TRANSPORT FOR NSW (TfNSW)

QA SPECIFICATION B350

UNDERWATER BRIDGE INSPECTIONS

NOTICE

This document is a Transport for NSW QA Specification. It has been developed for use with roadworks and bridgeworks contracts let by Transport for NSW or by local councils in NSW. It is not suitable for any other purpose and must not be used for any other purpose or in any other context.

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REVISION REGISTER

Ed/Rev Number	Clause Number	Description of Revision	Authorised By	Date
Ed 1/Rev 0		First issued	GM, IC	08.04.09
Ed 1/Rev 1	Global	References to "Roads and Maritime Services" or "RMS" changed to "Transport for NSW" or "TfNSW" respectively.	DCS	22.06.20
Ed 1/Rev 2	9 Annex B	Clause revised to allow payment either under Pay Item B350P8 or as a Variation to the Contract. Pay Item B350P8 revised to allow insertion of other project specific items and to align with Clause 9.	SMCSp	16.06.21

GUIDE NOTES

(Not Part of Contract Document)

USING TFNSW B350

TfNSW B350 has been developed specifically for use in routine underwater inspections of bridges comprising timber, concrete, iron and steel bridge elements. It should not be used for any other type of contract, without a full review of its practicability for that application.

TfNSW B350 is a QA Specification and the use of QA Specifications requires the Contractor to implement a quality management system that meets the quality management system requirements specified in TfNSW Q2.

Edition 1

This is the first issue version of the Specification. Further improvement and upgrading based on field experience is expected.

Comments and suggestions should be forwarded to the Supervising Engineer, Rehabilitation Methods, TfNSW Bridge Engineering, Telephone (02) 8837 0279, Facsimile (02) 8837 0023.

TECHNICAL REFERENCE NOTES

The following notes are intended to provide guidance to TfNSW personnel on the application of the Specification. They do not form part of the Contract.

Level of Surveillance by the Principal

To comply with the intention of government policy as well as TfNSW B350, underwater inspections carried out using TfNSW B350 require adequate surveillance and audit by the Principal. Surveillance should normally be provided by the Regional Bridge Support Officer.

Owing to the risks associated with underwater inspection work, the variability of inspection outcomes and the importance of the information gained during the inspections, it is expected that a relatively high level of surveillance, involvement and decision-making by the Principal will be required.

The minimum level of surveillance should be:

- At least one daily visit to the bridge site by the Principal's representative, during each phase of detailed inspection work at the bridge site.
- At least daily communication between the Principal's representative and the Diving Supervisor, during all other work at each bridge site.

Locations of Bridges to be Inspected

The Principal is responsible for providing information on the location of bridges to be inspected under the Contract in a concise form. An example of a map used for this purpose is shown in Figure GN.1.

The Principal must also specify the expected locations of the Boat Access Points or bridge access locations (where it is expected that a boat should not need to be deployed) for each bridge site, based on expected conditions at low tide (tidal waters) or normal water level (inland waters).

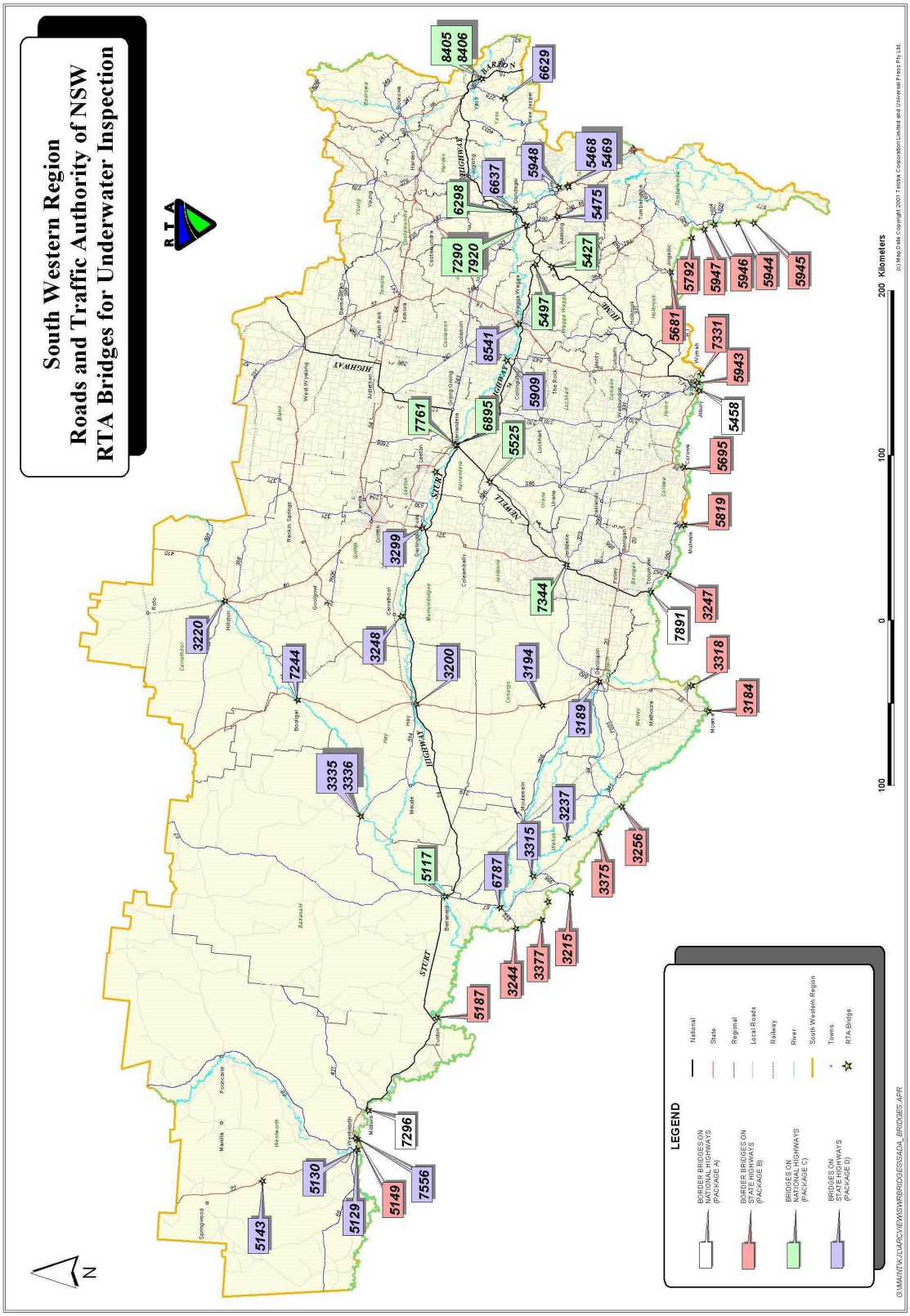

Fig GN.1 Example of Map of Bridges to be Inspected

Standard Reference System

The Principal must specify the Standard Reference System at each bridge (refer Clause 4.1.4), including the long-term reference marks on each pier and abutment for determining depth measurements (normally the soffit of the pile cap or headstock) and for High Water Level (tidal) or Normal Water Level.

This System is used for determining the boundaries of the underwater inspection, all depth measurements, and for referencing all reports, video camera logs, photos and samples. The reference marks must be features that would be easy to locate on future inspections, and must be kept consistent on different inspections of the same bridge and must be clearly recorded in the Bridge Information System.

Selection of Nominated Piles and Nominated Pile Cap Surfaces

At each bridge, the Principal is responsible for selecting and advising the Contractor of:

- the Nominated Piles for detailed inspection;
- the Nominated Piles to be high-pressure water cleaned for the detailed inspection; and
- the Nominated Pile Cap Surfaces for detailed inspection.

The selection of the Nominated Piles and the sub-group of Nominated Piles to be high-pressure water cleaned must:

- conform to Table B350.1, based on the total number of piles for each pile type; and
- ensure a random but evenly distributed selection along the bridge, with each pile type represented proportionally in relation to the total number of piles within each pile type; and
- take into account all piles that have been inspected or previously high-pressure water cleaned on recent underwater inspections, both to minimise the risk of excessive high pressure water cleaning on the pile and to ensure that, over time, all piles receive a detailed inspection.

It is recommended that, over a period of time, the selection of the Nominated Piles should be such that every pile receives a detailed inspection with hydrocleaning at least once every 40 years (based on a 4 year underwater inspection frequency according to the BIS Business Rules).

Where a pile is nominated for hand scraping, high-pressure water cleaning (which achieves a higher standard) is an acceptable alternative for cleaning, except for some metal surfaces (refer Clause 4.5.2).

The Principal may review the original selection of the Nominated Piles, depending on the conditions encountered during underwater inspection, and may select additional Nominated Piles for the purpose of ongoing monitoring.

Reporting of Condition Rating and Bridge Inspections

In accordance with the TfNSW Bridge Inspection Procedure, Bridge Elements must be rated according to the Condition State descriptions in Annexure B350/F Clauses F.1 to F.5.

Use the three template proformas shown in Annexure B350/H for documenting and reporting the underwater bridge inspection in accordance with TfNSW Bridge Inspection Procedure:

(a) Underwater Bridge Inspection – Summary Report for Bridge / Waterway (Form A)

This form summarises the general inspection assessment of underwater bridge elements and waterway, providing details such as date, conditions, person who carried out the inspection and

appropriate sign-offs. Use Form A to provide the overall details including waterway bed conditions.

Use one form per bridge.

(b) Underwater Bridge Inspection – General Inspection Report for Individual Elements (Form B)

This form is used to list all the Individual Elements, in the order given in the Standard Reference System: firstly by pier or abutment number, then by the individual element at the pier or abutment number (e.g. pile cap or pile number), then by Bridge Element (for example different pile types at one pier). The measured bed levels at each Individual Element are to be recorded.

The form indicates which Individual Elements are Nominated Piles or Nominated Pile Cap Surfaces. It provides an account of the detailed inspection reports and video camera logs (where required) for all cleaned faces or strips. Where an Individual Element is not nominated for a detailed inspection, comments are required on the visual inspection of that Individual Element.

Use as many forms as necessary for each bridge.

(c) Underwater Bridge Inspection - Detailed Inspection Report (Nominated Piles or Pile Cap Surfaces) (Form C)

Form C records the Condition Rating and Detailed Written Log for cleaned faces or strips, based on the detailed inspection. The long term depth reference mark, as specified in the Standard Reference System, should be stated.

One form is required for each cleaned face or strip of each Nominated Piles or Pile Cap Surfaces (i.e. each Individual Element).

To ensure better reliability of the condition ratings provided by the Contractor and to achieve consistency with TfNSW standards, the Regional Bridge Support Officer should carefully review the Contractor's ratings and work closely with the Contractor during the first few inspections under the Contract.

Underwater Inspection Report for TfNSW Bridge Information System

The detailed inspections of Nominated Piles and Nominated Pile Surfaces are intended to provide a representative sample of the condition of the substructure below water level.

The general visual inspection provides the overall picture. Unless abnormalities are evident from the visual inspection, the Nominated Piles and Nominated Pile Surfaces can be deemed to be representative.

It is the responsibility of the TfNSW Regional bridge personnel, usually the Regional Bridge Support Officer or an authorised TfNSW bridge inspector, to:

- Assemble the inspection reports and data provided by the Contractor.
- Review the condition ratings provided by the Contractor.
- Extrapolate the inspection data for the Nominated Bridge Elements (i.e. the inspected total quantities (ITQ) and condition ratings) to the **total quantity** (TQ) of each underwater Bridge Element, using the same proportions (%) in each condition state.

  This extrapolation is done on the basis that the Principal is satisfied that the Nominated Bridge

Elements are representative samples of the entire underwater substructure (i.e. that there are no anomalies). Where a Nominated Bridge Element is hand scraped, the condition rating of each strip is deemed to represent the entire pile or pile cap surface of which the strip forms part.

Note: The inspected total quantity (ITQ) and total quantity (TQ) for each underwater Bridge Element must be calculated based on the quantities that exist between the waterway bed level and either Normal Water Level (inland or non-tidal waters) or High Water Level (tidal waters), in accordance with Clause 1.1.

- Reduce the data to a standard four-page "TfNSW Bridge Inspection Report" and enter the inspection data into the TfNSW Bridge Information System (BIS) as an "Underwater Inspection". For "Bridge Inspector", input the Contractor's Diving Supervisor details.

  Only the condition of the inspected underwater Bridge Elements, with extrapolated quantities, are recorded as an underwater inspection in BIS.

- Note under "Inspector's Comments" that the condition rating of the underwater Bridge Elements is based on representative sampling, using extrapolated quantities to provide the proportions in each condition state.

The Inspection Reports supplied by the Contractor in electronic form (refer Clause 8.1) are to be uploaded as an attachment to the Underwater Inspection Report in BIS.

Each underwater bridge inspection should be entered into the BIS within four (4) weeks of receipt of the Inspection Reports from the Contractor, i.e. within eight (8) weeks of the inspection (refer to BIS Business Rules).

For further details of the procedure for recording Underwater Inspections in BIS, please contact the System Administrator for the TfNSW Bridge Information System, TfNSW Bridge Engineering, Telephone 02 8837 0857 Facsimile 02 8837 0052.

Determining Changes in Bed Levels

It is the responsibility of the Bridge Maintenance Planner to analyse the results of the inspection of waterway bed conditions for each bridge and to determine any changes in bed levels and other changes or trends in the waterway that may affect (or ultimately affect) the bridge structure, the embedment of the bridge foundations or the stability of the river banks.

The waterway bed levels (past and present) should be plotted on a copy of the Work-As-Executed (WAE) Drawings (including any subsequent approved structural modifications) showing bridge foundations and the original design bed levels along a longitudinal section of the bridge.

Using an appropriate common reference/datum/benchmark, the change in bed levels at each pier and abutment since the original construction and since the last inspection should be determined as follows:

(a) Plot the existing bed levels on the waterway cross section of the WAE Drawings;

(b) Plot the bed levels from the last inspection on the WAE Drawings;

(c) Calculate and mark up on the WAE Drawings the differences between:
- existing bed levels and original design bed levels; and
- between existing bed levels and bed levels from the last inspection.

The marked-up Drawings should show:

- Scour and other changes since the last inspection (particularly if a flood has occurred since the last inspection, or if the normal flow or tidal flow velocity is relatively high, or if the waterway has a history of unstable or changing channel conditions); and

- Changes in the positions of banks of the waterway, upstream and downstream of the bridge abutments, relative to those shown on the original WAE Drawings.

Appropriate summary of comments should be made in the "TfNSW Bridge Inspection Report" and entered into the BIS, supported by plotted copy of WAE Drawings showing the bed levels at different times (this is to be uploaded as an attachment to the Underwater Inspection Report in BIS).

Underwater Core Sampling

Given the risks associated with coring underwater surfaces (e.g. cutting structural reinforcement and corrosion of wrought iron and cast iron surfaces), coring of underwater surfaces should be limited and strictly controlled. Underwater core sampling should only be directed following due consideration of the observations of the underwater visual inspection.

The Bridge Maintenance Planner, after obtaining engineering advice from and having consulted with Bridge Engineering, is to develop a Core Sampling Plan that specifies the elements and locations of the cores and the required dimensions (i.e. diameter, depth) of the cores prior to any core sampling.

For concrete Bridge Elements, the core diameter is to be not less than 40 mm and not more than 75 mm, unless otherwise specified by Bridge Engineering.

Where possible, cores of concrete piles should be located along the axes of the piles.

It is recommended that cores be taken from the portion of each element in worst condition. Where distress extending from above water level to below water level is observed on a concrete surface, the core should be taken just above the low tide water level (MLWS).

Where the surface is cracked, the core should be taken within the length of, and centred on, the crack.

Structural engineering calculations and certification may be required to ensure that the cores can be safely taken without affecting the structural integrity of the element.

Prior to coring concrete Bridge Elements, the Contractor is to determine the precise core locations based on the Core Sampling Plan and the Work-As-Executed drawings (refer Clause 7.2.2).

Although it is preferable to verify the actual reinforcement locations on site using underwater covermeter measurements, this is not currently feasible due to the lack of suitable specialised equipment.

For metal elements, coring may be considered when the original thickness of the element is not known or when the results of non-destructive testing to establish the integrity of the metal element are ambiguous.

For restoration of core holes in concrete Bridge Elements, the use of the proprietary product specified in Annexure B350/A is recommended. Annexure B350/A will be updated if new products and techniques become available. Any alternative product is to be tested as required by Bridge Engineering before it can be used for core hole repairs. Cementitious mortars are more likely to promote bond development between the repair material and the saturated concrete substrate than epoxy materials.

For the restoration of core holes in metal Bridge Elements, Bridge Engineering will develop a standard method for the repair. Pending the development of a standard method, the method to be used is to be specified at the Pre-Tender Meeting, based on advice from Bridge Engineering.

Pay Items

The Pay Items and their intent (e.g. with reference to Boat Access Points) should be clarified at the Pre-Tender Meeting.

QA SPECIFICATION B350

UNDERWATER BRIDGE INSPECTIONS

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VERSION FOR:
DATE:

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FOREWORD

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REVISIONS TO PREVIOUS VERSION

This document has been revised from Specification TfNSW B350 Edition 1 Revision 1.

All revisions to the previous version (other than minor editorial and project specific changes) are indicated by a vertical line in the margin as shown here, except when it is a new edition and the text has been extensively rewritten.

PROJECT SPECIFIC CHANGES

Any project specific changes are indicated in the following manner:

(a) Text which is additional to the base document and which is included in the Specification is shown in bold italics e.g. ***Additional Text***.

(b) Text which has been deleted from the base document and which is not included in the Specification is shown struck out e.g. ~~Deleted Text~~.

TfNSW QA SPECIFICATION B350

UNDERWATER BRIDGE INSPECTIONS

1 GENERAL

1.1 SCOPE

This Specification sets out the requirements for the underwater inspection of bridge substructure elements between the waterway bed level and either High Water Level (tidal waters) or Normal Water Level (inland or non-tidal waters), in either salt water or fresh water less than 50 m deep (for bridges at sea level), or the corresponding diving depth for bridges at altitude.

This Specification includes high-pressure water cleaning or hand scraping of those piles and pile caps nominated for detailed inspection, inspection of the waterway, and the specified sampling and coring work.

Work other than inspections and sampling (such as removal of skirt panels, underwater repair work or underwater labouring) may also be required.

For bridges in the tidal zone, all references to “under water” or “below water level” are deemed to include the inter-tidal zone.

1.2 STRUCTURE OF THE SPECIFICATION

This Specification includes a series of Annexures that detail additional requirements.

1.2.1 Details of Work and Locations of Bridges to be Inspected

Details of work, specific to this Contract, are shown in Annexure B350/A.

The bridges to be inspected will generally be at various locations. A list of the bridges to be inspected and a map showing their locations is attached in Annexure B350/A.

For each bridge, the Principal will specify the location of the Boat Access Point or, where it is anticipated that a workboat would not be required, the bridge access location. These locations will be based on expected conditions at low tide (tidal waters) or normal water level (inland waters).

The number of Nominated Piles and Nominated Pile Cap Surfaces for detailed inspection will be according to Clause 4.4 and Table B350.1.

1.2.2 Measurement and Payment

The method of measurement and payment is detailed in Annexure B350/B.

1.2.3 Schedules of HOLD POINTS and Identified Records

The schedules in Annexure B350/C list the **HOLD POINTS** that must be observed. Refer to Specification TfNSW Q for the definition of **HOLD POINTS**.

The records listed in Annexure B350/C are **Identified Records** for the purposes of TfNSW Q.

1.2.4 Referenced Documents and Abbreviations

Unless specified otherwise or specifically supplied by the Principal, the applicable issue of a referenced document is the issue current at the date one week before the closing date for tenders, or where no issue is current at that date, the most recent issue.

Standards, specifications and test methods are referred to in abbreviated form (e.g. AS 1234). For convenience, the full titles are given in Annexure B350/M. Whenever a part of a standard is referenced, the common title is given separately and the part referred to only by its title.

1.3 PLANNING DOCUMENTS

The PROJECT QUALITY PLAN must include each of the documents and requirements listed in Annexure B350/D and must be implemented.

1.4 DEFINITIONS

The terms "you" and "your" mean "the Contractor" and "the Contractor's" respectively.

In addition to the standard terms defined in AS/NZS 2299.1 and the WorkCover NSW Guidelines attached to Annexure B350/I, the following definitions apply to this Specification:

Boat Access Point. The nearest location to the bridge where the workboat can be launched into the waterway. This is specified by the Principal.

Bridge Element. A component of the bridge structure, based on the classification given in the TfNSW Bridge Inspection Procedure.

Compression Chamber. A surface chamber in which persons may be subjected to pressures equivalent to or greater than those experienced when under water, or under conditions which simulate those experienced on an actual dive (AS/NZS 2299.1).

Condition State. The condition rating of a Bridge Element, based on the TfNSW Bridge Inspection Procedure.

Core Sampling Plan. Plan detailing the Individual Elements to be cored and the precise locations of cores within each Individual Element.

Fine crack. A crack less than 1.0 mm but greater than 0.3 mm in width. [Fine cracks less than 0.3 mm in width are impractical to pick out visually underwater, and hence do not need to be reported].

High Water Level (HWL). For tidal waters, the agreed level of tidal high water including spring tides, strictly "Mean High Water Springs [MHWS]". This defines the boundary of the underwater Bridge Elements for underwater bridge inspection. For practical purposes, it will be a long-term reference mark specified by the Principal, generally corresponding with the upper limit of significant marine growth.

Individual Element. Bridge Elements at different locations through the bridge, numbered and referenced according to the Standard Reference System.

Nominated Pile. A pile (representative of one pile type) that is nominated by the Principal for a detailed inspection. These piles must be cleaned, either by high-pressure water cleaning or hand scraping, prior to the detailed inspection.

Nominated Pile Cap Surface. A representative strip of the surface of each pile cap that is nominated by the Principal for a detailed inspection. These surfaces must be cleaned, either by high-pressure water cleaning or hand scraping, prior to the detailed inspection.

Normal Water Level. For inland or non-tidal waters, the agreed average water level. This defines the boundary of the underwater Bridge Elements for the underwater bridge inspection. For practical purposes, it will be a long-term reference mark specified by the Principal.

Pile Type. The combination of pile material, design and cross sectional dimensions. Piles in a bridge will be deemed to be of different pile types where there are significant differences in any of the above characteristics. The Principal will advise the different pile types at each bridge.

Standard Reference System. The standard orientation / reference system for substructure Bridge Elements. This is specified by the Principal and must be used for determining High Water Level or Normal Water Level, all depth measurements, and for referencing in all reports, video camera logs, photos and samples.

The local Standard Reference System for piles is contained in Annexure B350/G. Refer to Clause 4.1.4.

Total number of piles (for each pile type). The total number of each pile type at the bridge site.

1.5 PRINCIPAL'S APPROVAL

Where the Principal's approval is required, and/or where submission of documents is specified in this Specification, you must:

(a) give adequate notice to the Principal and/or submit the necessary documentation;

(b) obtain written approval or concurrence of the Principal prior to carrying out further work.

1.6 INFORMATION TO BE SUPPLIED BY THE PRINCIPAL

The Principal will provide you with a copy of the following information:

(a) Relevant Work-As-Executed drawings of each bridge, where available, including the general arrangement plan, waterway cross section, pile layout plan, pile details, and pier and abutment details;

(b) TfNSW Bridge Inspection Procedure Manual (June 2007);

(c) The Nominated Piles and Nominated Pile Cap Surfaces for detailed inspection (refer Clause 4.4);

(d) The Standard Reference System (refer Clause 4.1.4).

A list of the available registered drawings for the bridges to be inspected is provided in Annexure B350/A.

1.7 INFORMATION TO BE SUPPLIED BY THE CONTRACTOR

At least one week prior to commencement of work, submit the following information for the Principal's approval:

(a) Inspection Program, including details of proposed travel arrangements;

(b) Names, certificate numbers and evidence of certification for all divers who may be engaged on the work;

(c) Details and certification of the equipment to be used including Compression Chamber (if required), communications equipment, underwater video camera and still camera, and other tools to be used;

(d) Details of all necessary notifications to, and approvals from, the appropriate regulatory authorities, including but not limited to: NSW Maritime, the local Port Corporation, WorkCover NSW, vehicular or passenger ferry operators, and any other organisations as required; and

(e) Operations Manual, Risk Assessment details, Safe Work Method Statements and evidence of necessary insurances, as required by WorkCover NSW.

2 PLANNING AND PROGRAMMING OF WORK

Notify the Principal of each individual bridge inspection at least two (2) working days in advance.

Do not deviate from the approved Inspection Program without prior written approval from the Principal.

3 PERSONNEL AND EQUIPMENT

Supply all necessary personnel, equipment and resources required to carry out the inspection work, including underwater high-pressure water cleaning equipment. This includes making reasonable provision for any additional work required by the Principal under the Provisional pay items.

All personnel and equipment for diving work must comply with the requirements of the WorkCover NSW "Guidelines for Persons Engaged in Diving Work" (refer Annexure B350/I).

3.1 PERSONNEL

Provide a minimum 4-person team for all diving work under the Contract, comprising the Diving Supervisor, working diver, stand-by diver and separate diver's attendant (whose respective duties are specified in the WorkCover NSW "Guidelines for Persons Engaged in Diving Work" attached in Annexure B350/I).

The Principal may direct you to provide additional divers at the rate provided for under Pay Items B350P1 (b) and B350P2 (b).

All divers and other personnel engaged under the Contract must hold appropriate qualifications and certificates required under government regulations as specified in AS/NZS 2299.1.

All personnel who are engaged in bridge inspection activities, including the Diving Supervisor, must have completed a TfNSW training course in the use of the TfNSW Bridge Inspection Procedure within the last 5 years (refer Clause 4.2.2).

3.2 DIVING VESSEL

Any vessel used for diving work must:

(a) be registered as a commercial dive platform;

(b) meet the relevant NSW Maritime survey requirements;

(c) be controlled by a licensed boat handler; and

(d) display the appropriate lights, day marks and/or flags as required by the appropriate regulatory authority.

3.3 COMMUNICATION EQUIPMENT

Provide communication equipment that:

(a) is capable of continuous voice and video camera communication between the working diver and the Diving Supervisor (so that the Diving Supervisor and/or Principal can view the video camera output live at any time, if required), which can be recorded and made available as a record;

and

(b) ensures continuous telephone contact at each bridge site (utilising, for example, a satellite-based system suitable for remote areas) between the Diving Supervisor and the Principal, and suitable for emergency use.

3.4 COMPRESSION CHAMBER

When required by the WorkCover NSW Guidelines for Persons Engaged in Diving Work (refer Annexure B350/I):

(a) provide a Compression Chamber on site that complies with the requirements of AS/NZS 2299.1 and all relevant pressure vessel regulations, including inspection and certification; and

(b) provide additional trained person necessary to operate the chamber.

Note: A Compression Chamber is normally required only for diving depths exceeding 30 m.

3.5 TOOLS AND EQUIPMENT

You are responsible for providing all tools and equipment necessary for the underwater inspection work.

4 UNDERWATER INSPECTION

4.1 GENERAL

All diving work must be carried out in accordance with the Work Health and Safety Act 2011, associated regulations and the requirements of the WorkCover NSW Guidelines for Persons Engaged in Diving Work (refer Annexure B350/I).

All personnel, apparatus used and procedures followed during diving must conform to AS/NZS 2299.1.

4.1.1 Commencement of Work

HOLD POINT

Process Held:	Commencement of underwater inspections.
Submission Details:	At least 5 working days prior to the commencement of inspection at the first bridge site, submit the following documentation: (1) All information required under Clause 1.7. (2) Documentation (e.g. registration, certification) verifying that the personnel, diving vessel and Compression Chamber conform with the requirements of Clauses 3.1, 3.2 and 3.4. (3) Details of safe working procedures for diving and inspection. (4) Water Traffic Control Plans for each bridge site, where required (refer Clause 4.3).
Release of Hold Point:	The Principal will consider the submitted documents prior to authorising the release of the Hold Point

4.1.2 Preliminary Visual Inspection of Underwater Bridge Elements and Waterway

Visually inspect all accessible elements (Individual Elements) of the bridge, from water level or pile cap soffit level down to waterway bed level, to confirm the presence and continuity of the elements (i.e. to confirm no obvious section loss) and their embedment in the waterway bed, according to the details in the Work–As-Executed drawings supplied by the Principal. Inspection must include abutments, piers, footings, pile caps and exposed lengths of piles as applicable.

Note any obvious misalignments of Bridge Elements compared to the Work–As-Executed drawings, including piles that are out of plumb.

Where required by the Principal (to confirm earlier visual inspection of timber piles), make additional observations of the response of the timber piles to the passage of a heavy vehicle on the bridge (e.g. signs of splitting, crushing or movement). In this case, the heavy vehicle will be provided and operated by the Principal.

Carry out inspections in the most optimal conditions (e.g. light, time of day) for the features to be inspected. Provide artificial lighting where necessary to assist visual inspection in poor light conditions.

Where visual inspection is not feasible due to excessive turbidity of the water, assess the condition of the elements by feeling, probing or any other means approved by the Principal. Do not carry out inspections during conditions of abnormally high turbidity (e.g. silty water inflows immediately after rain and during flood conditions).

Carry out a visual inspection of waterway bed conditions (including debris and erosion monitoring) in accordance with Clause 5.

4.1.2 Detailed Inspection of Nominated Piles and Nominated Pile Cap Surfaces

After cleaning the surfaces of the Nominated Piles and Nominated Pile Cap Surfaces (refer Clause 4.4), carry out a detailed inspection of the cleaned surfaces as specified in Clause 4.5 below.

Prior to the detailed inspection of an element, the cleaned surface of the element must be clearly marked in crayon (to an accuracy of ± 0.02 m) showing the measured depth at each mark:

(a) at one-metre intervals of depth below the long-term reference mark specified in the Standard Reference System, which is normally the soffit of the pile cap or headstock; and

(b) at the High Water Level or Normal Water Level specified in the Standard Reference System.

This is to assist in identifying the actual locations of features and defects in the written logs, photographs and video camera logs.

Provide written logs, video camera logs (where required) and high quality colour photographs (where required) of all cleaned faces during the detailed inspection (refer Clauses 4.6 and 4.7 and 4.8 respectively), to show the condition of the cleaned surface of each element, including the existence of any defects, cracking, corrosion, damage or serious deterioration.

To minimise the risk of contamination and regrowth over cleaned surfaces, complete the detailed inspections and video camera logs (where required) and photos of cleaned surfaces within the following time limits:

(a) in salt or brackish water, within 72 hours of cleaning of the surface, unless otherwise approved by the Principal;

or

(b) in fresh water, within three (3) weeks of cleaning of the surface.

4.1.3 More Intensive Examination (If Required)

The inspections must include difficult-to-access areas (e.g. behind pile cap skirts, old formwork etc).

Where access for inspection is prevented by an obstruction, advise the Principal, who may direct removal of the obstruction. Skirt panels or other bridge attachments must not be damaged and must not be removed unless approved by the Principal.

If any serious deterioration, section loss, abnormalities or other potential problems is detected, inform the Principal immediately, and provide the necessary supporting details. The Principal may then order further cleaning and a more intensive examination of the element as a Variation to the Contract.

4.1.4 Standard Reference System

The Principal will specify the Standard Reference System at each bridge, including:

(a) the long-term reference mark on each bridge pier and abutment for determining depth measurements, including bed depths (normally the soffit of the pile cap or headstock);

(b) the long-term reference mark on each bridge pier and abutment for determining High Water Level (tidal waters) or Normal Water Level (non-tidal or inland waters); and

(c) the local pile reference system.

Use the Standard Reference System for determining High Water Level or Normal Water Level and all depth measurements.

Reference all reports, video camera logs, photos and samples according to the Standard Reference System, specifying the Bridge Element number, face and depth below the long-term reference mark for all features.

The Standard Reference System supplied by the Principal will number the abutments, piers and piles consistently with the Work-As-Executed Drawings (refer Annexure B350/A).

Annexure B350/G shows the local Standard Reference System for piles, providing their orientation.

HOLD POINT	(Upon completion of inspection of each bridge pier or abutment)
Process Held:	Removal of diving team from each bridge pier or abutment, after completion of inspection, prior to redeployment to the next pier or abutment.
Submission Details:	A report to the Principal on the bridge pier or abutment element condition, including advice of any serious deterioration, section loss, abnormalities or other potential problems detected.
Release of Hold Point:	The Principal will consider the report prior to authorising the release of the Hold Point

4.2 USE OF TFNSW BRIDGE INSPECTION PROCEDURE

4.2.1 Condition Rating of Inspected Bridge Elements

Rate and report all underwater Bridge Elements that have been visually inspected (including detailed inspections) and the bridge waterway in accordance with the TfNSW Bridge Inspection Procedure Manual (June 2007).

Report the Condition State of Individual Elements with an indication of the extent of that condition by defining the unit quantity of the Bridge Element in each condition state.

The Bridge Element codes, descriptions and units are specified in Annexure B350/E.

The Bridge Element Condition State descriptions for the different material types are specified in Annexure B350/F Clauses F.1 to F.4. The Condition State descriptions for the bridge waterway are specified in Annexure B350/F Clause F.5.

4.2.2 Trained Personnel for Bridge Inspections

All personnel engaged in the inspection and rating of bridge elements and the bridge waterway (including the Diving Supervisor) must have completed an official TfNSW training course in the use of the TfNSW Bridge Inspection Procedure within the last 5 years.

Where necessary, the Principal will provide an official one day training course, free of charge, at the location specified in Annexure B350/A, to those inspection personnel who have not received previous training. This course will address the particular requirements of underwater inspections and the use of the underwater inspection proforma.

Allow for your costs in relation to the training of your employees (where necessary) in Pay Item B350P1.

4.3 CONTROL OF WATERWAY TRAFFIC

Consult with Transport for NSW and the local Ports Corporation regarding the control of waterway traffic and fulfil all requirements of those authorities.

Where required, prepare and submit a Waterway Traffic Control Plan showing the relevant requirements and implement and maintain the water traffic controls during the work.

Maintain a diary, keeping records of the operation times of all waterway navigation markings used on each site. Supply a copy of the diary records to the Principal on completion of the work.

4.4 NOMINATED PILES AND PILE CAP SURFACES FOR DETAILED INSPECTION

4.4.1 General

Carry out detailed inspections on the Nominated Piles and the Nominated Pile Cap Surfaces.

Prior to their detailed inspection, clean the Nominated Piles and the Nominated Pile Cap Surfaces of crustaceans and other marine or aquatic growth, using either:

(a) high-pressure water cleaning, in accordance with Clause 4.5.1 (applied to certain Nominated Piles as specified in Clause 4.4.3); or

(b) hand scraping, in accordance with Clause 4.5.3 (applied to all other Nominated Piles and to all Nominated Pile Cap Surfaces).

Hand scraping is the minimum cleaning standard required. High-pressure water cleaning (which achieves a higher standard) is an acceptable alternative for hand scraping, except where it would damage the pile or where iron graphitisation is present (refer Clauses 4.5.1 and 4.5.2).

4.4.2 Selection of Nominated Piles

The Principal will specify the Nominated Piles for each pile type, numbered according to Table B350.1 (based on the total number of piles for each type).

Note: The Principal's selection will ensure that the Nominated Piles and the Nominated Piles to be high-pressure water cleaned:
(a) are randomly selected but evenly distributed along the bridge; and
(b) represent each different pile type in proportion to the total number of piles within each pile type.

The Principal may:

(a) review and amend the original selection of the Nominated Piles, depending on the conditions found during the underwater inspection; and/or

(b) nominate additional Nominated Piles for the purpose of ongoing monitoring (i.e. above the number specified in Table B350.1), using the same rate for payment as Pay Items B350P1 and B350P2.

4.4.3 Nominated Piles to be High-Pressure Water Cleaned

In salt or brackish water only, some Nominated Piles must be high-pressure water cleaned in accordance with Clause 4.5.1.

The Principal will specify the sub-group of Nominated Piles to be high-pressure water cleaned for each pile type, numbered according to Table B350.1 (based on the total number of piles for each type). Refer to Clause 4.4.2 Note.

Table B350.1 – Selection of Nominated Piles (for each pile type)

Total number of piles	Number of Nominated Piles	Number of Nominated Piles to be high-pressure water cleaned (salt or brackish water only)
Up to 20 piles	All piles are Nominated Piles	50% of the Nominated Piles, rounded up to the nearest integer
21 to 66 piles	20 piles	
67 to 96 piles	30% of the total number of piles, rounded up to the nearest integer	
97 to 150 piles	30 piles	
151+ piles	20% of the total number of piles, rounded up to the nearest integer	

The Principal may:

(a) review and amend the original selection of the Nominated Piles for High-Pressure Water Cleaning, depending on the conditions being found during the underwater inspection; and/or

(b) nominate additional piles to be high-pressure water cleaned for the purpose of ongoing monitoring (i.e. above the number specified in Table B350.1), using the same rate for payment as Pay Item B350P1 and B350P2; and/or

(c) specify that certain piles be excluded from high-pressure water cleaning. The exclusion may be because these piles have been repeatedly high-pressure water cleaned in recent inspections or because of a known high risk of damage or presence of cast iron graphitisation (refer Clause 4.5.2).

4.4.4 Nominated Piles for Hand Scraping

All other Nominated Piles (i.e. those not specified for high-pressure water cleaning in Clause 4.4.3) must be hand scraped according to Clause 4.5.3, unless you elect to use high-pressure water cleaning instead.

Where you elect to use high-pressure water cleaning, obtain the approval of the Principal before commencing cleaning. The required extent of cleaning is the same as for hand scraping (refer Clause 4.5.3).

HOLD POINT	(Prior to using high-pressure water cleaning in lieu of hand scraping)
Process Held:	High-pressure water cleaning of piles.
Submission Details:	(1) Piles nominated for high-pressure water cleaning in lieu of hand scraping. (2) Confirmation that high-pressure water cleaning will not damage the piles and that none of the piles are subject to graphitisation. (3) Method to mitigate environmental effects of high-pressure water cleaning.
Release of Hold Point:	The Principal will consider the submission and may approve or reject the use of high-pressure water cleaning in lieu of hand scraping prior to authorising the release of the Hold Point.

4.4.5 Additional Piles for Detailed Inspection (Based on Above-Water Condition)

For piles in salt or brackish water, where significant cracks or other defects are observed in the upper section (i.e. above the intertidal zone and below the soffit of the pile cap or headstock) of any piles not nominated for high-pressure water cleaning, the Principal will nominate one additional pile representative of the worst condition of the upper sections to be added to the Nominated Piles for High-Pressure Water Cleaning.

Based on the results of the detailed inspection of the additional pile, the Principal may order a Variation for further cleaning and a more intensive inspection of the piles.

4.4.6 Nominated Pile Cap Surfaces for Detailed Inspection

The Principal will advise the Nominated Pile Cap Surfaces for detailed inspection.

Hand scraping must be applied to the surfaces of each pile cap and abutment as specified in Clause 4.5.3, unless you elect to use high-pressure water cleaning instead and obtain the Principal's approval (as for piles - refer Clause 4.4.4).

Where sacrificial formwork is present on a pile cap, advise the Principal, who may direct a modified form of inspection or further work in accordance with Clause 9 or delete the inspection item.

4.5 CLEANING OF SURFACES FOR DETAILED INSPECTION

4.5.1 High-Pressure Water Cleaning

Where required under Clause 4.4.3, remove crustaceans and other marine growth from the entire perimeter or circumference of a pile, for its full length under water using high-pressure water cleaning.

High-pressure water cleaning must remove all marine growth and surface contamination to a uniform standard that enables fine cracks (i.e. less than 1.0 mm in width, normally not observable below 0.3 mm) to be observed but minimises damage to sound concrete. The water pressure, angle of attack and duration of surface exposure to high-pressure water cleaning must be carefully controlled at all times to minimise surface damage. Marine growth in cracks must be removed where the crack width exceeds 2 mm.

Note: As a guide, the delivered water pressure at the nozzle should be in the range 35 to 55 MPa (5,000 to 8,000 psi), depending on the extent of marine growth. The angle of attack should be approximately 45 degrees and the nozzle should be operated on a constant front. Where possible, use equipment that can provide variable pressure adjustment and turbo heads that can deliver enhanced effective working pressure (EWP).

If high-pressure water cleaning causes, or would cause, serious section loss that, in your opinion, would damage and threaten the integrity of the pile, stop cleaning and seek a direction from the Principal.

Unless approved otherwise by the Principal, high-pressure water cleaning equipment must use recirculated salt or fresh water from the waterway and must be operated from its truck or work punt without encroachment on the bridge deck.

4.5.2 Metal Surfaces

Where metal piles in salt or brackish water are nominated or proposed for high-pressure water cleaning, prior to commencement of high-pressure water cleaning, clean a representative 1 m long strip of one pile face at the bridge site by hand scraping and examine the surface to determine whether iron graphitisation is present.

During such hand scraping, take care to observe and report the location of any nodules of corrosion product. In this case, the Principal may order a Variation for a more detailed investigation of the corrosion.

Where iron graphitisation is found, all metal piles nominated or proposed for high-pressure water cleaning must be cleaned by hand scraping according to Clause 4.5.3 and must not be high-pressure water cleaned.

4.5.3 Hand Scraping

Where required under Clause 4.4.4 or 4.4.6, carry out hand scraping of piles or pile cap surfaces respectively. In all cases, thoroughly clean surfaces back to the original surface, firstly by hand scraping, followed by scrubbing with a stiff non-metallic brush.

On rectangular piles and bracing members, remove crustaceans and marine growth from a total width of 400 mm for the full length of the member under water as follows:

(a) two 100 mm wide strips (for the full length of the member under water) from a corner over the adjacent faces; and

(b) two 100 mm wide strips (for the full length of the member under water) from the central area of the remaining two faces.

For circular piles, remove crustaceans and marine growth from a minimum circumferential width of 100 mm, at the rate of one 100 mm wide strip per 2 m of circumference (rounded up to next even number), over the full length of the pile under water.

Remove crustaceans and marine growth from all pile caps, pier columns and abutments over a strip not less than 100 mm in width, over the full depth of that portion of the element cross section that is under water, with the strips located as follows:

(a) at every $^{1}/_{5}$ point along each long side of the element; and

(b) at upstream and downstream ends of the element, at the rate of one 100 mm wide strip per 2 m of end width (rounded up to next even number).

4.6 VIDEO CAMERA LOG OF CLEANED FACE OR STRIP

4.6.1 General

Record video camera logs of cleaned pile surfaces in conjunction with the detailed inspections, where:

(a) any defects, cracking or corrosion is evident on the cleaned surface; or

(b) visual inspection indicates that damage or serious deterioration has occurred to the element.

or as required by the Principal.

The video camera log must be in a digital format approved by the Principal.

Record the video camera log promptly after cleaning (refer to the time limits in Clause 4.1.2).

4.6.2 Video Camera Log

Your equipment must provide for continuous voice communication and video camera image between the working diver and the Diving Supervisor (refer Clause 3.3), irrespective of whether a video camera log is required or not.

For each element for which a log is required, make a continuous video camera traverse of each cleaned surface from water level to bed level (or reverse direction). Provide the working diver's commentary as voice-over.

The video camera recording must clearly show and describe all cracks 0.3 mm or greater in width, spalling, corrosion, discolouration, abnormalities or any other form of deterioration.

Describe all deterioration and features of interest including their size, extent and relationship with other faces or features.

Reference the video camera traverse to the element number, face and depth below the long-term reference mark for all features, according to the Standard Reference System (refer Clause 4.1.4).

Progress the video camera traverse in an orderly fashion, following the same sequence for each element and working in one direction through the elements at each pier or abutment. Record and show on the Detailed Logs the video camera recording timings for start and finish of each element face.

Provide good artificial illumination where natural light is not adequate to clearly define features such as fine cracks.

The rate of traverse must be sufficiently slow to clearly distinguish such details as fine cracking.

Note: As a guide, the rate of traverse should be approximately 2 m length of pile per minute.

4.7 DETAILED WRITTEN LOG OF CLEANED FACE OR STRIP

Based on the detailed visual inspection and the video camera log (where required), prepare detailed written logs for each cleaned face or strip of each nominated element (Individual Element), describing every form of deterioration using the same criteria as in Clause 4.6.2.

The detailed logs must be neatly written on printed forms replicating the Detailed Inspection Report format (Form C) shown in Annexure B350/H or, alternatively, in a detailed log format derived from Form C that is customised for each type of element and approved by the Principal.

Classify deterioration according to the requirements of the TfNSW Bridge Inspection Procedure Manual.

Estimate crack widths to the following accuracy:

(a) crack width less than 1 mm: ± 0.2 mm;

(b) crack width between 1 mm and 2 mm: ± 0.25 mm;

(c) crack width between 2 mm and 5 mm: ± 0.5 mm;

(d) crack width greater than 5 mm: ± 1 mm.

Estimate the width and depth of spalls or V-cracks to ± 5 mm.

Estimate the length of cracks or defects to ± 0.1 m.

Describe all colours, textures and abnormalities.

Accurately locate all features in terms of depth below the long-term reference mark for all features to an accuracy of ± 0.1 m, using the pile reference markings provided in Clause 4.1.2.

4.8 PHOTOGRAPHS

Provide clear digital colour photographs of cleaned pile surfaces of minimum 8 Megapixel resolution showing the principal deterioration features (refer Clause 4.1.2), to support the inspection reports, detailed written logs and video camera logs where:

(a) any defects, cracking or corrosion is evident on the cleaned surface; or

(b) visual inspection indicates that damage or serious deterioration has occurred to the element.

Photographs of cleaned surfaces must include a non-reflective metric scale or other suitable reference feature of a standard dimension placed against the surface and, where feasible, at least one crayon reference marking showing the depth below the long-term reference mark.

Underwater photos must be taken in the most optimal conditions (e.g. light, time of day) for the feature being photographed and provide artificial lighting where necessary.

In turbid conditions, modify the underwater camera as necessary to enhance the clarity of photos using a method approved by the Principal (e.g. attach sealed box containing clear water between camera and object being photographed, use offset strobe lighting).

Provide photographs in the following formats:

(a) One hard copy to support the hard copy inspection report;

(b) An electronic copy on a CD in .JPG format.

4.9 GIRTH MEASUREMENTS OF TIMBER PILES

Measure and record the diameter of each timber pile at the following locations:

(a) At waterway bed level;

(b) Within the splash zone at the point where necking is most severe (e.g. “lady’s waist" in tidal waters);

(c) At soffit of pile cap or headstock, or top of pile (e.g. fender).

Note any other features of timber pile deterioration.

5 INSPECTION OF WATERWAY BED CONDITIONS

In conjunction with the pile inspections, inspect and measure the bed of the waterway to allow assessment of changes in bed levels that may affect the bridge foundations or bridge approaches.

Measure and record the existing depth of the waterway bed at the upstream and downstream ends of each pier and abutment. Use the same long term depth reference mark as for pile inspections (i.e. depth below soffit of pile cap or headstock) according to the Standard Reference System and note the date and the location of the bed level measurements. Measure depths to ± 0.2 m.

Note: Refer bed depth measurements to the long term depth reference mark on the pier or abutment as specified in the Standard Reference System, to ensure consistent measurements between different inspections over time. Measured water depth (e.g. obtained from shot line or calibrated diver’s depth gauge) needs to be adjusted for dimension between actual water level and the long term reference mark to obtain the bed depth.

Take photographs of the bed conditions according to Clause 4.8.

Note down the following:

(i) The estimated flow velocity (normal flow or at peak tidal flow);

(ii) Presence of debris against bridge substructure elements;

(iii) Any heavy siltation or obstruction of any part of the waterway;

(iv) Any other unusual waterway conditions.

The Principal may order a Variation for a more intensive extent of inspection and investigation, as necessary to diagnose the cause of particular problems (e.g. bridges exhibiting signs of settlement).

6 WATER SAMPLING AND TESTING

At each bridge site, collect a representative 1.0 litre sample of the water from the waterway, place it in an uncontaminated container, mark and despatch it to a suitable laboratory and test it for the properties set out in Table B350.2. The sample marking must identify the bridge name, sample date and the tidal conditions when sampled (for tidal waters).

Provide a report of the test results as part of the Inspection Report for each bridge.

Table B350.2 – Water Testing

Property	Test Method
(i) pH	APHA 4500-H^+ B (Electrometric Method)
(ii) Chlorides	APHA 4500-Cl^- D (Potentiometric Method)
(iii) Nitrates (metal bridge elements only)	APHA 4500-NO_3^- F (Automated Cadmium Reduction Method)
(iv) Sulphates	APHA 4110 B (Ion Chromatography Method)
(v) Phosphates	APHA 4500-P F (Automated Ascorbic Acid Reduction Method)
(vi) Hardness	APHA 3111 B [for constituents] APHA 2340 B (Hardness by Calculation)
(vii) Conductivity (indicator of salinity)	APHA 2510 B
(viii) Total Dissolved Solids (indicator of total soluble salts)	APHA 2540 C (Total Dissolved Solids Dried at 180°C)

Note: APHA is American Public Health Association

7 CORE SAMPLING

7.1 GENERAL

The Principal may order a Variation for core samples to be taken in concrete or metal surfaces.

HOLD POINT

Process Held:	Core sampling and restoration of core holes (concrete or metal surfaces).
Submission Details:	(1) Procedure for taking of core samples from surface. (2) Procedure for the repair treatment of core holes. (3) Technical data sheet for the repair material to be used.
Release of Hold Point:	The Principal will consider the submitted documents prior to authorising the release of the Hold Point

The Principal will provide:

(a) a Core Sampling Plan that specifies the number of cores, the Bridge Elements and the locations for the cores;

(b) the required dimensions (i.e. diameter, depth from face) of the cores.

7.2 CORE COLLECTION

7.2.1 General

Take the cores according to the Core Sampling Plan and the required dimensions.

Take the cores at right angles to the face of the surface.

After coring, mark the core hole locations on the element surface using a brightly coloured crayon, to facilitate their identification for later repair treatment of the core holes.

7.2.2 Concrete Surfaces

For concrete surfaces, determine the precise location of each core as accurately as possible based on the Work-As-Executed drawings of the concrete Bridge Element, to ensure a minimum 25 mm clear distance between the core periphery and the nearest (embedded) reinforcing bar.

Where the reinforcement configuration would prevent the taking of cores, obtain direction from the Principal.

Prepare a Work-As-Executed Core Sampling Plan, based on a marked-up copy of the Core Sampling Plan to represent the actual core locations.

7.3 REPAIR TREATMENT OF CORE HOLES - CONCRETE SURFACES

7.3.1 Period to Effect Repair

Repair and restore each core hole within two weeks of taking each core.

7.3.2 Preparation of Core Hole

Locate each core hole by reference to the Work-As-Executed Core Sampling Plan and the crayon markings on the surface of the Bridge Element.

Inspect and clean the core hole to ensure that the core hole and its terminal end are free from accumulated debris or residue from coring, with the aggregate clearly visible in the walls of the hole. Check exposed ends of the core hole for loose or irregular edges and scour the edges smooth as necessary.

If the elapsed time from initial coring to commencing the repair exceeds two weeks, clean the core hole using high pressure water cleaning (or an alternative method approved by the Principal) to remove marine growth.

7.3.3 Repair Material

The material for repairing core holes must be a fast-setting, high early strength, low-shrinkage, non-sag cementitious or epoxy-based repair mortar, of similar density to concrete, that is suitable for plugging holes in an underwater application (including salt water).

Repair material must meet the performance requirements of Table B350.3 and be recommended for the underwater application by the manufacturer.

Repair material must be capable of displacing water with minimal washout and must be resistant to chloride and sulphate attack. When hardened, the material must be no more permeable than the parent concrete.

Repair material must be free of chlorides.

The pot life of the repair material must be between 5 and 15 minutes and must be appropriate for the method of application and the underwater application conditions (e.g. depth).

Provide manufacturer's test certification verifying compliance with the material properties specified in Table B350.3.

Known suitable repair material products are listed in Annexure B350/A5.

Carry out a field trial of the repair material to confirm its suitability for underwater use before it is used in any core hole repair. Alternatively, provide evidence to the Principal of a satisfactory field trial of the repair material on a recent project.

Table B350.3 –Core Hole Repair Materials

Property	Test Method	Minimum Performance Requirements
Compressive Strength	AS 1012.9 BS 6319.2 or approved equivalent	5 MPa at 3 hours 10 MPa at 24 hours 25 MPa at 7 days
Unrestrained Shrinkage	AS 2350.13	500 microstrain at 28 days
Underwater Bond Strength	Direct Tension Test *	0.25 MPa at 24 hours 0.5 MPa at 7 days
Splitting Tensile Strength	AS 1012.10	1.5 – 2.0 MPa at 7 days

* Carry out the Direct Tension Test using a 75 mm x 150 mm cylinder cast in two stages in two materials. Cast the lower half length first, using a concrete material representative of the parent concrete, then cure in fresh water for 7 days. After curing, cast the upper half length using the repair material, while fully submersed in salt water. Cure the completed cylinder, fully submersed in salt water, for another 7 days. Remove the cylinder from water, fix dollies to both ends of the cylinder and test in direct axial tension.

7.3.4 Mixing and Installation of Repair Material

Prepare and mix each batch of repair material above water in accordance with the manufacturer's recommended procedure. Use potable fresh water for mixing cementitious repair materials. Use clean containers for each new batch of repair material. Thoroughly clean containers that contain residues of previously mixed material before using for new mixes.

Carry each batch of mixed material down to the core hole location. Install repair material within the manufacturer's recommended pot life. Do not retemper installed repair material once initial set has occurred. Discard any mixed material that has lost its plasticity or passed the recommended working pot life.

Where the core hole terminates within the Bridge Element (i.e. it is not a through hole), press a small portion of the repair material into the terminal end of the hole and compact it to ensure all edges and

voids are filled. Continue to place, fill and ram repair material in increments of approximately 50 mm along the hole. When the hole is completely filled, hold the installed material in place until initial set has occurred.

For a through hole, insert an initial plug of repair material from one face and then continue to insert and ram additional material into the hole in increments of approximately 50 mm along the hole, until the repair material begins to be ejected from the opposite face. Counter-ram the material at the opposite face and hold both ends in place until initial set has occurred.

Rub off excess material to restore a smooth surface to the Bridge Element. Inspect newly placed repair material 15 minutes after initial set to ensure that there are no gaps or cracks around the core hole perimeter. Where gaps or cracks are observed, immediately remove all newly placed repair material from the core hole, clean the hole and refill the hole with new material.

7.4 REPAIR TREATMENT OF CORE HOLES - METAL SURFACES

Repair and restore each core hole within 1 week of taking each core. The Principal will specify the method of repair treatment for the core holes at the Pre-Tender Meeting.

7.5 CORE HANDLING AND DOCUMENTATION

7.5.1 Core Identification and Registration

Register and identify (by marking and tag/label) each recovered core, showing the following information:

(i) Date cored;

(ii) Bridge name;

(iii) Pier number;

(iv) Pile number;

(v) Face orientation;

(vi) Core location:

- Depth below the pile cap soffit or headstock (piles);
- Location referenced to edges of pile cap face (pile cap).

7.5.2 Core Photographs

Take digital colour photographs of each recovered core that:

(a) are of minimum 10 Megapixel resolution;

(b) are viewed at right angles to the long axis of the core;

(c) show the core fragments laid out in correct orientation alongside a non-reflective metric scale (covering the full length of the core); and

(d) show the core identification details specified above.

7.5.3 Packing and Despatch of Cores

After identification, registration, documentation and photography, carefully pack and despatch the cores to the Principal at the designated address advised by the Principal.

7.5.4 Documentation

Submit a copy of the identification, registration and documentation details, photographs and a Work-As-Executed Core Sampling Plan to the Principal as a supplement to the detailed written logs.

8 INSPECTION REPORTS

8.1 GENERAL

Within four (4) weeks of the completion of the underwater inspection of each bridge, provide a summary inspection report, detailed inspection logs, video camera tapes and all other required information for that bridge to the Principal. This report must include any photos and sketches.

Use the template forms included in Annexure B350/H for reports and detailed logs, unless approved otherwise by the Principal.

Provide reports in the following formats:

(i) One hard copy of the report (neat handwritten format is acceptable), including hard copy photographs;

(ii) Two electronic copies on a CD, one in PDF format and one in MS Word format.

8.2 REPORTS

Address the following aspects in your inspection report:

(a) Water Quality

Describe water quality as either fresh, brackish or saline.

Report the properties of water according to Table B350.2.

(b) Water Visibility

Describe water visibility as either clear, cloudy or visibility nil.

(c) Waterway Bed Conditions (including Debris)

If scour has occurred, record the approximate location, depth, width and length of the scour and the susceptibility of the bed to further scour.

Assess the presence or otherwise of debris in the waterway, its location and size and its possible effect on the bridge.

(d) Comments

General comments are required on any issues peculiar to the bridge, including comments about the overall condition of the structure and the severity of deterioration.

(e) Element Condition

Report the Condition State of Individual Elements according to the TfNSW Bridge Inspection Procedure Manual with an indication of the extent of that condition by defining the unit quantity of the element in each condition (refer Clause 4.2).

Describe Element Codes, Element Units and Condition States for measurement according to Annexures B350/E and B350/F.

(f) Visual Evidence

Provide photographs showing the typical condition of each inspected element with the inspection report.

(g) Sketches

If any significant cracks, exposed reinforcement or spalls are encountered during the visual inspection, submit sketches as part of the report, in support of the detailed written logs. Include the following in the sketches:

(i) Pier number;

(ii) Pile number;

(iii) Crack measurements (width, length and depth) if possible;

(iv) Reference to pile face and depth below long term reference mark for all features, according to the Standard Reference System.

9 WORK OTHER THAN INSPECTION AND SAMPLING

The Principal may from time to time order additional work other than inspection and sampling, such as underwater repair work or work requiring the provision of labour. Payment for such work will be made either under Pay Item B350P8 or as a Variation to the Contract.

ANNEXURE B350/A – PROJECT SPECIFIC REQUIREMENTS

Refer to Clauses 1.2.1 and 1.6.

A1 LIST OF BRIDGES TO BE INSPECTED

Serial	Road No.	Bridge No.	Bridge/Waterway Name	Registered Drawing(s) No.

Note: Extracts from the following bridge drawings listed above are attached, showing the general arrangement plan, the pile layout plan and pile and other substructure details in the waterway area.

A2 OTHER PROJECT SPECIFIC REQUIREMENTS

A3 MAP OF BRIDGES TO BE INSPECTED

A map is attached.

A4 DETAILS OF TRAINING COURSE IN TFNSW BRIDGE INSPECTION PROCEDURE

Details are attached.

A5 REPAIR MATERIALS

Clause	Description	Known Suitable Products
7.3.3	Cementitious core hole repair mortar	EMACO S90 UW

ANNEXURE B350/B – MEASUREMENT AND PAYMENT

Refer to Clause 1.2.2.

Payment is made for all activities associated with completing the work detailed in this Specification in accordance with the following Pay Items.

A lump sum price will not be accepted for schedule of rates pay items.

Pay Item B350P1 - Normal Rate for Diving Team while diving or preparing to dive on site

This schedule of rates pay item covers payment for active work on site by the diving team during normal working hours, according to the following sub pay items (a) and (b). It applies from the time of arrival at the bridge site (usually the Boat Access Point) until the time of departure from the bridge site on each day.

The quantity is the estimated total duration of work at all bridge sites. Separately itemise the breakdown of the estimated duration at each bridge site.

The unit of measurement is per hour (i.e. the hourly rate) for the diving team organisation specified.

The hourly rate must specify, as a note:

- the number of hours per day for which the diving team receives normal rates of pay, i.e. no overtime. This must be specified for:
  - Monday to Friday (not less than 8 hours each day).
- the number of persons in the normal diving team for (a). This must be not less than 4 men.

The above rates include:

(i) Training of personnel in TfNSW Bridge Inspection Procedure Manual (refer Clause 4.2.2);

(ii) All relevant equipment and costs, including major equipment items such as the work boat and cleaning equipment and on-site consumables such as fuel;

(iii) All cleaning, using high-pressure water blasting and hand scraping;

(iv) Provision of a Compression Chamber, when required, including the additional trained person necessary to operate the chamber and all relevant costs;

(v) Establishment and disestablishment costs at each bridge site;

(vi) Diving team accommodation expenses; and

(vii) Provision of voice and video camera communication between the diver and the Diving Supervisor.

This pay item does not include travel time, which is paid under Pay Item B350P3.

(a) Normal Diving Team Rate

The hourly rate including full allowance for the normal diving team and all necessary equipment and resources required.

(b) Additional Diver (Provisional Item)

The hourly rate for each additional diver in excess of (a), if directed by the Principal under Clause 3.1.

Pay Item B350P2 - Overtime Rate for Diving Team while diving or preparing to dive on site

This schedule of rates pay item covers payment for active work on site by the diving team in excess of the normal number of hours of work per day specified under Pay Item B350P1. The sub pay items correspond to those in Pay Item B350P1. It applies from the end of normal working hours at the last bridge site each day until the time of departure from that bridge site.

The quantity is the estimated total duration of overtime work at all bridge sites.

The unit of measurement is per hour (i.e. the hourly rate) for the diving team organisation specified.

This pay item does not include travel time, which is paid under Pay Item B350P3.

(a) Normal Diving Team Rate

The hourly overtime rate including full allowance for the normal diving team and all necessary equipment and resources required (as set out in Pay Item B350P1)

(b) Additional Diver (Provisional Item)

The hourly overtime rate for each additional diver in excess of (a), if directed by the Principal under Clause 3.1.

Pay Item B350P3 - Travel time for Diving Team

This pay item covers payment for travel to, from, or between bridge sites and does not include active work on site which is paid under Pay Items B350P1 and B350P2.

The quantity is the estimated total duration of travel time work for all bridge sites. Separately itemise the breakdown of the estimated duration at each bridge site.

The unit of measurement is per hour (i.e. the hourly rate) for the entire diving team organisation, including any additional divers and all equipment transported.

Pay Item B350P4 - Inspection Reports

This pay item covers payment for producing the written inspection reports according to Clause 8, including provision of high-quality digital colour underwater photographs to supplement the inspection reports in accordance with Clause 4.8.

The unit of measurement is per bridge inspected.

This pay item includes all relevant costs (e.g. to interpret and analyse inspection information, complete proformas, supply an underwater camera with adaptations to improve photographic clarity in turbid conditions, and provide consumables).

Pay Item B350P5 - Water Sampling

This pay item covers payment for collection of water samples at a bridge site and testing of the samples in accordance with Clause 6.

The unit of measurement is per bridge.

This pay item includes all relevant costs (e.g. to supply equipment, prepare and despatch specimens for testing, test specimens and produce test reports).

Pay Item B350P6 - Video Camera Log (Provisional)

This pay item covers payment for the provision of the digital video camera log of the cleaned faces or strips of bridge elements where required according to Clause 4.6.

The unit of measurement is per linear metre of each (cleaned) pile face traversed.

This pay item includes all relevant costs (e.g. to supply video camera with adaptations to improve photographic clarity in turbid conditions, provide consumables, edit and indent video logs).

Pay Item B350P7 - Core Sampling (Provisional)

This pay item covers payment for taking core specimens from concrete or metal surfaces, in accordance with Clause 7, where directed by the Principal. Use the relevant sub pay items (a) and (b).

The unit of measurement is per core successfully taken.

This pay item includes all relevant costs (e.g. to supply equipment, repair core holes, supply repair materials, provide identification marks; document, prepare and package specimens for despatch; and despatch costs).

(a) Concrete Cores

(b) Metal Cores

Pay Item B350P8 - Work Other than Inspection and Sampling (Provisional)

Insert here any items of work, other than inspection and sampling, that may be required. State also the unit of measurement, whether "Lump Sum", "per person-hour" or any other unit of measurement, against each sub-pay item.

This pay item covers the payment for work other than inspection and sampling, where directed by the Principal in accordance with Clause 9. The unit of measurement is as stated above.

ANNEXURE B350/C – SCHEDULES OF HOLD POINTS AND IDENTIFIED RECORDS

Refer to Clause 1.2.3.

C1 SCHEDULE OF HOLD POINTS

Clause	Description
4.1.1	Commencement of underwater inspections
4.1.4	Removal of diving team from each bridge pier or abutment after completion of inspection, prior to redeployment to the next pier or abutment
4.4.4	High-pressure water cleaning of piles (prior to using high-pressure water cleaning in lieu of hand scraping)
7.1	Core sampling and restoration of core holes (concrete or metal surfaces)

C2 SCHEDULE OF IDENTIFIED RECORDS

The records listed below are Identified Records for the purposes of TfNSW Q.

Clause	Description of Identified Record
4.6	Video camera log of cleaned surface or strip
4.7	Detailed written log of cleaned surface or strip
4.8	Photographs
4.9	Girth measurements of timber piles
5	Record of bed levels
6	Water sampling test reports
7.5	Core registration and photographs
8	Inspection Reports on Bridge Elements

ANNEXURE B350/D – PLANNING DOCUMENTS

Refer to Clause 1.3.

The following documents are a summary of documents that must be included in the PROJECT QUALITY PLAN. The requirements of this Specification and others included in the Contract must be reviewed to determine additional documentation requirements.

The information to be submitted as part of the PROJECT QUALITY PLAN includes, but is not limited to, the following:

(a) Details of calibration of diving equipment;

(b) Location and details of Compression Chamber and the trained personnel to operate it.

ANNEXURE B350/E – BRIDGE ELEMENTS

Refer to Clauses 4.2.1 and 8.2.

Use the following Bridge Element codes, descriptions and units in reporting underwater bridge inspections.

Element Code	Description of Element	Units
UCPL	Underwater CPIL - Concrete - Reinforced/Prestressed - Pile	m^2 of exposed surface area
UCPR	Underwater CPIR - Concrete - Reinforced/Prestressed - Pier (excluding any Headstock or Piles)	m^2 of exposed surface area
USDB	Underwater SDBR - Steel - Diaphragm/Bracing/Secondary Member	m^2 of exposed surface area
USPL	Underwater SPIL - Steel – Pile (including steel-cased concrete Pile or Caisson)	m^2 of exposed surface area
USPR	Underwater SPIR - Steel – Pier (excluding any Piles or Secondary Members)	m^2 of exposed surface area
UTPL	Underwater TPIL - Timber – Pile	each
UCAB	Underwater CABW - Concrete - Reinforced/Prestressed - Abutment and Wingwalls	m^2 of exposed surface area
MWWY	Waterway	each

ANNEXURE B350/F – BRIDGE ELEMENT CONDITION STATES

Refer to Clauses 4.2.1 and 8.2.

In accordance with the (latest) TfNSW Bridge Inspection Procedure Manual, Edition 2, June 2007, rate the Bridge Elements according to the following Condition State descriptions in Clauses F.1 to F.5.

The Principal will specify which concrete Bridge Elements are Reinforced Concrete or Prestressed Concrete, if not specified on the Work-As-Executed Drawings.

Cast iron and wrought iron Bridge Elements are to be rated as for steel Bridge Elements.

For underwater steel Bridge Elements, unlike atmospheric steel, no separate Bridge Elements are provided for the protective coating. The condition rating of underwater steel is governed by material and structural issues, not its protective coating, due to the effects of immersion, marine growth and damage from cleaning. In the intertidal zone, breakdown of a protective coating is adequately captured by its material and structural effects.

F.1 Concrete Condition States (Reinforced Concrete)

State 1 The element shows no deterioration. There may be discolouration, efflorescence, and/or superficial cracking.

State 2 Minor cracks and spalls may be present but there is no exposed reinforcement or surface evidence of corrosion of reinforcement.

State 3 Some delaminations, significant cracks or spalls may be present or some reinforcement may be exposed. Corrosion of reinforcement may be present but loss of section is minor and is not sufficient to warrant an analysis to ascertain the impact on the strength and/or serviceability of either the element or the bridge.

State 4 Advanced deterioration. Corrosion of reinforcement and/or loss of concrete section is sufficient to warrant an analysis to ascertain the impact on the strength and/or serviceability of either the element or the bridge.

Note: Excludes concrete culverts.

F.2 Concrete Condition States (Prestressed Concrete)

State 1 The element shows no deterioration. There may be discolouration, efflorescence, and/or superficial cracking.

State 2 Minor cracks and spalls may be present but there is no evidence of corrosion of the non-prestressed reinforcement or deterioration of the prestress system.

State 3 Some delaminations, significant cracks or spalls may be present. There is no evidence of deterioration of the prestress system. Corrosion of non-prestressed reinforcement may be present but loss of section is minor. There is not sufficient concern to warrant an analysis to ascertain the impact on the strength and/or serviceability of either the element or the bridge.

State 4 Delaminations or spalls or cracks or corrosion of non-prestressed reinforcement are prevalent. There may also be exposure and deterioration of the prestress system (manifested by loss of bond, broken strands or wire, corrosion or failed anchorages, etc.).

There is sufficient concern to warrant an analysis to ascertain the impact on the strength and/or serviceability of either the element or the bridge.

F.3 Steel Condition States

State 1 There is no evidence of section loss or damage or cracking.

State 2 Surface rust or minor pitting has formed or is forming. There is no measurable loss of section. There may be minor deformations that do not affect the integrity of the element. There are no cracks in the steel or welds. All bolts and rivets are in sound condition.

State 3 Heavy pitting may be present. Some measurable section loss is present locally, but not critical to structural integrity and/or serviceability of the element. There may be some loose or missing bolts or rivets. Defects have been assessed as not sufficient to impact on the ultimate strength and/or serviceability of the element.

State 4 Section loss is sufficient to warrant analysis to ascertain the impact on the ultimate strength and/or serviceability of either the element or the bridge. There may be cracks and/or deformations in the steel or welds. There may be numerous failed or missing bolts or rivets. Defects may impact on the ultimate strength and/or serviceability of the element.

F.4 Timber Condition States

State 1 The timber is in good condition with no evidence of decay. There may be cracks, splits and checks having no effect on strength or serviceability.

State 2 Minor decay, marine borer infestation, splitting, cracking, checking or crushing may exist but none is sufficiently advanced to affect serviceability.

State 3 Medium decay, marine borer infestation, splitting, cracking or crushing has produced loss of strength of the element but not of a sufficient magnitude to affect the serviceability of the bridge.

State 4 Advanced deterioration. Heavy decay, marine borer infestation, splits, cracks or crushing has produced loss of strength that affects the serviceability of the bridge.

Note: The piles may have a concrete encasement to protect against marine borers. Any deterioration of this protective layer shall be investigated and included in the report.

F.5 Bridge Waterway Condition States

State 1 There is little or no change in the location, shape or level of the channel from the natural or formed channel.

State 2 Sedimentation, vegetation or debris in the channel bed has reduced the waterway through the structure. Minor scour has occurred but it does not threaten to undermine footing(s) or culvert invert slabs or expose piles at pier(s) or abutment(s) or erode the embankment(s).

State 3 General or local scour or lateral erosion has the potential to undermine the footing(s) or culvert invert slabs or expose the piles at pier(s) or abutment(s) or has caused disturbance of embankment material. Sedimentation may have blocked more than 20% and less than 25% of waterway area.

State 4 General or local scour or lateral erosion has undermined the footing(s) or culvert invert slabs or exposed the piles at pier(s) or abutment(s) or has caused loss of embankment or embankment protection material. Sedimentation may have blocked more than 25% of waterway area.

ANNEXURE B350/G – STANDARD REFERENCE SYSTEM FOR PILES

Refer to Clauses 1.4 and 4.1.4.

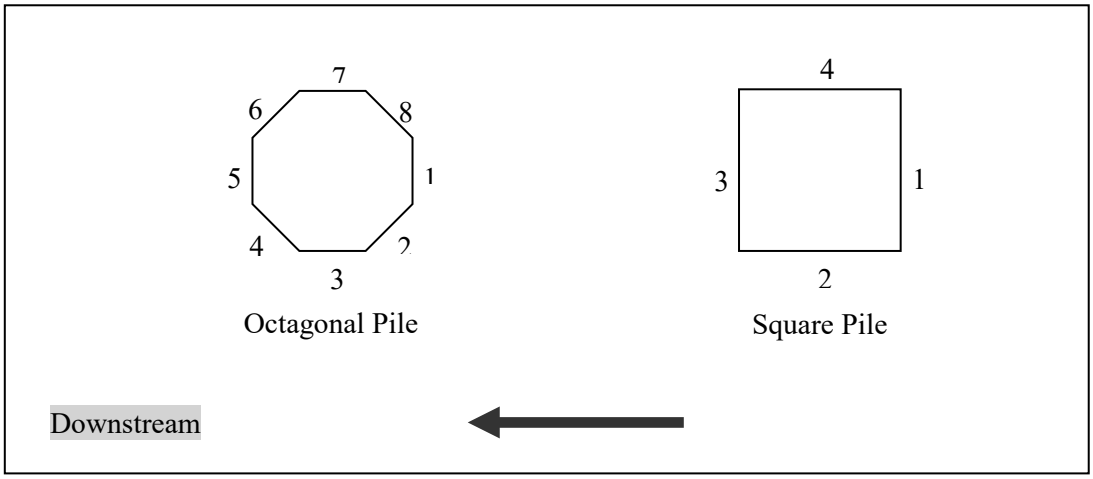

Figure B350/G.1 – Face Numbering

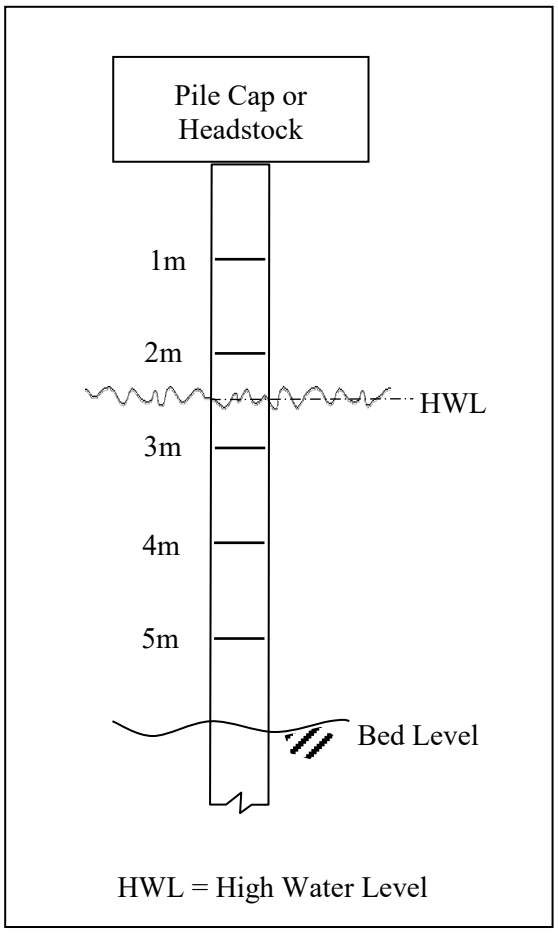

Figure B350/G.2 Depth Markings (from soffit of pile cap/headstock)

ANNEXURE B350/H – INSPECTION FORMS

Refer to Clauses 4.7 and 8.1.

Use the three template proformas shown on the following pages for documenting and reporting the Bridge Element Condition rating and Waterway according to the TfNSW Bridge Inspection Procedure:

(a) Underwater Bridge Inspection – Summary Report For Bridge / Waterway **(Form A)**

(b) Underwater Bridge Inspections – General Inspection Report for Individual Elements **(Form B)**

(c) Underwater Bridge Inspections – Detailed Inspection Report Form (Nominated Piles or Pile Cap Surfaces) **(Form C)**

UNDERWATER BRIDGE INSPECTION - FORM A

SUMMARY REPORT FOR BRIDGE / WATERWAY

Bridge No.:	
Bridge Name / Description:	
Date(s) of Inspection:	
Inspection Conditions:	Est. Water Temp. ……..°C Weather: …… River Flow: ……
Water Quality:	Fresh / Brackish / Saline
Water Visibility:	Clear / Cloudy / Nil Visibility
Waterway Bed Material:	
Waterway Bed Scour: (show bed depths in General Inspection Report for Individual Elements)	
Waterway Bed Debris:	
General Comments: (Underwater Bridge Condition Summary)	

LIST OF ATTACHMENTS

1. Water Test Report
2. General Inspection Report For Individual Elements
3. Detailed Inspection Reports (see General Inspection Report for summary)
4. Video Camera Logs (number of logs attached) .....

Total normal hours worked (team)	**Total overtime hours worked (team)**	**Total hours of travelling to bridge (team)**	**Diving Team Size (persons)**

Dive Team

Diving Supervisor: ……

Lead Diver (underwater): ……

Other(s): ……

……

Signed: …… (Diving Supervisor)

(TfNSW COPYRIGHT AND USE OF THIS DOCUMENT - Refer to the Foreword after the Table of Contents)

UNDERWATER BRIDGE INSPECTION – FORM B

GENERAL INSPECTION REPORT FOR INDIVIDUAL ELEMENTS

Bridge Name: ……..…….. **Bridge No:** .....

Abutment or Pier No.	**Element or Pile No.**	**Element Code** (refer Annexure B350/E)	**Bed Depth below nominated reference** (refer Clause 5)	**Nominated for Detailed Inspection?** (Yes/No)	**Detailed Inspection Reports** (No. Pages attached)	**Video Camera Log of Cleaned Surfaces?** (Yes/No)	**Comments on Element Condition** *(Mandatory for Individual Elements not nominated for detailed inspection. All Individual Elements on the bridge must be accounted for as line entries on this form, and more than one page may be required)*

Page …….. of …….

UNDERWATER BRIDGE INSPECTION - FORM C

DETAILED INSPECTION REPORT (NOMINATED PILES or PILE CAP SURFACES)

(includes Condition Rating and Written Log for Single Cleaned Face or Strip)

Bridge Name: …… **Bridge No:** .....

Pier/Abutment No. .....Element No. . . .. Cleaning Method: High-pressure water / Hand scraping

Element Code & Type: .....

Total quantity & unit for element: .....

A. CONDITION RATING

Condition State	Estimated quantity in Condition State	Remarks
1		
2		
3		
4		
Total		

B. DETAILED WRITTEN LOG FOR CLEANED FACE OR STRIP

Depth reference: .....

Depth below reference (m)	Description of Defect or Condition	Condition State
0.5		
1.0		
1.5		
2.0		
2.5		
3.0		
3.5		
4.0		
4.5		
5.0		
5.5		
6.0		
6.5		
7.0		
7.5		
8.0		

ANNEXURE B350/I – WORKCOVER NSW GUIDELINES FOR PERSONS ENGAGED IN DIVING WORK WITHIN NSW

Refer to Clause 1.4 and 3.

WORKCOVER NSW
GUIDELINES FOR PERSONS ENGAGED IN DIVING WORK WITHIN NSW (VERSION: JANUARY 2008)

SCOPE

These guidelines apply when diving work is carried out within New South Wales waters.

Nothing in these guidelines shall be construed to waive or modify any obligation imposed pursuant to the Occupational Health and Safety Act 2000 or the Occupational Health and Safety Regulation 2001.

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FOREWORD

The success of any diving operation is directly related to careful and thorough planning.

The nature of each operation will determine the scope of the planning effort, but certain considerations will apply to every operation.

The following guidelines have been prepared to assist Diving Supervisors in the planning and conduct of diving operations within the State of New South Wales.

DEFINITIONS

In these guidelines, unless the context's subject matter otherwise requires:

"**Approved**" means approved by WorkCover through compliance with the Occupational Health & Safety Regulation 2001.

"**Dive Control Position**" means a single, designated location, which shall be adjacent to where a diver enters the water and from which the Diving Supervisor can supervise, monitor and control all systems and functions which relate to the life support and safety of a diver in the water.

When Divers are operating on float-lines, the Dive Control Position shall be in the safety boat tending the divers.

"**Diving Work**" means work in which diving is conducted using underwater breathing apparatus and includes work by the dive team in direct support of the diver but does not include diving undertaken solely for personal enjoyment at the time of the activity (without gain or financial compensation).

"**Plant**" includes any machinery, equipment and appliance.

PERSONNEL FOR DIVING OPERATIONS

At every diving operation, unless otherwise approved, the following persons shall be present:

(a) A supervisor

(b) A standby diver

(c) A diver's attendant

(d) A diver

The Supervisor may act as the diver's attendant, but shall not be nominated as the diver or standby diver. **(Documented Risk Assessment is required to justify less than 4 person dive team).**

QUALIFICATIONS OF PERSONNEL

(a) Diver

A person shall not be a diver unless that person:

(a) Is at least 18 years of age

(b) Has been certified as medically fit to dive in compliance with Appendix L of Standard AS/NZS2299.1 "Occupational Diving Operations," and

(c) Is in possession of the appropriate Certificate of Competency as a Diver issued by ADAS (The Australian Diver Accreditation Scheme).

(b) Diver's Attendant

A person shall not be a diver's attendant unless that person:

(a) Is at least 18 years of age; and

(b) Has sufficient knowledge of:

(i) Underwater work;

(ii) The signals and communication devices used in diving operations;

(iii) First aid; and

(iv) Equipment used in diving operations.

(c) Stand-By Diver

A person shall not be a stand-by diver unless that person:

(a) Is in possession of the appropriate Certificate of Competency as a Diver;

(b) Has been certified as medically fit to dive; and

(c) Has an approved level of competence in the rescue and treatment of another diver in an emergency situation.

(d) Diving Supervisor

1. A person shall not be a Diving Supervisor unless that person:

(a) Is trained and experienced in diving and in the use of plant and procedures associated with diving work;

(b) Is, or has been, a competent diver with adequate knowledge and experience of the diving techniques being used;

(c) Has been appointed in writing by that person's employer to supervise diving work; and

(d) *Is in possession of the appropriate Certificate of Competency as a Diving Supervisor ADAS (Australian Diving Accreditation Scheme).*

AS/NZS 2299.1:2007 should now be implemented as standard industry practice; pending the review of the Occupational Health and Safety Regulation 2001

2. A person shall not be appointed a Diving Supervisor unless that person has an approved level of competence in general and under- water medical first-aid treatment; such as

(a) Holds a current recognised first-aid certificate; and

(b) Has gained sufficient competence:

(i) To diagnose and render first-aid treatment for barotrauma, decompression sickness, gas toxicity, hypoxia and anoxia;

(ii) In the application of expired air resuscitation, external cardiac message and the use of mechanical aids to resuscitation; and

(iii) In the use of restrictive bandages and the treatment of wounds.

OPERATING REQUIREMENTS

MANNING LEVELS

1. At all times when any diving work is or is about to be carried out there shall be present a sufficient number of divers and other competent persons to ensure so far as is reasonably practicable that the work can be undertaken safely, and to operate all plant necessary for the safe conduct of the work.

2. Unless otherwise approved, diving work shall not be carried out unless, during the period when a diver is in the water, there are present and engaged in that work at least three persons – one Diving Supervisor / Attendant with two divers. At all times during the diving work these persons shall be readily available to assist in that work.

3. (a) In every diving operation one member of the diving team who is a diver, other than the Diving Supervisor of that operation, shall be the stand-by diver.

   (b) Unless otherwise approved, the stand-by diver shall be at all times in the immediate vicinity of the dive control position and is ready to dive immediately as required but may perform duties which do not prejudice the safety of any diver in the water.

4. Where two divers are in the water at the same time one may act as stand-by diver for the other provided that no decompression is required following the dive and that both divers have:

   (a) At all times, visual contact with each other.

   (b) Means to communicate with the surface and

   (c) Independent breathing medium supplies, or an air receiver of sufficient capacity to support the two divers for the duration of the dive.

5. Nothing shall prevent the stand-by diver or any other diver, if instructed to do so by the Diving Supervisor, from going to the assistance of any other diver in an emergency.

6. When diving operations require the use of a Compression Chamber there shall be present an additional person trained to operate the chamber control panel under the direct supervision of the Diving Supervisor.

PLACE FROM WHICH DIVING IS ALLOWED

Diving operations shall be conducted only from a platform or vessel:

(a) That is safe and suitable for the purpose;

(b) On which the equipment necessary for the diving operations is kept; and

(c) That has suitable and safe means of access to and egress from the water for both the working diver and any rescue or stand-by diver in an emergency.

DECOMPRESSION SCHEDULES

Diving work shall not be carried out unless the decompression schedule that is used in that work conforms to Australian Standard AS/NZS 2299.1 – “Occupational Diving” and used in accordance with the instructions therein.

BREATHING MEDIUM QUALITY

Compressed air for breathing supplied by an air compressor shall not be used in diving work unless, within the period of three months proceeding that work, the compressed air delivered by the compressor has undergone a test that has shown that the compressed air satisfied the standard referred to in Standard AS/NZS 2299.1 "Occupational Diving".

SUITABILITY OF PLANT

All plant used in diving operations shall be:

(a) Properly designed in accordance with recognised codes of construction;

(b) Be suitable and safe for the conditions in which it is intended to be used;

(c) Be properly maintained and comply with the requirements of Standard AS/NZS 2299.1 "Occupational Diving"; and

(d) Where its safe use depends on the depth or pressure at which it is used, it is marked with the safe working pressure or the maximum depth at which it may be used.

ADDITIONAL REQUIREMENTS FOR PLANT

1. The diving plant and equipment shall:
   - (a) Include a lifeline for each diver except where the nature of the diving operations renders a lifeline unsuitable, in which case an approved alternative system for ensuring the diver's safety is to be used;
   - (b) Include a system enabling oral and/or manual means of communication to be carried out between the diver and the Diving Supervisor.
   - (c) Where lifting and handling equipment used in connection with diving work, comply with the requirements of the Occupational Health and Safety Regulation 2001, eg. Rigging and dogging.
   - (d) Where diving work is carried out at a depth exceeding 30 metres, unless otherwise approved, include a surface Compression Chamber with all necessary ancillary equipment. The chamber and equipment shall comply with the requirements of Australian Standard AS/NZS 2299.1: 2007.
   - (e) Where environmental conditions dictate, include an adequate means by which a diver can be maintained at a safe temperature.
   - (f) Include minimum first-aid equipment as detailed in the Regulations;
   - (g) Include for use by a diver during diving operations:
     - (i) A knife to be carried in an accessible position at all times whilst diving;
     - (ii) A weight belt, which shall be of the quick-release type;
     - (iii) A bailout cylinder to be worn by the diver, the capacity of which cylinder shall be such as to allow the diver to swim in an emergency, the maximum possible excursion distance to the surface.
     - (iv) A harness to secure the air supply hose and the equipment to the diver

2. Where the nature of the diving operation renders a shot-line unsuitable, an approved alternative system for ensuring the diver's safety shall be used.

SELF CONTAINED UNDERWATER BREATHING APPARATUS (SCUBA)

1. No diving operation shall be carried out with the use of Self Contained Underwater Breathing Apparatus:
   (a) In the performance of any work which involves the use of any crane, hoist, scaffolding, or explosives, or any plant other than diving equipment;
   (b) In any circumstances where prolonged physical exertion is required of the diver; and
   (c) In any circumstances where a direct ascent to the surface could not be carried out by the diver in an emergency.

2. Self Contained Breathing Underwater Apparatus may be used for the following or similar types of work providing that the Regulations are complied with in all respects:
   (a) Inspection of construction work;
   (b) Sea-bed searches;
   (c) Underwater survey.

AIR SUPPLY EQUIPMENT

1. Compressed air for breathing supplied by an air compressor shall not be used in diving operations unless:
   (a) There is connected to the system supplying air from the compressor to the diver a pressure volume tank, water and oil filter and a carbon monoxide filter (where practicable); and
   (b) The air intake from the compressor is located in a position in which it will not be affected by exhaust gases and in which it will take in only uncontaminated fresh air.

2. A cylinder filled with compressed air shall not be used in diving operations unless:
   (a) It has been filled with and contains after filling only compressed air satisfying the requirements of Standard AS/NZS 2299.1: 2007.
   (b) Suitable procedures, which comply with the requirements of Australian Standard AS 2030, were used for the filling, gas testing, maintenance, storage and transport of the cylinder.

SURFACE SUPPLY AIR HOSES

1. A hose shall not be used in diving operations for the conveyance of compressed air at a pressure exceeding one quarter of the burst pressure as specified in sub-clause (2).

2. The burst pressure of a hose shall be defined as the pressure at which that hose, or another hose similar in all aspects of it, has burst when tested at ambient temperature.

3. A hose shall not be used in diving operations for the conveyance of compressed air unless:
   (a) It has been tested not more than 12 months prior to those operations at a pressure equal to 1.5 times its maximum expected operating pressure;

(b) It is kink resistant;

(c) It is capable of carrying the compressed air at a flow rate required in the operations;

(d) The hose and its couplings are in alignment;

(e) The couplings are not scoured or substantially corroded;

(f) The couplings contain no damaged threads;

(g) The hose fittings are made of brass, stainless steel, monel metal or other non-corrosive material;

(h) The fittings connecting the hose with other hoses or to the plant or equipment are incapable of accidental disengagement or loosening; and

(i) It is, where practicable, of such diameter and has such type of connection as will minimise the incorrect connecting of hoses and fittings.

BREATHING MEDIUM SUPPLY

1. Diving operations shall not be carried out unless there is provided:

   (a) A pressure reducing regulator to control the pressure at which compressed air is supplied to the diver from the cylinder; and

   (b) A means to allow ready changeover to an alternative pressure reducing regulator or an alternative compressed air supply in case of failure of the primary pressure reducing regulator or the primary compressed air supply.

PRESSURE MEASURING EQUIPMENT

1. Diving work in which surface supply breathing equipment is used shall not be carried out unless they use in that work:

   (a) Equipment to enable a person on the surface to ascertain, at all times during which a diver is submerged, the depth of the diver;

   (b) A gauge to enable a person on the surface to ascertain the pressure at which compressed air is supplied from on-line compressors or cylinder.

   (c) A gauge to enable a person on the surface to ascertain the pressure at which the compressed air is supplied to the diver; and

2. Where a surface Compression Chamber is used, pressure measurement equipment and gauges as indicated in Standard AS/NZS 2299.1: 2007.

DIVING OPERATIONS OUTSIDE THE SCOPE OF AS/NZS 2299.1

When carrying out diving work outside the scope of AS/NZS 2299.1 such as mixed gas including NITROX with greater than 22% Oxygen, or saturation diving, the Offshore Petroleum Act 2006 and Commonwealth Petroleum Submerged Lands (Diving Safety) Regulation 2002 and associated guide lines should be used as a guide to the safe conduct of diving operations.

These can be found at http://www.nopsa.gov.au/diving.asp

The use of SNORKEL DIVING based on a RISK Assessment could only occur for INSPECTION purposes with direct and immediate access to the surface.

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ANNEXURES B350/J TO B350/L – (NOT USED)

ANNEXURE B350/M – REFERENCED DOCUMENTS AND ABBREVIATIONS

M1 REFERENCED DOCUMENTS

Refer to Clause 1.2.4.

TfNSW Specifications

TfNSW Q	Quality Management System

TfNSW References

TfNSW Bridge Inspection Procedure Manual, Edition 2, June 2007

NSW Government

Work Health and Safety Act 2011

Australian Standards

AS 1012	Methods of testing concrete
AS 1012.9	Determination of the compressive strength of concrete specimens
AS 1012.10	Determination of indirect tensile strength of concrete cylinders ('Brazil' or splitting test)
AS 2030	The verification, filling, inspection, testing and maintenance of cylinders for storage and transport of compressed gases
AS/NZS 2299.1	Occupational diving operations – Standard operational practice
AS 2350.13	Methods of testing Portland, blended and masonry cements - Determination of drying shrinkage of cement mortars

British Standards

BS 6319.2	Testing of resin and polymer/cement compositions for use in construction. Method for measurement of compressive strength

M2 ABBREVIATIONS

APHA: American Public Health Association

WAE: Work-As-Executed