G-TEK AUSTRALIA PTY LIMITED
WATERFRONT REDEVELOPMENT
DARWIN, NORTHERN TERRITORY

INITIAL REPORT

1.0 Introduction

URS Australia has been contracted to prepare an Environmental Impact Statement (EIS) in relation to a Northern Territory Government initiative to construct a Convention Centre and redevelop the Darwin foreshore area in the general area of the Fort Hill and Stokes Hill wharves.

G-tek Australia Pty Limited (G-tek) has been contracted to conduct UXO assessment of the proposed site and provide technical support to intrusive test operations. The first component within this contract has now been completed and this report provides information from the activities undertaken.

2.0 Areas Covered

The foreshore site is an irregularly shaped area of approximately 25 hectares, consisting of wharves and minor infrastructure at the south west (Fort Hill) end, through areas of used and unused reclaimed tidal flats and remnant tidal flats to the Stokes Hill wharf and oil storage areas in the north east.

The initial component of the task was to establish the potential for unexploded ordnance (UXO) within the area of interest.

3.0 Personnel Employed on Task

Project Manager/Ammunition Technical Officer – Greg Guthrie

4.0 Dates of Conduct

The task was undertaken between 22 September and 3 October 2003; Greg Guthrie mobilized to Darwin on 24 September.

5.0 Methodology

The primary methodology used within this component of the task was to search for, and review, available source material relating to military activity within the Darwin area in general and the redevelopment area, in particular, with an emphasis on allied and Japanese operations from early 1942. This methodology aimed to attempt to identify the potential for remnant UXO, the source and nature of potential UXO and the areas of potential UXO contamination within the proposed redevelopment site.

6.0 Historical Review

A series of files and other documents within the National Archives of Australia (NAA), the Australian War Memorial (AWM), Darwin Library, Joint Ammunition Logistics Organisation (JALO) NT, as well as personal material and material provided from the library of Mr Bob Alford have formed the basis for the historical review; a list of reference material reviewed is included at Attachment A to this report. In addition to research and desktop review, time has been spent on the waterfront comparing the current landforms and structures to the historical material.

A list of ordnance related definitions and abbreviations is included at Attachment B.

7.0 Summary of Findings

7.1 Japanese Air Raids

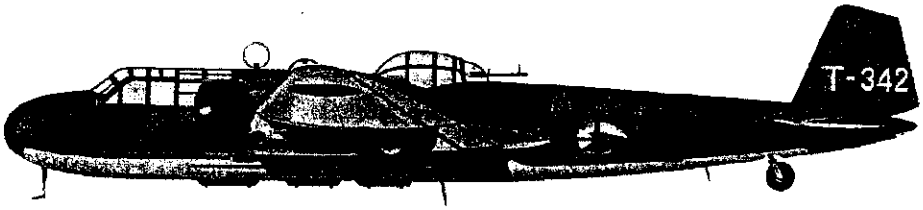
The Japanese air raids on Darwin are well documented in a number of sources and will not be fully outlines here. Of the 64 recorded raids between 19 February 1942 and 12 November 1943, however, 28 are known to have been directed at "Darwin Town" and the immediate area of interest.

These included:

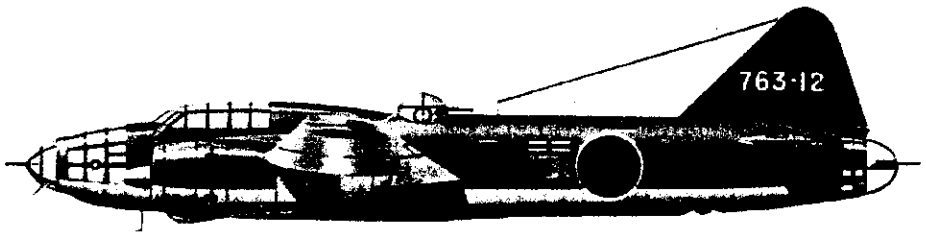
- Raid 1, 19 February 1942, Shipping and Oil Tanks.
- Raid 11, 2 April 1942, Oil Tanks.
- Raid 18, 15 June 1942, Stokes Hill.
- Raid 19, 16 June 1942, Town Area
- Raid 39, 27 September 1942, Frances Bay.
- Raid 51, 21 January 1942, Frances Bay.
- Raid 53, 15 March 1943, Oil Tanks.
- Raid 54, 2 May 1943, Floating Dock.

Some of these raids included the largest numbers of aircraft used in any of the raids, 54 dive-bombers and 17 heavy bombers in the first raid, and collectively 110 bombers in the other seven *(Table, 44 p78-79)*.

The primary Japanese Navy level bombers used within these raids appear to have been the G3M "Kyuuroko chuukoh" (Nell), the G4M "Ishiki rikukoh" (Betty) and the B5N "Kyuunana Kankoh" (Kate).



G3M "Nell" *(43)*



G4M "Betty" *(43)*

Each G3M "Nell" was capable of carrying up to 800kg of bombs on raids, while the G4M "Betty" was capable of carrying 1,000kg. The B5N "Kate" was used as either a torpedo bomber or a high level bomber; in the high level role its under wing rack could carry 2 x 250kg or 6 x 60kg bombs, while an additional 3 x 250kg bombs could be carried on the fuselage. In addition to the bomber loads, escorting "Zero" fighters were also capable of carrying 2 x 60kg bombs each. The exact nature and mix of bombs carried would have normally varied by the target selected for each raid, but for land attack, would have generally been high explosive (HE), thin cased, to cause major cratering and damage, HE, thick cased, to cause high levels of fragmentation and damage to personnel and soft targets such as vehicles, or incendiary to maximize damage from the resultant fires. The Japanese Navy had a range of such bombs available to it from within its own resources and these were supplemented by captured Allied stocks from Malaysia, Singapore and the Philippines.

7.2 Japanese Explosive Ordnance

Records of actual explosive ordnance (EO) delivered within particular areas of Darwin are not clear from the records examined.

During the interview with Major General Blake during the Official Inquiry into the air raids, he stated, "examination of the aerodrome shows that anti-personnel, incendiary, and a few 250 lb bombs were dropped" *(22 p52)*.

Mr E R Harvey, of the Department of the Interior, when reporting on repairs to infrastructure damaged by bombing indicated that during the raid of 25 April 1942, damage to the 12-inch water main from the Manton (Dam) "was caused by Daisy Cutters which landed close to the pipe and in one case directly on top of the pipe. There were 56 holes put in the pipe by flying steel." *(17 folio 96)*; he also reports of the raid of 16 June 1942 (Darwin Town Area) "some damage was sustained by buildings in the town area, but the worst feature was the destruction of tanks Nos. 10 and 11 at the Naval Oil Fuel Installation Area. It appears that a bomb scored a direct hit on tank No. 10 and both tanks Nos. 10 and 11 burned fiercely." *(17 folio 121)*.

The Department of Home Security report on bombing in Darwin on 19 February 1942 states "As far as can be determined at present, about 360 bombs were dropped, and types included 60Kg (132 lb.) H.E.'s. and Incendiaries, Anti-personnel (Daisy Cutters) assumed as 12Kg. (26lb.), and 500Kg. (about 1100 lbs. or ½ ton) H.E.'s". *(35 Appx A)*.

7.3 Japanese Unexploded Ordnance

Also unclear from the records are the number of failures within the bombs dropped resulting in UXO.

The Department of Home Security report on bombing in Darwin on 19 February 1942 states "The percentage of unexploded bombs having impact type fuses was low, and should be noted in view of reports from Malaya and China, which indicated a high percentage of "duds"; very little information was gathered in respect of the number of long delay type bombs." *(35 Appx A)*.

During the Official Inquiry; Wing Commander Griffith stated, "I cannot tell how many bombs were dropped in the low dive initial attack, but I estimate the bombs dropped in the high level attack to be 50 to 54." *(23 p320)*. With 54 bombers used in the raid, this estimate of numbers appears low, and is far below the Department of Home Affairs estimate (360); his estimate of UXO also appears low, he believed that only two UXO were found at the RAAF Base after the initial raids "an unexploded bomb buried 12 feet deep near the officers' mess, and one bomb with its nose only buried and the tail projecting, on the main runway" *(23 p 321)*. Of these, the shallower one may have been the 60kg bomb photograph at the airbase *(44 p22)*.

During the Official Inquiry, Lieutenant Colonel Woodman in his evidence stated "Around the post office I counted four bombs: one on the corner, one on the road, one in the square near the Administration house, and each would be 1,000 lbs." *(24 p607/608)*. From the Transcript of Evidence, it is unclear if he is referring to craters caused by bombs or UXO, but the wording would seem to suggest UXO.

8.0 Allied Explosive Ordnance

In addition to potential Japanese UXO within the area of interest, the potential for Allied EO and UXO to also be remnant within the area was considered. Sources of potential contamination may include material from within bombed vessels, materiel from active anti aircraft countermeasures and material lost while unloading/loading within the wharf area and other general wartime activities.

8.1 Initial Shipping Damage

Three vessels were within or close to the former Darwin Wharf at the time of the initial raid:

- Inside Berth, Barossa, damaged but salvaged and towed away.
- Outside Berth, Neptuna, damaged, exploded and sank.
- HMAS Swan, damaged but repaired.

Of principal interest of these is the Neptuna, which was damaged initially by a "near miss" and subsequently was set on fire by a hit forward of the forward funnel; the order to abandon ship was given "The cargo of 4" naval shells and depth charges could only hasten that decision." *(47 p34)*. A later newspaper article by Douglas Lockwood reported, "The freighter Neptuna which had been unloading a cargo of depth charges and ammunition, blew up at her berth with a terrifying explosion that was heard many miles away. Debris and spars from her decks were blown 300 feet high" *(16 folio 28)*. The cargo of other shipping damaged or sunk during the raid has not been located. Anecdotal information has indicated that divers within Darwin Harbour have seen items ranging from 3-inch Mortar projectiles to depth charges in the bay sediments, but these have not been confirmed.

8.2 Salvage Operations

A review of material relating to the salvage operation by the Fujita Salvage Company to remove the wrecks from Darwin Harbour revealed no mention of any EO or UXO being removed from any of the vessels. Royal Australian Navy divers inspected the sites of the works on a number of occasions and reported, "With "Neptuna", the Japanese have kept their agreement in removing this wreck entirely" *(16 folio 174)*. What other works may have been done by the Navy divers is not known, nor what may have been removed or located by Mr Carl Atkinson a local diver, who initially "bought some of the harbour wrecks, and landed parts of their cargo, ...Deccaville tracking – the metal mesh used by the Allies to lay down airstrips in the jungle – tools, salvageable metal; souvenirs such as the Peary's wheel – all were landed by Atkinson and often sold" *(47 p59)*.

It is understood from the reports reviewed that permission was granted for some salvaged shipping to be brought ashore near the old boom jetty for further cutting up and preparation for shipping to Japan. An un-referenced report within JALO refers to this occurrence and states "This resulted in EO on these ships being dumped on the foreshore and not reported by the Japanese workers. They were later located by school children in the mud, being visible only at very low tides. This area has had a decline in UXO reports since the extensions to the Iron Ore Wharf commenced. This has involved earth fillings being laid 4m to 5m in depth over the contaminated portion of the foreshore."

8.3 Anti Aircraft Defences

Contemporaneous accounts indicate that all of the armed vessels within the harbour area attempted to protect themselves and others by shooting at the attacking aircraft. In addition, 3.7inch anti aircraft batteries were located at various intervals around Darwin Harbour, including a battery on the Darwin Oval to the north west of Fort Hill *(48)* to defend "the RAN's Oil Fuel Installation in the centre of Darwin" *(47 p39).*

It can be anticipated that not all anti aircraft munitions fired would have functioned as intended. One UXO 3.7inch HE projectile, probably fired from the Quarantine Battery, was recovered during Wickham Point road works during 2003, and it is probable that further UXO 3.7inch and other anti aircraft projectiles are remnant within the area of interest.

8.4 Lost Material

Loading/unloading ships, particularly using ships' cranes and rope slings often results in the loss of material into the sea adjacent to the loading area and such items are seldom recovered. Past experience at Naval wharves has shown that packaged and loose individual items of EO are often recovered during dredging operations within loading/unloading areas.

9.0 Landforms

Based on a review of contemporaneous photographs and records and a review of current material and the site itself, it is obvious that a large portion of the area of interest has changed considerably since WW11. Those areas that appear to be basically unchanged include the area of the oil storage facilities and its surrounds at Stokes Hill, the escarpment area adjacent to Kitchener Drive, very early fill areas around the former Fort Hill and the current tidal areas out to the Fort Hill and Stokes Hill wharves.

Darwin Wharf Area 1938 *(32)*

The majority of the area south of Kitchener Drive has been apparently filled with material from unknown sources, but would have included natural material from Fort Hill and development works within "Darwin Town". Photographs reviewed include Japanese bombs recovered from Wood Street *(50)* and Smith Street *(51)* during building works in 1972 and it has also been anecdotally reported that 2 x 60kg Japanese UXO were recovered during the dredging of the Darwin Harbour Fishing Mooring Basin. While these were in "natural" areas, it is possible that some UXO may have been inadvertently transported into the area in fill. From JALO records, the latest item of Japanese UXO reported within greater Darwin was a 70kg Incendiary Bomb recovered from Ludmilla in July 2003.

10.0 Conclusions

Based on the number of raids within the area and the load capability of the aircraft involved, it is considered that in excess of 100 tonnes of bombs were dropped in or near the area of interest; averaging this tonnage as 60kg bombs, the most common type subsequently located, this may equate to in excess of 1,600 individual bombs.

From this potential number of items dropped in the area during the raids of 1942-1943 and a conservative estimate for failures (5-10%) it is anticipated that some 80-160 UXO would have been remnant from the raids on "Darwin Town" and the wharf area. Records on actual numbers located immediately after the raids or in subsequent years are incomplete or unavailable.

As a result of the initial assessment works conducted, the following conclusions are made:

- There is a potential for remnant Japanese UXO within the Waterfront Redevelopment Site.
- There is a potential for remnant Allied EO and UXO within the site.
- A high potential for remnant UXO exists in areas of land that remain basically unchanged from their 1942-1943 form.
- A high potential for remnant UXO exists in the harbour mud areas, including within those areas that remain unchanged since 1942-1943 and under the areas of subsequent fill.
- A potential exists for remnant UXO within fill material from soil excavations subsequent to 1942-1943, including material from Fort Hill and "Darwin Town".
- A high potential for remnant Allied EO exists in the harbour mud areas, including within those areas that remain unchanged since 1942-1943 and under the areas of subsequent fill.

Greg Guthrie
General Manager Explosive Ordnance Disposal
7 October 2003

Attachments:

A. List of Material Reviewed

B. Standard Definitions and Abbreviations

Attachment A

List of Material Reviewed

Serial	Reference	Item	Location
1	*NAA SP155/1 Def 39269G	File – Allied War Council	Sydney
2	NAA SP155/1 803	File – Dept of Interior	Sydney
3	NAA SP1048/7 308147	Report	Sydney
4	NAA D646 70/62/378(1)	File – Dept of Civil Aviation	Sydney
5	NAA SP857/10 PR/1508	File – Dept of Works and Housing	Sydney
6	NAA PA857/2 PA387	File – Property Acquisitions	Sydney
7	NAA SP857/10 PR1437	File – Dept of Works	Sydney
8	NAA C1904 28	Report	Sydney
9	NAA C1707 61	File – Dept of Home Security	Sydney
10	NAA SP24/1 1942/230 Pt 1	File – War Damage Commission	Sydney
11	NAA C1707 14	File – Dept of Home Security	Sydney
12	NAA SP1048/7 S7/1/47	Manifest	Sydney
13	NAA SP1048/7 S7/1/46	Manifest	Sydney
14	NAA SP106/4 SPCI 362	Memo – Dept of Information	Sydney
15	NAA SP106/4 SPCI 364	Memo – Dept of Information	Sydney
16	NAA F1 1959/2177	File – NT Administration	Darwin
17	NAA E114 1942/94 File 1	File – Dept of Interior	Darwin
18	NAA F1 1941/75	File – NT Administration	Darwin
19	NAA E114 1942/94 File 2	File – Dept of Interior	Darwin
20	NAA F1 1942/364	File – NT Administration	Darwin
21	NAA F1 1944/173	File – Government Secretary's Office	Darwin
22	NAA A816/XR 37/301/293 Pt 1	Transcript of Evidence	Darwin
23	NAA A816/XR 37/301/293 Pt 2	Transcript of Evidence	Darwin
24	NAA A816/XR 37/301/293 Pt 3	Transcript of Evidence	Darwin
25	NAA F1 1949/258	File – NT Administration	Darwin
26	NAA A2671 202/1944	File – Dept of Works	Darwin
27	NAA E125 52/953 Pt 1	File – Dept of Works	Darwin
28	NAA F649 S67	File – Dept of Works	Darwin
29	NAA E116 N336 Pt 1	File – Allied Works Council	Darwin
30	NAA E116 N336 Pt 2	File – Allied Works Council	Darwin
31	NAA E116 N336 Pt 3	File – Allied Works Council	Darwin
32	NAA M10 3/83	Digital Photograph	Canberra
33	NAA A1200 L13046	Digital Photograph	Canberra
34	NAA A2684 872	Digital File	Canberra
35	**AWM54 812/3/16	Report	Canberra
35	AWM54 423/11/45	Report	Canberra
37	awm.gov.au/encyclopedia	Listing – Darwin Air Raids	Canberra
38	awm.gov.au/atwar	Remembering 1942	Canberra
39	naa.gov.au/Publications	Fact Sheet 195	Canberra
40	home.st.net.au	Details, Darwin, 19 February 1942	www
41	home.st.net.au	Japanese Air Raids, 19 February 1942	www
42	home.interlink.or.jp	Imperial Japanese Navy Airplanes	www

Serial	Reference	Item	Location
43	Angelfire.com	Combat Aircraft of the Pacific War	www
44	Aviation Historical Society, NT	Darwin's Air War, 1942-1945, Bob Alford	Held
45	Commonwealth of Australia	Darwin and the NT 1942-1945, Dept of Veterans' Affairs	Library
46	Melbourne University Press	The Shadow's Edge, Alan Powell	Library
47	Zip Print, Darwin	A War at Home, Tom Lewis	Held
48	Dept of Information and Mapping, NT	Map, "The Early War Years"	Held
50	RAAF Photograph G6091	Japanese 120lb Aerial Bomb, Wood St, Aug 72	***BA
51	RAAF Photograph G7924	60kg Japanese Incendiary, Smith St, Aug 72	BA
52	RAAF Photograph G742	Japanese Aircraft Bomb	BA
52	RAAF Photograph G743	Japanese Aircraft Bomb	BA
54	RAAF Photograph G476	Japanese Aircraft Bomb	BA
55	RAAF Photograph G236	Aircraft Bomb dropped by Japanese	BA
56	NT Government	Darwin City Waterfront, Information Brochure and Factsheets 1-9	Held

(*NAA – National Archives of Australia **AWM – Australian War Memorial *** Bob Alford)

Attachment B

Standard Definitions and Abbreviations

Ammunition (Ammo): Ammunition is a contrivance charged with explosives, propellants, pyrotechnics, initiating compositions or nuclear, biological or chemical material for use in military operations including demolitions. Certain ammunition can be used for training, ceremonial or other non-operational purposes. This definition is deemed to include explosives in made up charges, explosives in bulk, non explosive projectiles of all natures, non explosive stores and components, dummy, imitation, instructional and other inert items intended to represent any item of ammunition.

Ammunition Produce (Ammo Produce): Non-energetic stores and components used in the assembly or initiation of ammunition.

Explosive Ordnance (EO): All munitions containing explosives, nuclear fission and fusion materials and biological and chemical agents. This includes bombs and warheads; guided and ballistic missiles; artillery, mortar, rocket, and small arms ammunition; all mines, torpedoes, depth charges; demolition charges; pyrotechnics; grenades; clusters and dispensers; cartridge and propellant actuated devices; and all similar or related items or components explosive in nature.

Explosive Ordnance Waste (EOW): Explosive Ordnance Waste is any inert item or component of explosive ordnance contaminating an area as a result of the manufacturing process, military training activities, or planned disposal operations.

Fragmentation (Frag): Metallic fragments of the fractured casing of explosive ordnance resultant from the initiation of high explosive filling and often projected at high velocity over considerable distances from the point of initiation.

Hazard Reduction Operation (HRO): An operation designed to reduce the EO hazard within the boundaries of an affected area.

Military Produce (Mil Produce): Any item located during field operations identifiable as military in origin that is not ammunition related.

Small Arms: Personal or crew served weapons of less than 20mm calibre capable of firing a projectile, and shotguns of all gauges.

Small Arms Ammunition (SAA): Ammunition for small arms, ie ammunition for weapons of less than 20mm in calibre and for shotguns of all Gauges.

Small Arms Ammunition Waste (SAAW): Inert material remnant from the transport, packaging, preparation, and use of SAA.

Unexploded ordnance (UXO): Explosive ordnance which has been primed, fuzed, armed, or otherwise prepared for action and has been fired, dropped, launched, thrown, projected or placed in such a manner as to constitute a hazard to operations, installations, personnel or material and remain unexploded either by malfunction or design or for any other cause.

G-TEK AUSTRALIA PTY LIMITED
WATERFRONT REDEVELOPMENT
DARWIN, NORTHERN TERRITORY

POST ACTIVITY REPORT

1.0 Introduction

URS Australia has been contracted to prepare an Environmental Impact Statement (EIS) in relation to a Northern Territory Government initiative to construct a Convention Centre and redevelop the Darwin foreshore area in the general area of the Fort Hill and Stokes Hill wharves.

G-tek Australia Pty Limited (G-tek) has been contracted to conduct unexploded ordnance (UXO) assessment of the proposed site and provide technical support to intrusive test operations. The first component within this contract has been completed and reported in our Initial Report; this report provides information and details on the subsequent technical support activities undertaken.

Since the Initial Report, further historical material has been reviewed and collated, and this additional information further reinforces the conclusions contained in the Initial Report.

Japanese Unexploded Ordnance

An aerial photograph of the wharf area in 1943 clearly shows the location of the sunken Neptuna, and a large number of bomb craters and impact points within the tidal mud area between the reconstructed wharf and the then foreshore adjacent to Stokes Hill. Cratering within Stokes Hill itself is less obvious, but the two destroyed oil tanks are visible *(A War at Home, Tom Lewis, Zip Print, Darwin p37).*

Allied Explosive Ordnance

An additional eyewitness account of the explosion of the Neptuna in also included in the same reference, and this states, "Parts of the ship and its cargo of munitions including naval depth charges were scattered far over the harbour and town" *(A War at Home, Tom Lewis, Zip Print, Darwin p36).* From this description, it is possible that EO from the Neptuna may have been spread further than the then tidal areas of the site and may also be located within natural landforms from the period.

A review of the JALO Explosive Ordnance Incident Reports (EOIR) indicate the recovery of an unfired 4inch HE Naval Projectile from Carey Street, Darwin, in 2001, approximately 1,250 m from the Neptuna site. This item is consistent with a referenced Neptuna cargo report and is within the realistic dispersal range of material subjected to the size of the explosion that apparently occurred on the Neptuna.

2.0 Area Covered

The foreshore site is an irregularly shaped area of approximately 25 hectares, consisting of wharves and minor infrastructure at the south west (Fort Hill) end, through areas of used and unused reclaimed tidal flats and remnant tidal flats to the Stokes Hill wharf and oil storage areas in the north east.

URS Australia developed an intrusive test program for sites within this area, and, as the G-tek Initial Report indicated the probability of varying natures of UXO remnant within the test areas, an appropriately equipped, Defence trained Ammunition Technician was provided to provide UXO safety support to the test program.

3.0 Personnel Employed on Task

Project Manager/Historical Review – Greg Guthrie

Site Ammunition Technician – Tony McCreadie

4.0 Dates of Conduct

The task was undertaken between 11 October and 13 November 2003 with Tony McCreadie on site for a total of 21 days during that period.

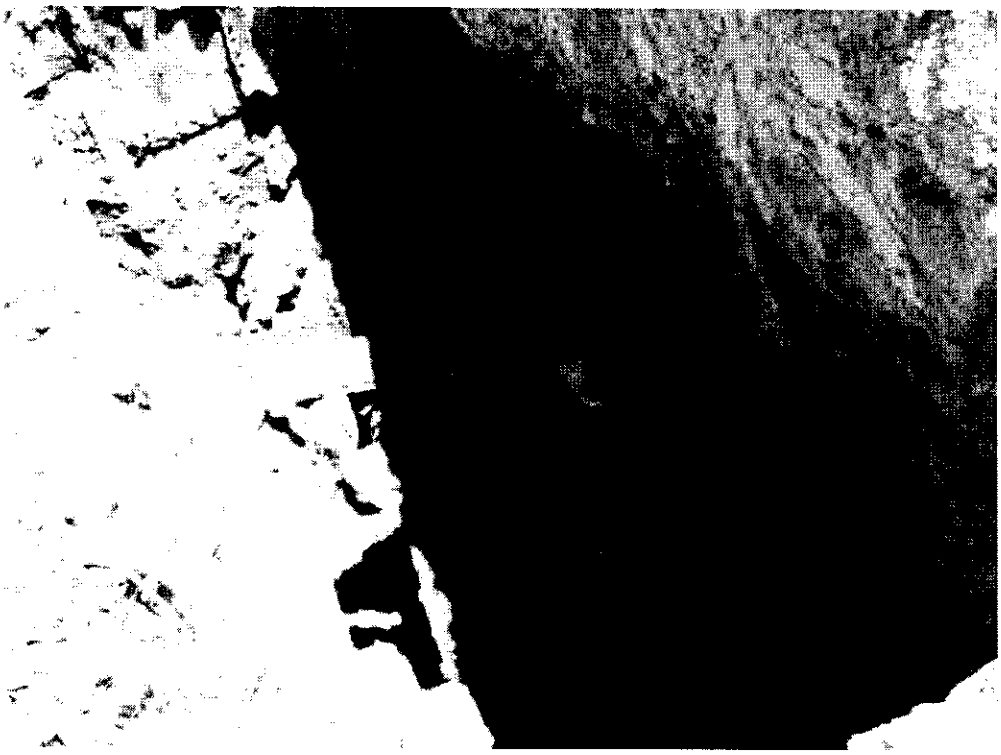
5.0 Methodology

The methodology used within this component of the task was in accordance with G-tek Standard Operating Procedure (SOP) 08_05 Support to Geotechnical Investigation, which was reviewed and approved by the Client prior to the commencement of intrusive works. In general terms this required that the Site Technician work as part of the test team, use a gradiometer to regularly test the pit and spoil for ferrous metal content, and visually review metallic material within the pit and spoil to identify any explosive ordnance related components.

6.0 Activities

During the initial part of the program, test pits and drilling were primarily conducted within the reclaimed areas of the harbour foreshore and Stokes Hill. The second part of the program concentrated more on testing along the western portion of the site and within the harbour mudflats when tides permitted.

Photograph 1 – Pit, Harbour Foreshore



Photograph 2 – Pit, Below Stokes Hill on "Warrago" Hull

Within many of the areas tested, large amounts of metallic debris were found to be located on or near the surface.

Photograph 3 – Surface Debris, Western Foreshore Area

Support to the testing of some 78 pits was provided during the first part of the test program, with test to an additional 77 test areas being supported during the second part of the program. As water wells drilled were cased with metal sleeves, no down hole testing by the Site Technician was conducted; surface testing and ongoing advice was provided for some areas of the site considered as having more potential of having 1940's natural levels closer to the current ground furface.

7.0 Observations / Results

Metallic debris was generally found on or near the surface in many of the areas tested.

Metallic debris was consistently found within test pits within the reclaimed areas of the site.

Within the reclaim areas, the water table generally prevented penetration of the pit into original 1940's level material.

No items of explosive ordnance (EO) or unexploded ordnance (UXO) were identified within any of the areas tested.

No fragments or component parts of EO or UXO were specifically identified within any of the areas tested.

8.0 Conclusions

It is considered that UXO safety support was successfully provided to the intrusive testing program developed for this site.

It is considered that random remnant EO and UXO may be located within the natural areas of the site below the various levels of fill, and that:

- The amount of metallic debris within the fill will mask any attempt to individually identify them.
- The items should present no risk of functioning if undisturbed.
- Any required bulk removal of natural material should be conducted on the assumption that EO and UXO are remnant within that natural material.

Greg Guthrie
General Manager Explosive Ordnance Disposal

21 November 2003

Attachment:

A. Standard Definitions and Abbreviations

Attachment A

Standard Definitions and Abbreviations

Ammunition (Ammo): Ammunition is a contrivance charged with explosives, propellants, pyrotechnics, initiating compositions or nuclear, biological or chemical material for use in military operations including demolitions. Certain ammunition can be used for training, ceremonial or other non-operational purposes. This definition is deemed to include explosives in made up charges, explosives in bulk, non explosive projectiles of all natures, non explosive stores and components, dummy, imitation, instructional and other inert items intended to represent any item of ammunition.

Ammunition Produce (Ammo Produce): Non-energetic stores and components used in the assembly or initiation of ammunition.

Explosive Ordnance (EO): All munitions containing explosives, nuclear fission and fusion materials and biological and chemical agents. This includes bombs and warheads; guided and ballistic missiles; artillery, mortar, rocket, and small arms ammunition; all mines, torpedoes, depth charges; demolition charges; pyrotechnics; grenades; clusters and dispensers; cartridge and propellant actuated devices; and all similar or related items or components explosive in nature.

Explosive Ordnance Waste (EOW): Explosive Ordnance Waste is any inert item or component of explosive ordnance contaminating an area as a result of the manufacturing process, military training activities, or planned disposal operations.

Fragmentation (Frag): Metallic fragments of the fractured casing of explosive ordnance resultant from the initiation of high explosive filling and often projected at high velocity over considerable distances from the point of initiation.

Hazard Reduction Operation (HRO): An operation designed to reduce the EO hazard within the boundaries of an affected area.

Military Produce (Mil Produce): Any item located during field operations identifiable as military in origin that is not ammunition related.

Small Arms: Personal or crew served weapons of less than 20mm calibre capable of firing a projectile, and shotguns of all gauges.

Small Arms Ammunition (SAA): Ammunition for small arms, ie ammunition for weapons of less than 20mm in calibre and for shotguns of all Gauges.

Small Arms Ammunition Waste (SAAW): Inert material remnant from the transport, packaging, preparation, and use of SAA.

Unexploded ordnance (UXO): Explosive ordnance which has been primed, fuzed, armed, or otherwise prepared for action and has been fired, dropped, launched, thrown, projected or placed in such a manner as to constitute a hazard to operations, installations, personnel or material and remain unexploded either by malfunction or design or for any other cause.

STANDARD OPERATING PROCEDURE
08_05
Support to Geotechnical Investigation

1.0 INTRODUCTION

Within areas having the potential to contain UXO it may be often required to conduct intrusive investigation for other than UXO contamination ie to ascertain soil or fill types, ground strength or for other specific reasons.

This SOP details the action to be taken by G-tek Australia in providing UXO safety support and technical input to geotechnical and similar intrusive investigations in areas potentially contaminated by UXO. The task will be conducted by an appropriately qualified and equipped EOD technician.

2.0 PURPOSE

The primary aim of support to geotechnical investigation is to ensure the safety of personnel conducting the investigations. This will be done by systematically searching areas prior to intrusion occurring and locating and isolating any items of UXO or EO remnant within the investigation area.

In addition to the provision of safety support, support to geotechnical investigation also allows the collection of information relating to the potential for UXO/EO contamination through the review of material removed and the identification of fragmentation and other remnant UXO/EO related material.

3.0 SCOPE

The contractual arrangements made between G-tek and its Client shall specify the type of investigation being conducted and the areas to be subjected to investigation. Such arrangements will also include the responsibilities of each party for the provision of investigation tools, including plant, which may be utilised during the investigations.

4.0 METHOD

The choice of method for any geotechnical support will be based on an understanding of the weapons systems used within a site and the overall geology of the site. These will result in the ability to utilise the nature, size and probable depth of resultant potential UXO and potential for geophysical interference to equipment to allow informed decisions to be made as to the most appropriate method and equipment for each project.

In general terms, each support task will follow the same sequence within each site to be investigated. The site will be defined, the surface examined and cleared of potential UXO and progressive search for UXO will continue until the full required area/depth for investigation has been completed.

4.1 Surface Clearance

Once the area for investigation has been defined the EOD technician will conduct a visual and instrumented search of the area to ensure that the area is clear of surface and near surface UXO and the intrusive investigation can commence.

Within many investigation tasks, minor adjustment to the investigation area can be made as a result of the initial surface clearance, allowing investigation to begin in areas that are assessed as being clear of surface or near surface items.

4.2 Mechanical Excavation

Mechanical excavation is to be conducted incrementally to the depth required. Each increment should be to no more than half the search depth capability of the instrument being used to support the investigation or a volume of soil that is practical to remove and examine.

In natural soil this would generally be to 150mm for search capability reasons where a Metal Detector is being used, and no more than 500mm for soil volume reasons where a Gradiometer is in use.

Area or deep investigation will generally be conducted within a linear trench using plant appropriate to the particular task. The trench will be incrementally dug keeping the arm or boom of the plant between the trench and the plant. G-tek staff and supported investigators will be required to wear high visibility vests during the task, and will remain behind the plant in a position known to the plant operator during the excavation process.

Once the appropriate increment has been excavated, the plant operator will tip the material to one side of the trench and place the excavation bucket on the ground near the removed material. The EOD technician will examine the formed excavation for the presence of any UXO or EO related material and will then conduct instrumented search of the base of the excavation prior to allowing the balance of investigation staff to examine the excavation.

While geotechnical personnel are examining the excavation, the EOD technician will examine the material removed from the excavation and, as necessary, conduct an instrumented search of the removed material.

This process will continue sequentially until the geotechnical investigation is complete or UXO is discovered which prevents the continuation of the task at that time.

4.3 Excavation Safety

All trenching is to be conducted in accordance with local regulations and personnel are not to enter unsafe or unstable trenches for sampling, search or investigation.

Where deep trenches being made, the base is to be searched using Gradiometer with extension lead attached to the probe. The probe is to be lowered into the trench

at the end opposite to the plant and, from the stable end closest to the plant, is to be slowly drawn along the bottom of the trench, noting readings during the movement. As necessary, the process may be repeated a number of times along the base of the trench to ensure full coverage of the base.

Where stability of the trench sides is uncertain, gradiometer operations will be conducted from scaffold planking or similar solid timber material placed across the full width of both ends the trench and extending not less that one metre either side of the trench (ie with a 1200mm wide trench a minimum 3.2m long plank should be used).

4.4 Wells and Core Sampling

Where water-monitoring wells are being installed or core sample drilling being conducted, the same incremental system will apply using Gradiometer with extension cord to allow movement of the probe within and to the depth of the hole being drilled (to a maximum of 30m). The extension cord is to be marked in one-metre increments with flagging to ensure that the probe depth is accurately monitored.

4.5 Fill or Capping in the Search Area

Where fill or other material that has no potential to contain UXO forms the top layer of the investigation area, the geotechnical investigators, rather that G-tek staff, may better set the incremental depths initially required.

5.0 RECORDS

G-tek will maintain appropriate detailed records of each support task conducted and can make them available to authorities as required.

STANDARD OPERATING PROCEDURE
09_01
Action to be taken on Discovering UXO/EO

1.0 INTRODUCTION

This SOP details the actions to be followed when UXO or EO are located during G-tek Australia Pty Limited EOD operations.

2.0 PROCEDURES

2.1 Initial Action

When an UXO or item of EO (or an item reasonably suspected of being an UXO or EO) is discovered, the search operator is to stop searching within that area, mark the area with flagging tape 1 metre from the item and notify the task EOD operator.

The EOD operator will examine the item and confirm its identity.

Once a UXO or EO (or suspected UXO or EO) has been located, no work is to occur within a 5-metre radius, until the object is cleared. This radius may be extended by the EOD operator as required based the perceived hazard from the item, the nature of other works being conducted, and risk to personnel, equipment and infrastructure.

Unfamiliar UXO or EO should be destroyed in situ or remotely pulled then destroyed by the competent authority.

Only UXO or EO that are identified confirmed as safe to handle may be moved and destroyed at a central disposal site. All other UXO should be pulled remotely or destroyed in situ.

2.2 Recording

Confirmed UXO or EO will be marked, recorded, and photographed in accordance with the protocols established for the Project.

Any unfamiliar or unexpected UXO or EO that is encountered is to be reported to the Manager of the Project. Photographs, sketches and notes are to be made of any unfamiliar item and the details included in the report.

2.3 Reporting

Confirmed and suspected UXO and EO are to be reported to the competent disposal authority in accordance with the protocols established for the Project. Standard report formats are to be used for reporting and IMSMA forms are to be used wherever possible.

2.4 Disposal and/or Clearance

Disposal and/or clearance of UXO/EO will be conducted by the competent authority with the support and cooperation of G-tek site staff. The G-tek Manager will ensure liaison with the competent authority is conducted regularly to ensure that any required disposal/clearance activities cause minimal disruption to the ongoing project activities.

Where possible, UXO and EO will be destroyed on the day that they are found. The Manager of the Project is responsible for coordination of all actions relating to the destruction UXO and EO.

When a UXO or EO is destroyed in situ, consideration is to be given to the use of sandbags or other engineering methods to deflect the blast of demolitions and reduce metal contamination of cleared areas.

2.5 Post Disposal/Clearance

Once the UXO or EO has been cleared, the search operator is to research the ground where the item was originally found, in order to verify that no further items are remnant.

Once this secondary search is complete normal search is to resume from the point of the find and other activities may continue within originally excluded 5 metre radius of the find.

STANDARD OPERATING PROCEDURE
09_03
MARKING OF UXO

1.0 INTRODUCTION

Once an UXO has been discovered on a site, the position of the UXO is to be marked to ensure that the item is not inadvertently disturbed during ongoing site operations.

The hazard marking system used may vary according to the location of the site, the security of the site, disposal authority requirements or the potential for deliberate or inadvertent interaction with the item by non-task personnel.

Where considered necessary or desirable, a hazard marking system may be necessary to delineate the extent of the UXO hazard area and may include signs, markers or physical barriers.

Minimal time delay should occur between the discovery of UXO and disposal or destruction. Known time delays will impact on the marking method selected and any need for a boundary hazard marking system.

2.0 UXO HAZARD SIGN

The UXO Hazard Sign used will be in the format shown. The sign will be Signal Red and White on the front and White on the rear. If the wording **Danger UXO** is required on the hazard sign, it is to be included in White in the Local Language and may also be included in one of the six recognised UN languages (English, French, Russian, Chinese, Arabic or Spanish).

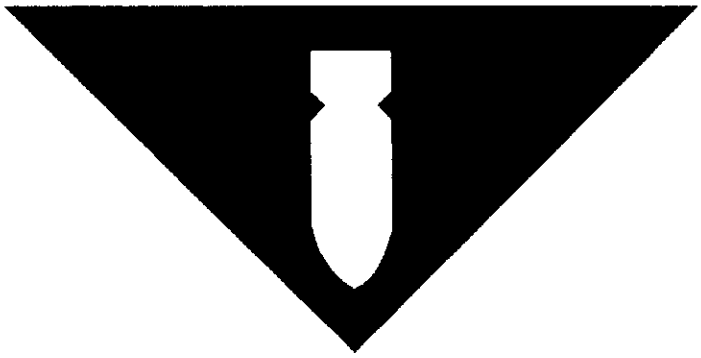


Figure 1 – UXO Hazard Sign

3.0 MARKING INDIVIDUAL UXO HAZARD

3.1 Overt Marking

Method 1. Position a wooden stake in the ground 1.5 metres from the discovered item, between the item and the clearance start point, and:

- Attach a strip of red flagging tape at the top of the stake, allowing not less than 600 mm of free tape either side of the knot.
- Attach a UXO symbol not less than 50 mm below the flagging facing the clearance start point.
- Attach a second strip of red flagging tape not less than 50 mm below the UXO symbol again ensuring not less than 600 mm of free tape either side of the knot.

Method 2. Position a wooden stake in the ground 1.5 metres from the discovered item, between the item and the clearance start point, and:

- Attach a strip of red flagging tape at the top of the stake, allowing not less than 600 mm of free tape either side of the knot.
- Attach a second strip of red flagging tape not less than 300 mm below the first strip again ensuring not less than 600 mm of free tape either side of the knot.

Inter visibility. Within either of these methods, where the exact position of the UXO may not be readily visible from the marker, one end of the lower flagging tape is to be extended to the ground in the direction of the UXO and tied to a rock (or similar) half way between the marker and the item.

3.2 Covert Marking

Where it is not appropriate to the site to highlight the position of the UXO because of the potential for interference to the item by unqualified persons or possible delay in disposal, the item position is to be recorded using DGPS/GPS, and the item lightly reburied. Coloured flagging tape is to be placed in a visible position within 5 m of the item and the direction and distance from the flagging to the item is to be recorded.

3.3 Caching

Where items need to be cached for later disposal, the cache position is to be recorded using DGPS/GPS. Three prominent natural features, unlikely to be moved in the short term and spaced around the cache, are to be also recorded using DGPS/GPS and their distance from the cache also recorded. This method should only be used where it is known that the disposal authority will not be able to attend the site in the short term, and the public is not likely to come in contact with exposed individual items.

4.0 MARKING HAZARD AREAS

Temporary marking systems may be used to mark the perimeter of a potential UXO hazard area and should include both signage and physical barriers. Signs are not to be positioned more than 30m apart and within 5m of turning points.

Educational or instructional material in the local language may be used to supplement UXO Hazard Signs as appropriate.