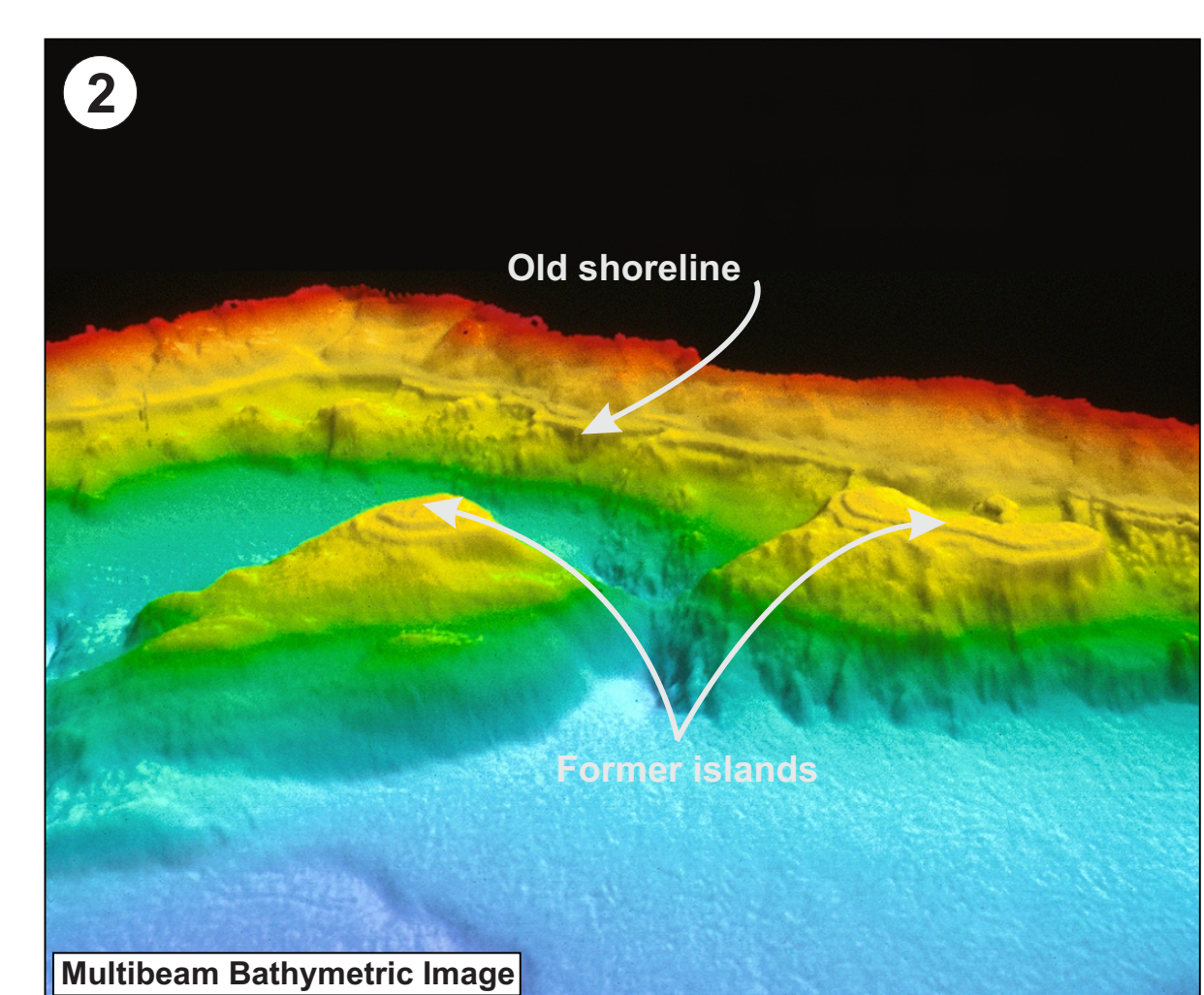
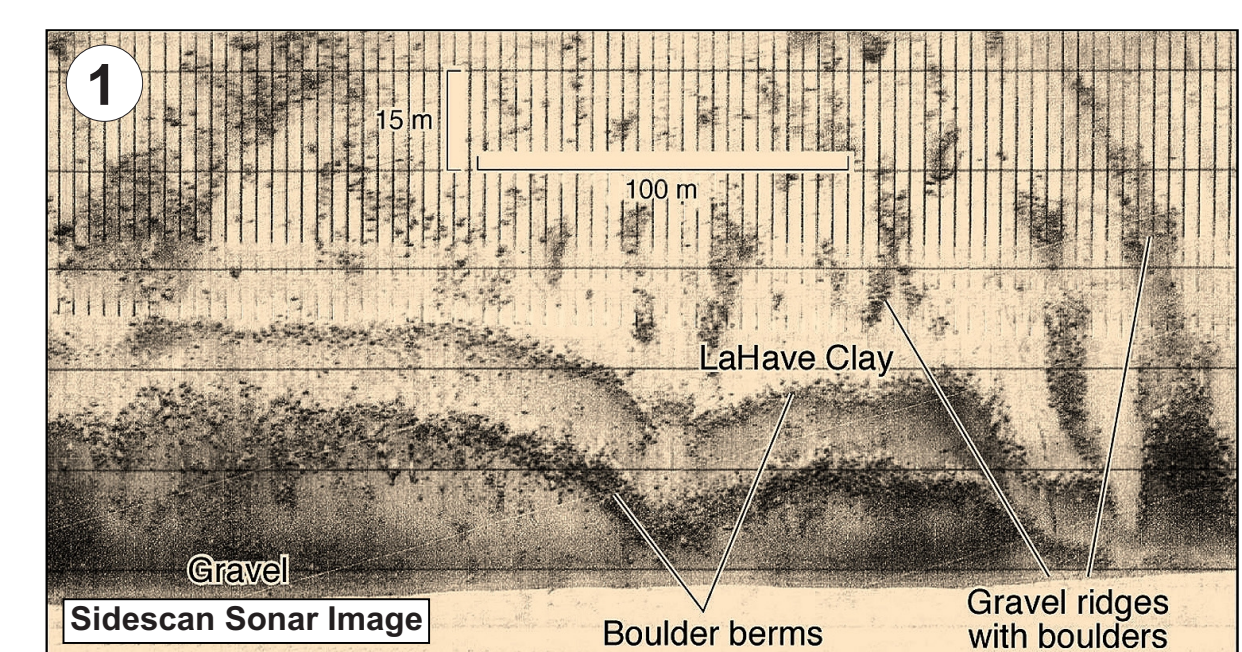
The seabed of Halifax Harbour contains a number of features that can be classified into natural and anthropogenic features. Natural features are formed by nature and consist of bedforms such as sand waves, sedimentary furrows, boulder berms, moraines, and pockmarks. Anthropogenic features are those formed by human activity and include anchor marks, cables, shipwrecks, dredge spoils, bridge and dock remains. The anthropogenic imprint on the harbour bottom is very dense, particularly in the inner harbour, and makes the collection of natural unaffected samples difficult. This poster illustrates and describes boulder berms, dredged areas and spoils, spud can marks, mining pits, and enigmatic gravel circles.



BOULDER BERMS

Two boulder berms (ridges of boulders) in Bedford Basin mark an old lake shore (Figure 1). They now lie at 23 m water depth and were formed approximately 6000 years ago.

Figure 2 is a 3D multibeam bathymetric image of the western side of Bedford Basin showing the location of two large former islands defined by the boulder berms that ring them. They presently occur in water depths of less than 23 m.

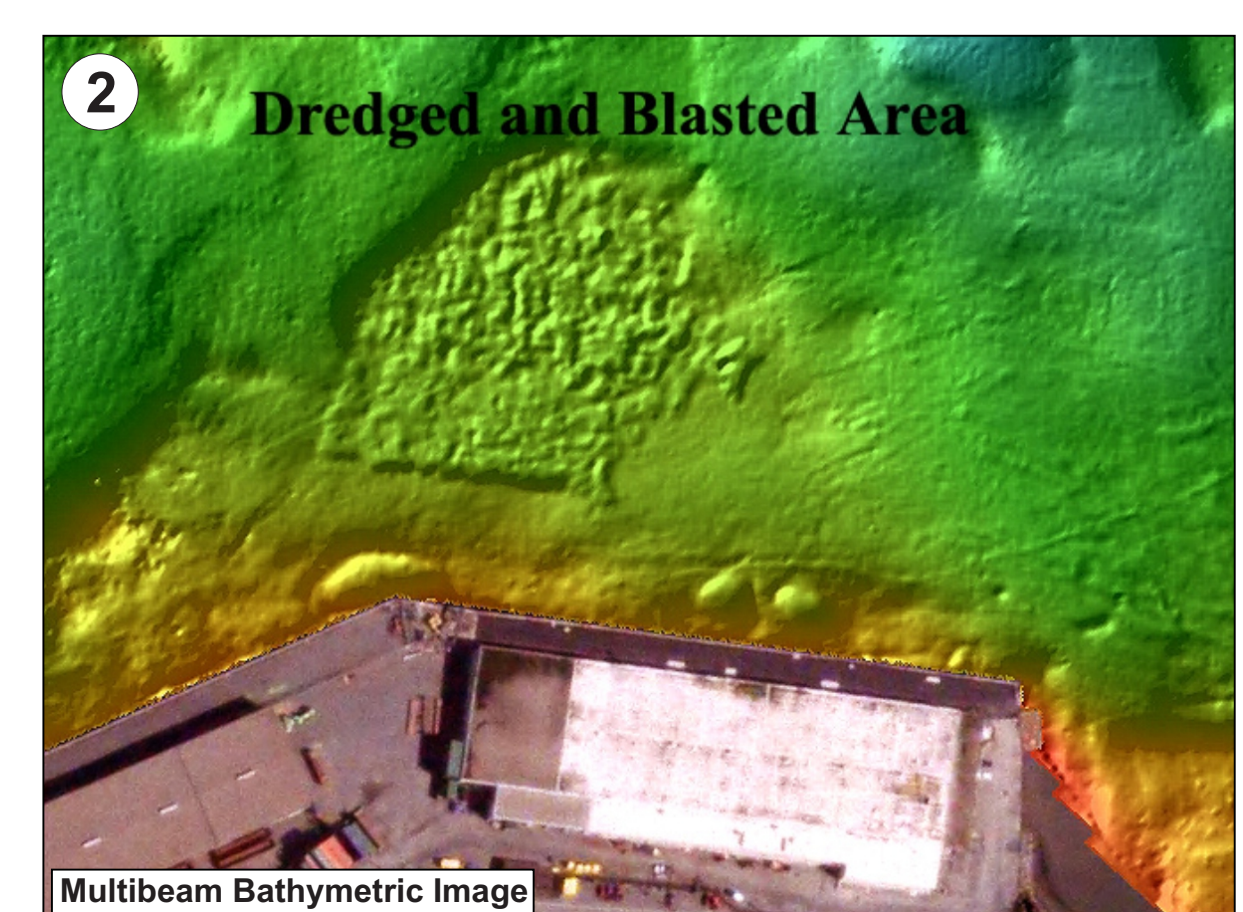
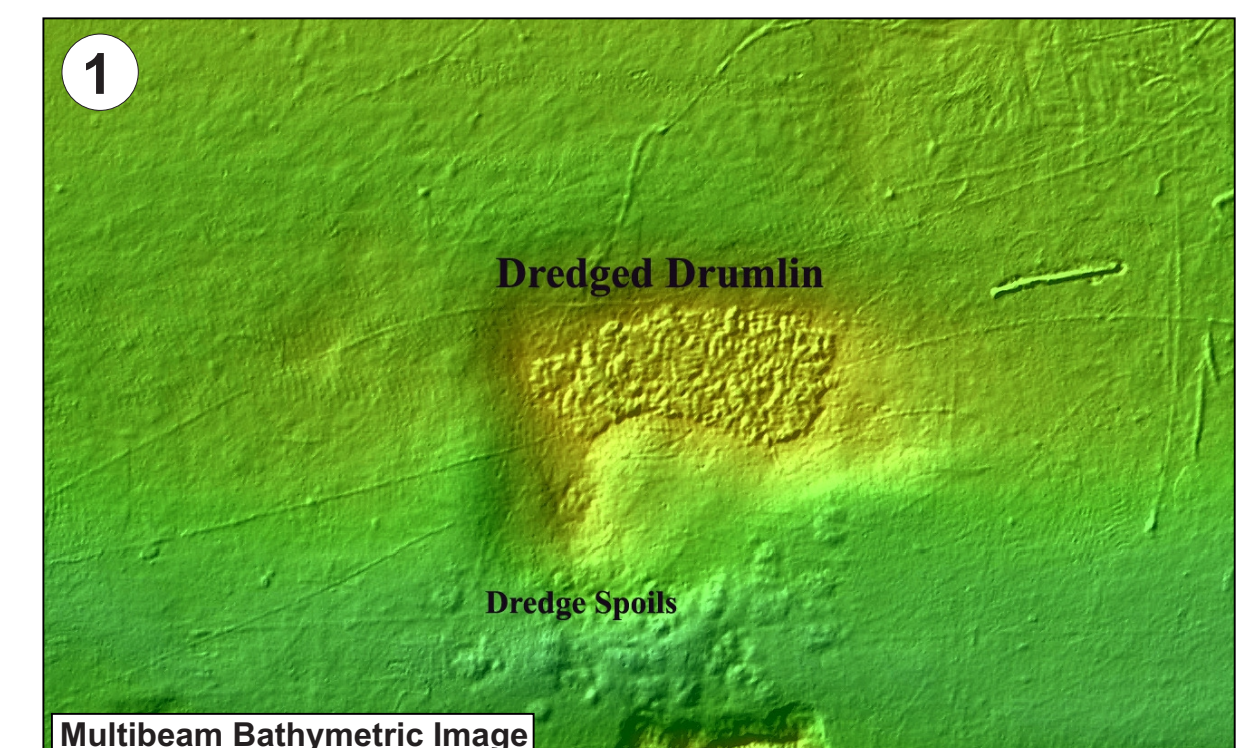


DREDGED AREAS

Many areas of the harbour bottom have been dredged to provide deeper water for the passage of large vessels. A drumlin (Little Georges Bank) adjacent to the naval dockyard in Halifax has been dredged with a clam-shell bucket (Figure 1).

Dredging for fill has taken place in Bedford Bay near the mouth of the Sackville River, and has been extensive adjacent to the former Texaco Canada refinery dock in Eastern Passage. An area of seabed adjacent to Pier 9 in The Narrows has been blasted (Figure 2) and dredged to increase water depth.

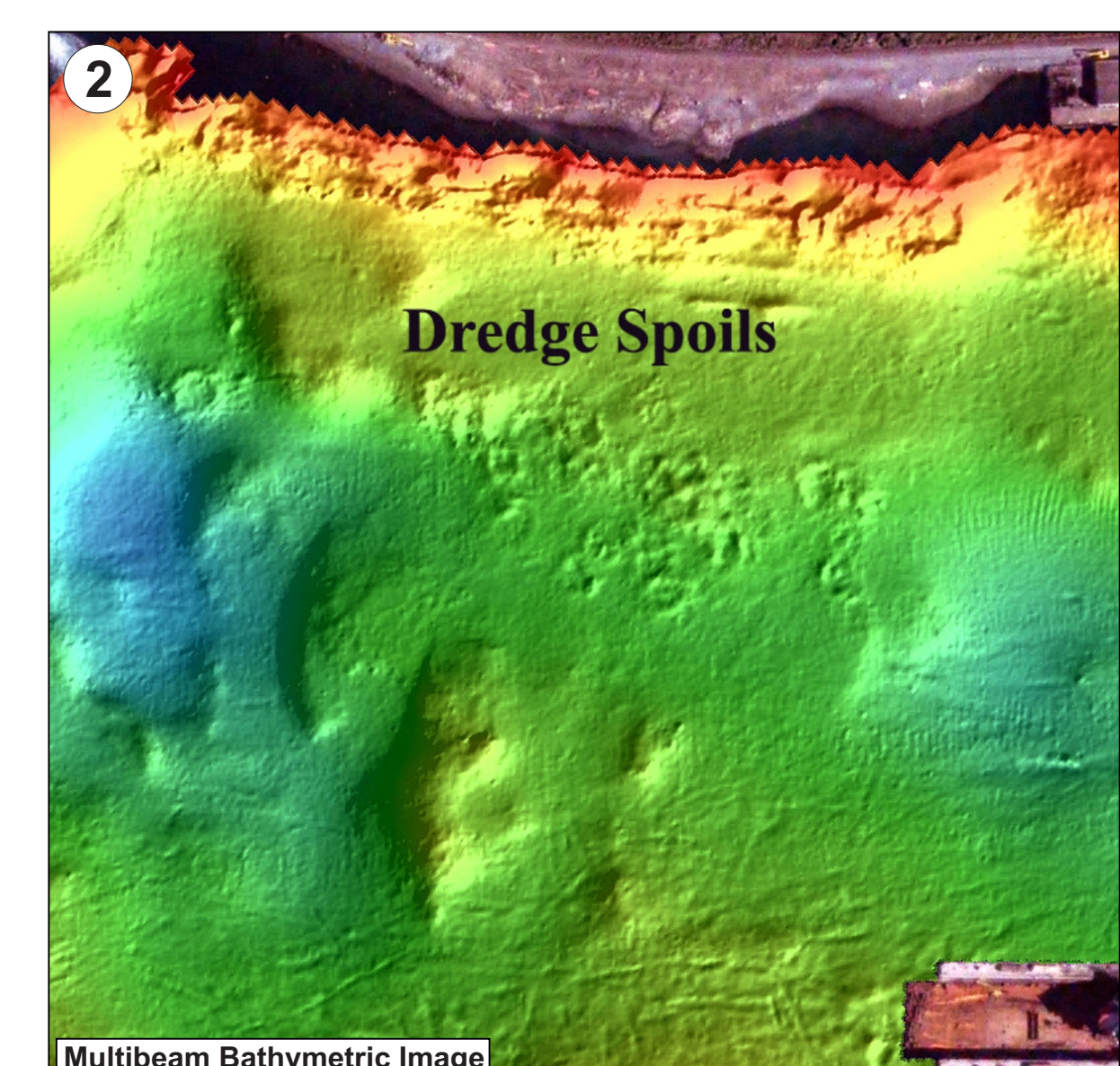
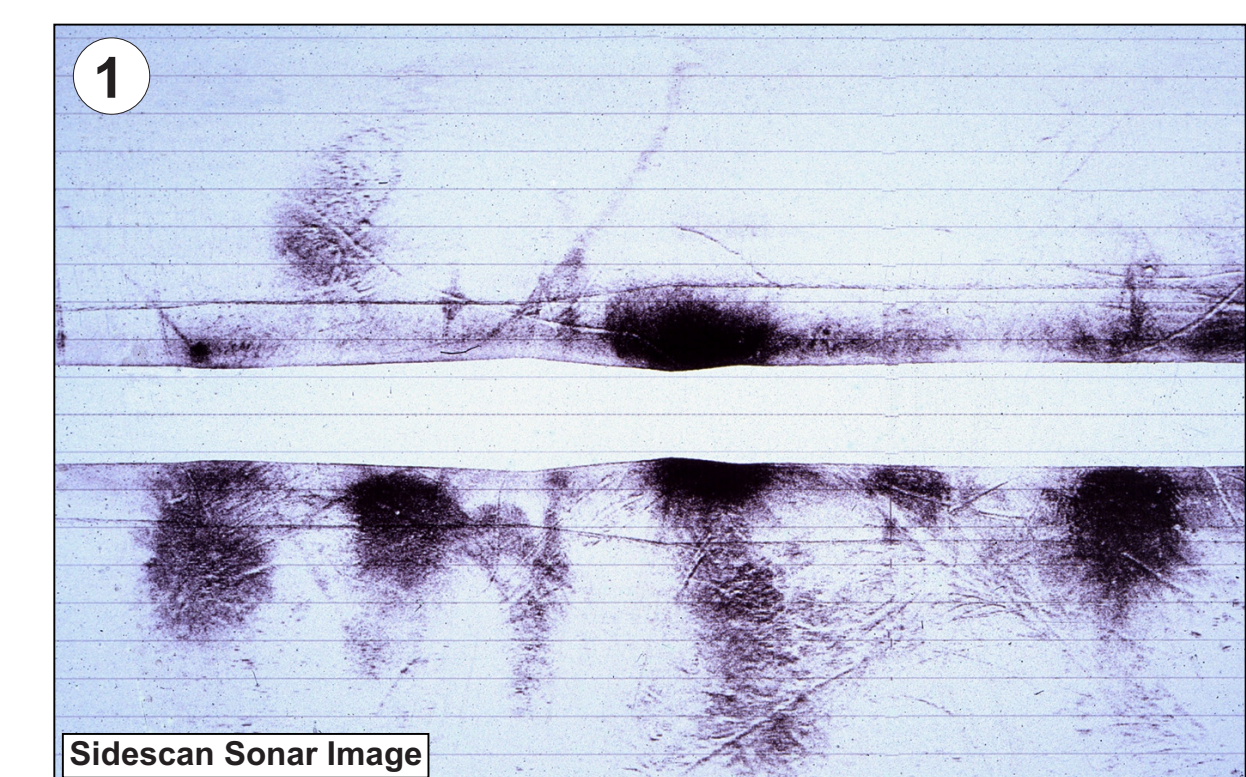
The Narrows is the shallowest area of hard seabed in the harbour and may require future dredging to accommodate the passage of the next generation (post-Panamax) of large container ships in order to use the terminals in Bedford Basin. Dredging is commonplace in large harbours undergoing maintenance and expansion and this activity will likely continue in Halifax Harbour.



DREDGE SPOILS

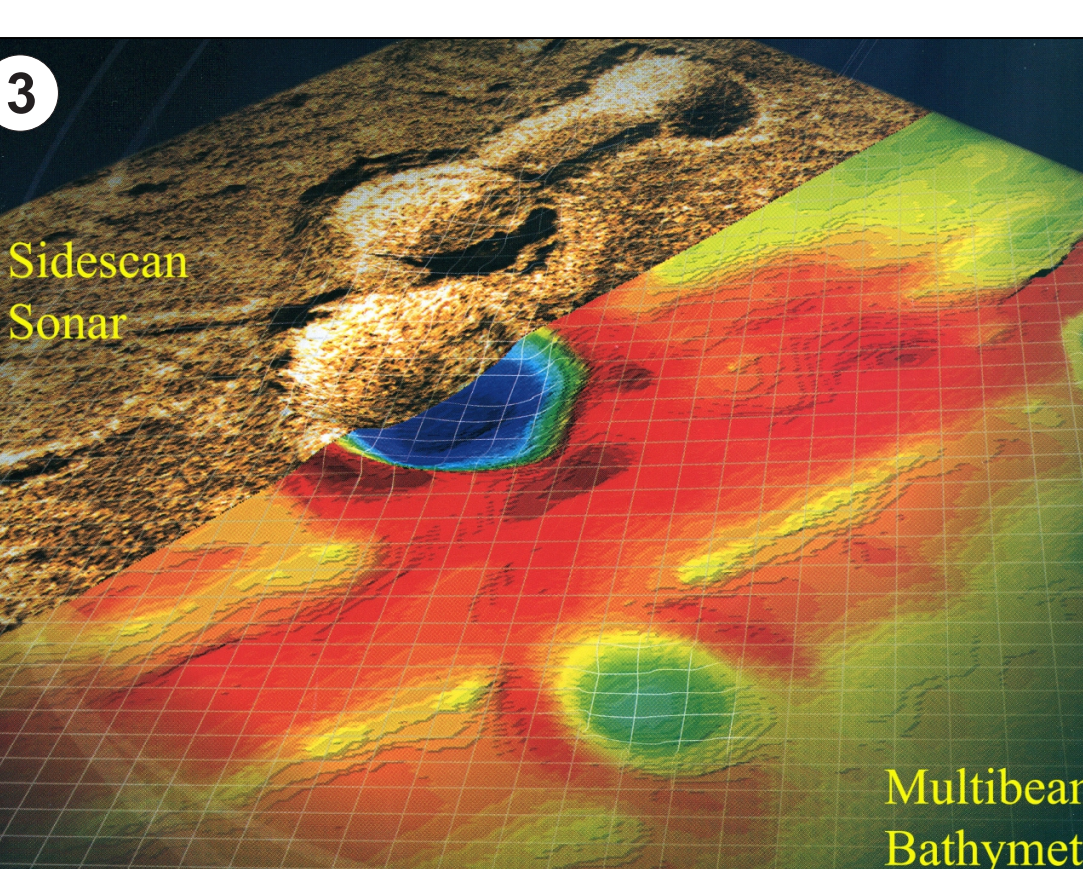
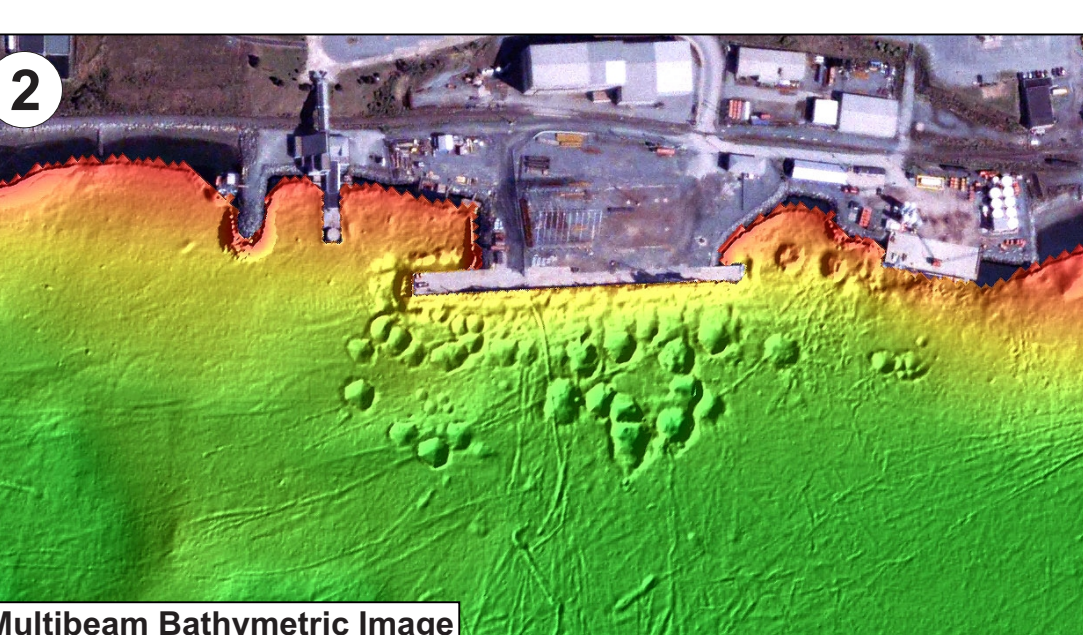
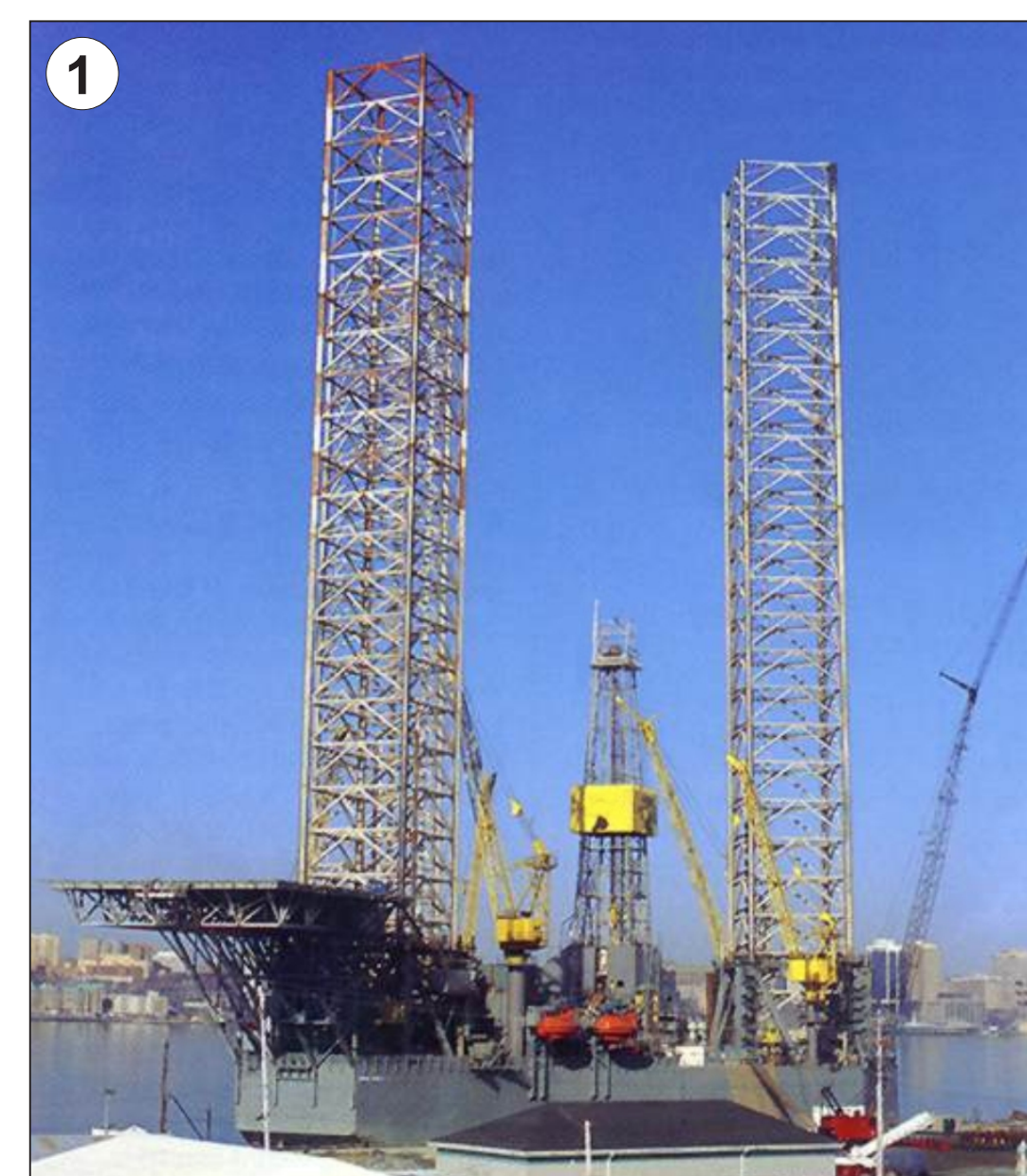
Dredge spoils are deposits of material discharged to the seabed by barges. Figure 1 shows a sidescan sonar image of circular dredge spoils at the seabed of Bedford Basin. They consist of a wide variety of materials such as sediments, construction debris, docking materials, gravel, boulders, garbage, and unidentified debris. The dredge spoils range up to 40 m in diameter and are generally circular in shape (Figure 2). Dredge spoils at the entrance to Northwest Arm have also been dumped on LaHave Clay (mud) compressing and displacing it into depressions that resemble pockmarks (gas-escape craters). In some areas these dredge spoils have resulted in the venting of the gas-charged sediments directly beneath the spoils.

The largest occurrence of dredge spoils is in Bedford Basin where approximately 200 have been identified covering approximately 5% of the deep basin floor. They also occur as positive features at several locations in The Narrows (Figure 2) and are scattered about the seabed of other areas of the inner harbour. Very few were found in the outer harbour. The practice of dumping dredge spoils in the harbour has been largely discontinued.



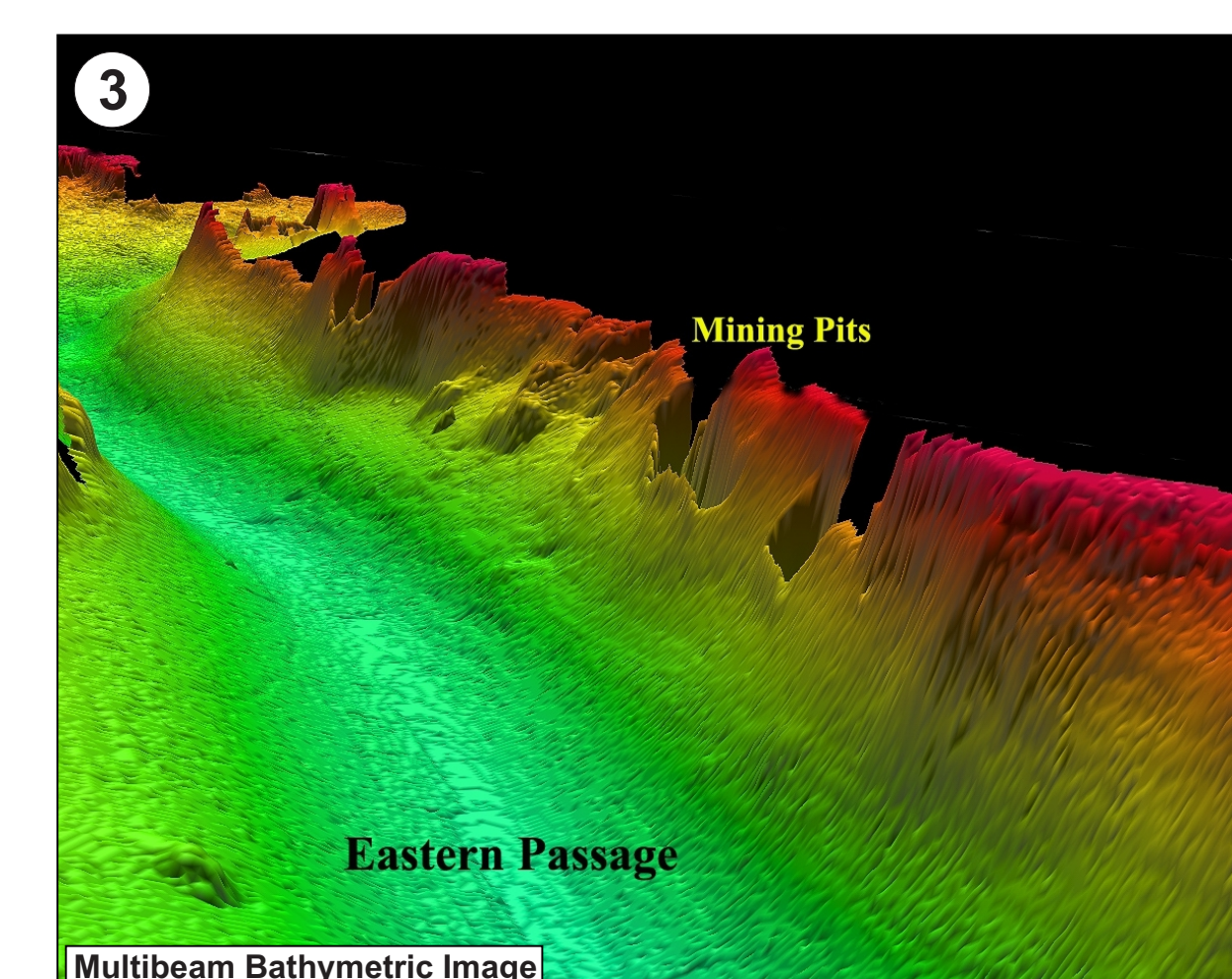
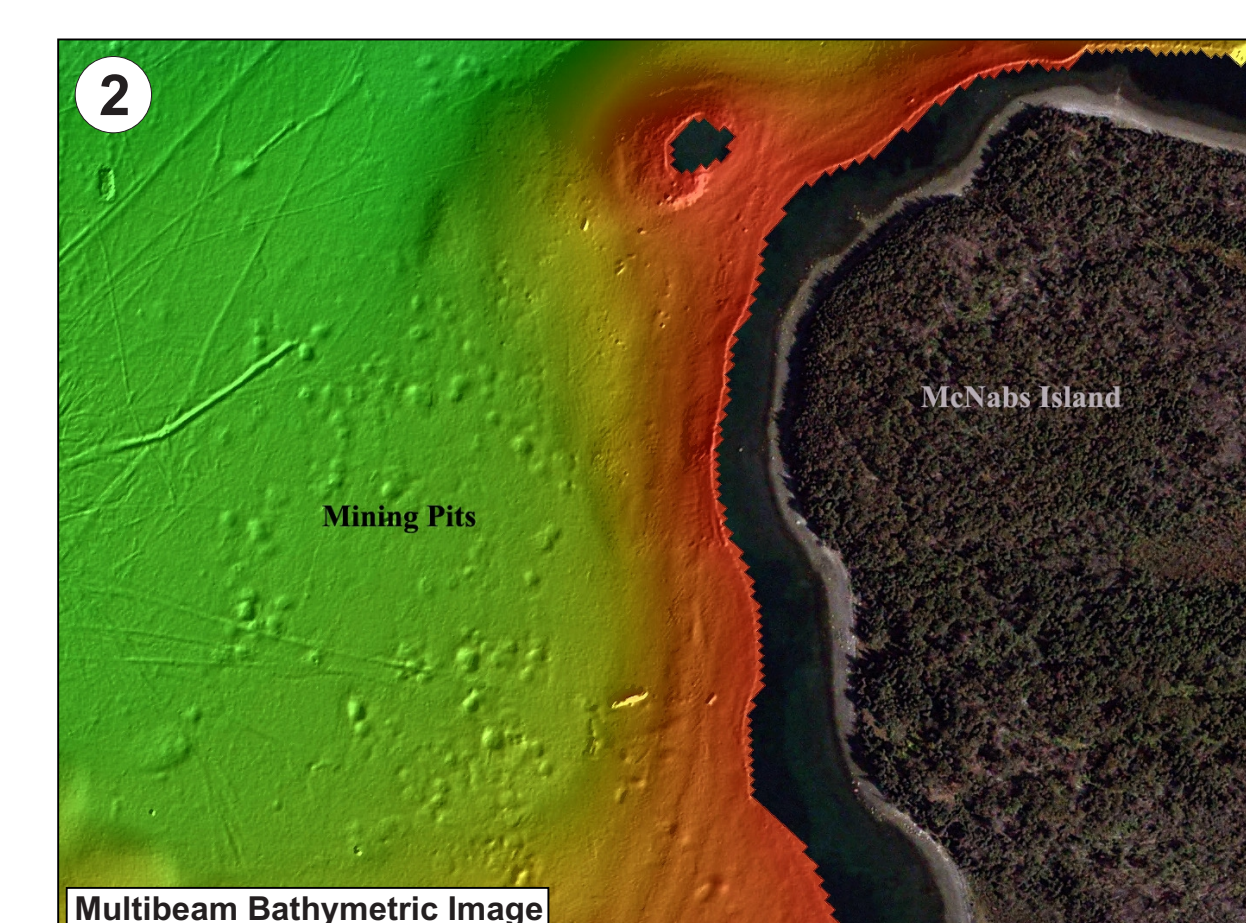
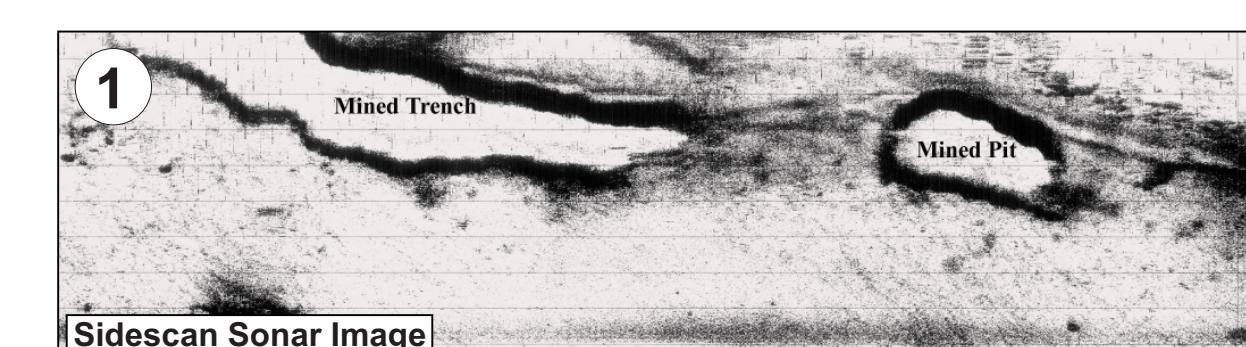
SPUD CAN MARKS

Spud can marks are circular depressions on the seabed that result from jack up oil rigs (Figure 1) placing their feet on the seabed as they jack themselves up. The weight of the rig is transferred to the seabed and the feet, or spud cans, dig into the seabed producing circular depressions flanked by mud squeezed ridges (Figures 2 and 3).



MINING PITS

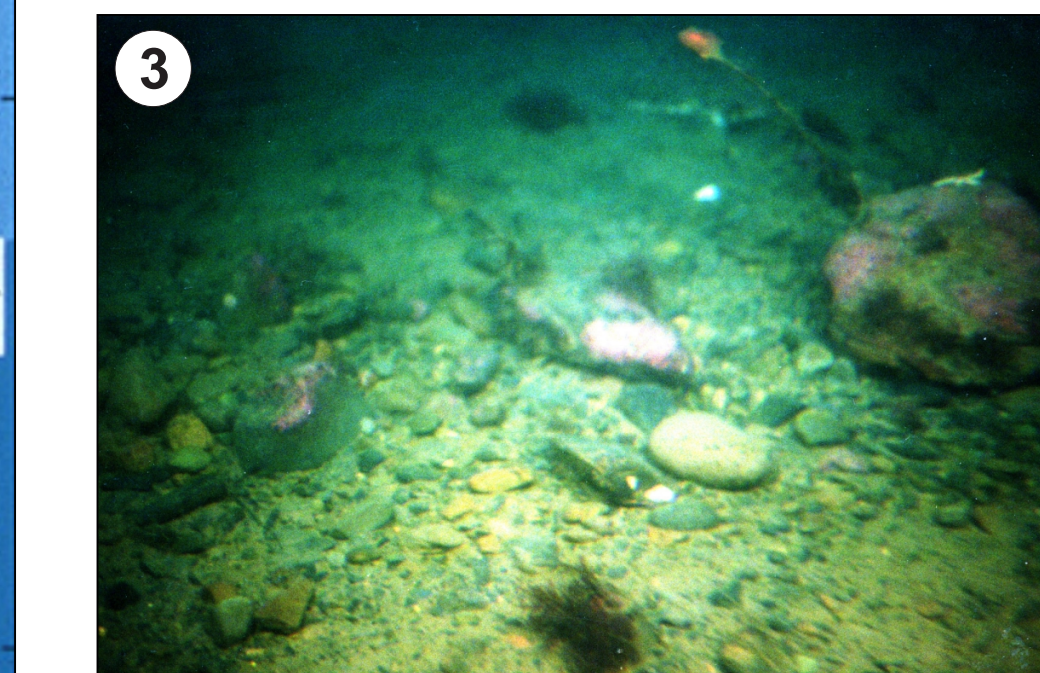
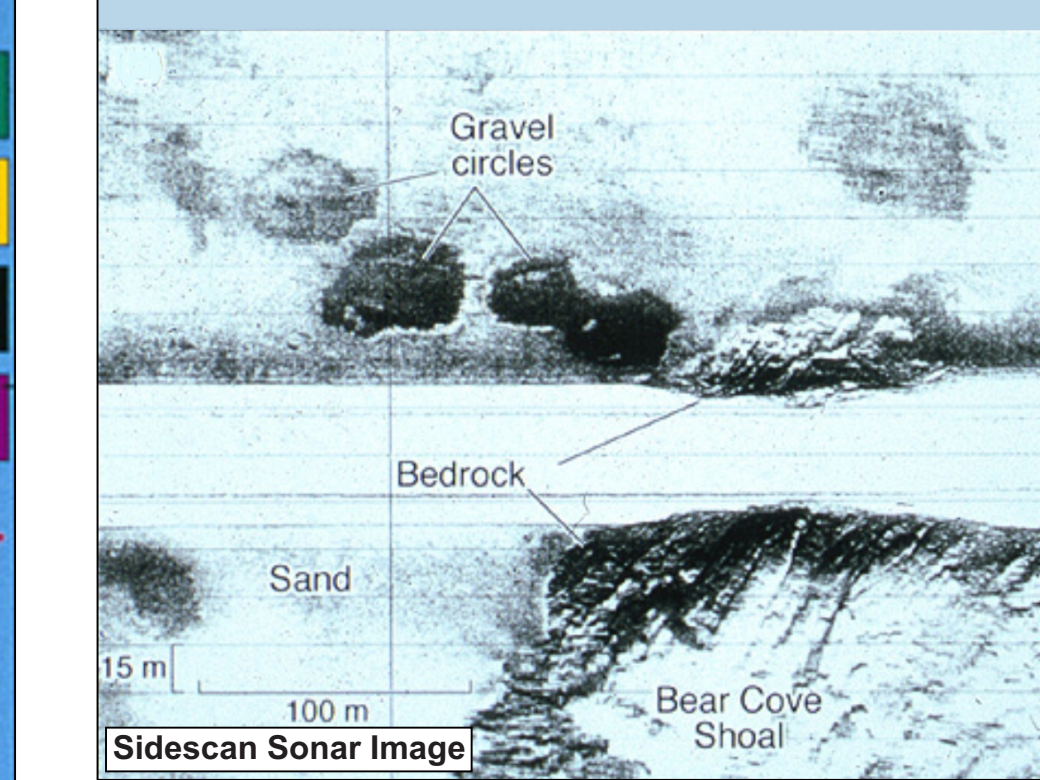
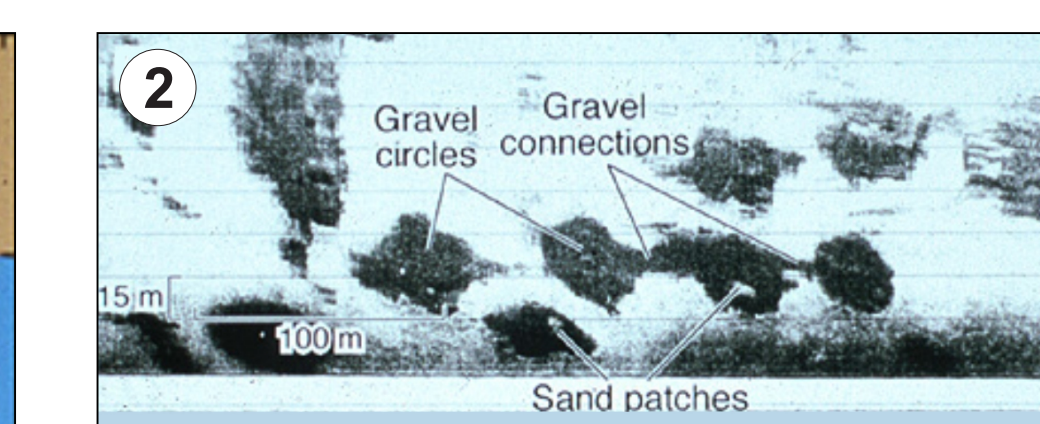
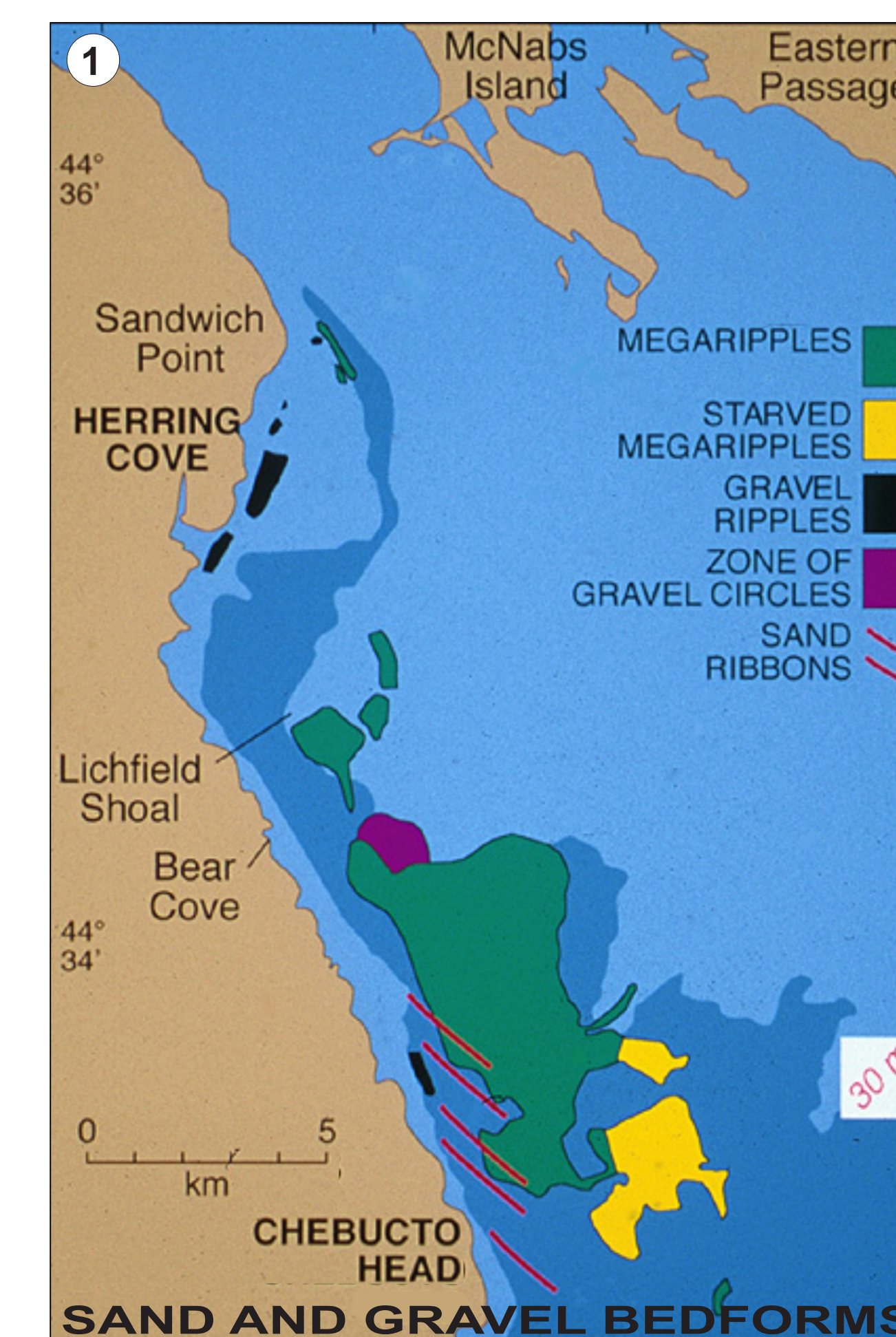
Seabed mining for placer gold and aggregates (sand and gravel) has taken place in Halifax Harbour. Aggregate mining was conducted with dredges and produced circular depressions and linear trenches (Figures 1, 2 and 3). Most aggregate mining took place in the shallow waters to the north and east of McNabs Island.



GRAVEL CIRCLES

The most unusual bedforms found in the harbour are called "gravel circles". A field of approximately 90 gravel circles, each up to 25 m in diameter (Figure 1) occurs in the outer harbour adjacent to Bear Cove Shoal on the eastern side of the deep outer harbour channel. The circles are slight depressions 20–40 cm lower than the surrounding sandy seabed and occur in 30 m of water. Sidescan sonar records show that in some groups, individual circles are connected by narrow, linear gravel deposits giving the circles a beaded appearance (Figure 2). They also occur as single, isolated, circular features. Small patches of sand occur in the centre of many of the circles.

Remotely operated vehicle (ROV) video, submersible observations and seabed samples confirmed that the circles are slight depressions of well-rounded cobbles (6.4–25.6 cm) and boulders (larger than 25.6 cm), with shells (Figure 3). Sand forms a thin layer outside the depressions. The adjacent bedrock shoals are very steep and shallow rapidly to 16 m water depth over short distances of less than 50 m.



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Some of the photographs and images are from the private collection of Gordon Fader.