Bridges, geotechnical structures and other significant highway structures inspection policy

1 Introduction

This policy document sets out the requirements for the inspection of bridges, geotechnical structures and other significant highway structures on the state highway network including the structural aspects of tunnels. Note that the requirements for the inspection of mechanical and electrical (M&E) equipment and building elements in tunnels are covered by NZTA S8 *Tunnels management and inspection policy*[1].

2 Definition of structures

"Bridge" shall include all structures which directly support vehicle traffic, including culverts and multiple culverts with a total waterway area greater than 3.4m², critical small culverts with a total waterway area less than or equal to 3.4m² and all stock underpasses and pedestrian subways.

"Geotechnical structures" shall include structures within the state highway corridor meeting the following criteria:

- soil structures as defined in *Bridge manual*[2], but excluding unreinforced slopes and embankments (unless supported by ground treatment/improvement works)
- retaining structures ≤1.5m within 1m of the road edge line
- rockfall and slope debris control structures
- slope works, including drainage, required to achieve and maintain slope stability.

"Other significant highway structures" shall include highway structures within the state highway corridor meeting any of the following criteria:

- highway structures where public safety or critical network function is likely to be significantly affected in the event of failure, irrespective of ownership
- highway structures of high value
- highway structures requiring specialised engineering inspection.

Examples of other significant highway structures that meet the above criteria:

- retaining walls >1.5m high
- footbridges/cycle bridges
- redundant bridges (accessible)
- large drainage structures
- large cantilever and gantry signs/signals
- non-road bridges within the road corridor
- tunnels
- noise walls
- slope protection works
- critical river protection works
- major coastal protection works
- critical small culverts
- large stabilised slopes/batters
- large lighting masts
- CCTV masts

For tunnels, the scope of inspections shall include all structural parts of the tunnel including portals, structural linings, suspended ceilings, cladding panels and

ventilation shafts and associated civil structures including water and detention tanks. The inspection of building elements of tunnels such as stairs, walkways, roofs and doors and associated control buildings, such as tunnel control rooms and maintenance depots, are covered by NZTA S8[1].

The Transport Agency's *Highway structures information management system* (HSIMS) asset database for bridges and other significant highway structures shall be maintained by the Structure Inspection Engineer. Any changes to HSIMS shall be agreed with the Principal (the NZ Transport Agency's Project Manager or their agent) or the Tunnel Manager where applicable. (The role of Tunnel Manager is defined in NZTA S8[1].)

3 Standard of structure inspection

The standard to which inspections shall be carried out is defined in the publication *Inspection manual for highway structures*[3]. This manual shall be adopted for highway structure inspections except as modified by this policy. Where there is conflict between the manual and policy, the policy shall take precedence. All references in the manual to "Supervising Engineer" and "Inspector" shall be read as "Structure Inspection Engineer" and "Structure Inspector" respectively.

Further guidance that is more specific to tunnels can be found in FHWA-HIF-15-005 *Tunnel operations, maintenance, inspection, and evaluation (TOMIE) manual*[4], BD 53 *Inspection and records for road tunnels*[5] and BA 72 *Maintenance of road tunnels*[6].

4 Responsibilities for structure inspection

4.1 Routine surveillance inspections

These must be carried out by staff who are competent to identify and report on superficial faults that occur. They must be personnel with either at least five years of experience in the maintenance of highway structures or with relevant qualifications.

4.2 General, principal and special inspections

These must be carried out under the control of the Structure Inspection Engineer.

4.2.1 For each of the NZ Transport Agency's bridges and other structures management contracts an individual must be designated the Structure Inspection Engineer. If the Structure Inspection Engineer does not have geotechnical competencies, then a Geotechnical Structure Inspection Engineer shall be designated for any geotechnical structure inspections. (For simplicity throughout this specification, all instances of 'Structure Inspection Engineer' shall be considered as 'Structure Inspection Engineer or Geotechnical Structure Inspection Engineer as relevant for the type of structure under consideration'.)

The Structure Inspection Engineer must have experience of the construction, inspection and maintenance of structures or geotechnical structures, and must be able to interpret condition in terms of structural action. As a minimum, the Structure Inspection Engineer

must be a Chartered Professional Engineer (CPEng or equivalent) with at least 10 years of relevant experience.

The Structure Inspection Engineer shall:

(a) maintain overall management and technical supervision of the structure inspection and maintenance programme for those structures scheduled by the Principal

(b) take responsibility for the technical competence of all personnel involved in inspections

(c) take responsibility for the structural safety of all structures advised by the Principal

(d) take responsibility for consulting with specialist staff when necessary

(e) ensure that the schedule of structures and the inspection requirements are appropriate and comply with this policy

(f) either review or appoint a Design Engineer to review all inspection reports

(g) approve all inspection reports

(h) undertake an on-site review and reconciliation of at least three general inspection reports and at least three principal inspection reports (where these are undertaken) representative of the inspections being carried out by each inspector in that year (but no less than a total of 2% of all structures in the annual inspection programme) for each inspector annually unless agreed otherwise with the NZ Transport Agency's Lead Advisor Structures. A summary of the results of all reviews shall be submitted to the Principal.

4.2.2 Other personnel who shall undertake inspections are defined as follows:

(a) Structure Inspector

A Structure Inspector must be experienced in construction, inspection and maintenance of bridges, geotechnical structures and other significant highway structures (as relevant with sufficient competencies). A Structure Inspector must be either a professional engineer or a person who, from extensive practical experience, is competent to judge the condition of structures. A Structure Inspector must have a minimum of five years of relevant inspection experience relevant to the structure type, and/or have been assessed through audit by the Structure Inspection Engineer of actual inspections, as having commensurate knowledge and skills.

Structure Inspectors must also have completed a NZ Transport Agency endorsed inspection training course unless agreed otherwise by the NZ Transport Agency's Lead Advisor Structures or Lead Advisor Geotechnical for geotechnical structures.

(b) Specialist staff

(i) Design Engineer

A Design Engineer who is responsible for inspection must have at least five years' experience in the design of bridges, geotechnical structures and other significant highway structures (as relevant with sufficient competencies), and must be able to interpret observations in terms of structural action.

(ii) Other specialist staff

In any situation where identification of faults in the particular material or structure is considered by the Structure Inspection Engineer to be outside the competence of the normal inspection staff, a specialist must be engaged to advise them. Specialist staff must be used for the following situations, but shall not be limited to them:

- structures showing significant deterioration of structural steel members and fixings (cracking, corrosion, distortion), or significant breakdown of protective coatings
- structures showing significant decay of timber members
- structures showing alkali/aggregate reaction, chloride attack, spalling of concrete, corrosion of concrete reinforcement, or other concrete defects
- structures which incorporate uncommon materials, such as fibre composite materials
- geotechnical structures requiring roped or other specialist access (suppliers shall be agreed with the principal).

5 Categories and frequencies of inspection

The various categories of inspection and the frequency with which they are to be undertaken for bridges, other significant highway structures, tunnels structures and geotechnical structures specifically are listed in tables 1, 2, 3 and 4 respectively in appendix A, and described below. Where specific personnel are referred to, they shall be as defined in section 4. For the purposes of scheduling inspections, general inspections shall substitute for routine surveillance inspections and principal inspections shall substitute for general inspections.

The frequency of general and principal inspections for certain types of other significant highway structures detailed in table 2 may be reduced. The frequency of these inspections shall be determined through risk analysis and agreed between the Structure Inspection Engineer and the Principal and shall be documented in HSIMS. Suitable guidance for determining which structures can have reduced inspection frequencies can be obtained from chapter 8 of BD 63 *Inspection of highway structures*[7].

The inspection frequency for the other significant highway structures detailed in table 2 must not be reduced if they display any of the following attributes:

- located in a severe (marine) environment
- at moderate/high risk of scour
- at moderate/high risk of flooding
- structure is substandard under load assessment
- condition is poor or unknown
- signs of concrete deterioration (eg alkali aggregate reaction, chloride attack)
- collapse of the structure would affect a railway
- noise walls that are subject to fatigue
- structures with fire hazards or a history or evidence of fire damage.

5.1 Routine surveillance inspection

Routine surveillance inspections shall be carried out in accordance with the relevant requirements of the *Inspection manual for highway structures*[3] and *State highway maintenance contract proforma manual* (SM032)[8]. The inspections shall identify any obvious defect which may affect the safety of highway users or anything else needing urgent attention, such as those items listed below:

- impact damage from vehicles, especially to structural elements, guardrails and handrails
- build-up of flood debris
- adequacy of signs and road marking
- erosion damage
- deck drainage function
- road settlement in tunnels or on bridge approaches and condition of road and deck surfacing
- expansion joint function
- water seepage in tunnels
- movement or cracking of bridge substructures, retaining walls, tunnel lining and tunnel portal walls
- structures involved in a major accident, chemical spillage or fire.

Significant defects must be reported immediately to the Structure Inspection Engineer.

5.2 General inspection

The procedures required are described in *Inspection manual for highway structures*[3]. During a general inspection, personnel shall verify that the descriptive data recorded for each highway structure in HSIMS is correct, or note any necessary changes.

For highway structures which have no history of maintenance problems and are considered by the Structure Inspection Engineer to present no specific difficulty, the inspection may be carried out by a Structure Inspector.

Where a need is identified by the Structure Inspection Engineer, the inspection shall be carried out by a Structure Inspector and/or a Design Engineer or other specialist staff as the Structure Inspection Engineer may direct.

5.3 Principal inspection

The purpose of a principal inspection is to provide specific information on the physical condition of all inspectable parts of a structure. It is more comprehensive than a general inspection.

The procedures described in *Inspection manual for highway structures*[3] shall be followed. The inspection shall be carried out at close quarters of all inspectable parts of the structure, and include adjacent earthworks and waterways where they may affect the behaviour or stability of the structure.

'Close-quarter' is defined as a distance close enough to determine the condition of the element. This is typically within 3m of the element. Where it is not possible to inspect all elements at close quarters and where 'special access' equipment is not specified, a representative portion of all elements, as determined appropriate by the Structure Inspection Engineer, shall be inspected at close quarters and the condition of the remaining elements shall be visually compared (using binoculars or other optical equipment) to the close-quarter inspected elements. Elements not inspected within close quarters must be inspected at close quarters (ie within 3m) during the subsequent principal inspection.

The inspection shall utilise as necessary suitable inspection techniques such as hammer tapping to ensure the visual interpretation reflects the actual condition.

Where specific access requirements or features requiring specific or unusual inspection or specialist staff are identified, they shall be recorded as a 'principal inspection – specific access or specialist inspector' in HSIMS. Such structures are likely to have one or more of the following features or conditions (noting that this list is not exhaustive):

- bridge inspection (underbridge) vehicles, elevated work platforms or specialised industrial rope access are required to achieve close-quarter inspection
- confined space entry is required to enter structures such as box girders and culverts
- the bridge soffit from ground or water level is greater than 6m in height
- the structure crosses or is adjacent to a third party's property or asset that makes access to the structure difficult (eg bridges over railway lines)
- boat access is required to inspect sub or superstructure elements in close quarters
- very high retaining walls (>6m)
- there are components requiring specialist inspection.

The Structure Inspection Engineer upon agreement from the Principal may use alternative means of access for areas of difficult or dangerous access, eg obscured parts of a structure and/or confined spaces. See section 7 for more details.

5.4 Special inspection

The procedures required are described in *Inspection manual for highway structures*[3]. Special inspections involve particular types of structure or particular circumstances. The Structure Inspection Engineer shall identify structures requiring special inspections, document them as such in HSIMS and maintain a schedule of structures requiring regular special inspections, which define the specific inspection requirements including frequency and access requirements.

5.4.1 Acceptance inspection

The purpose of these inspections is to provide a formal mechanism for recording and agreeing the current status of or outstanding work required to a structure prior to changeover of responsibility. Typical examples are for pre-opening, the end of a defect liabilities period, transfer and handback inspections.

It is good practice to programme the inspection one month prior to changeover of responsibility and whenever possible the opportunity to make use of existing access arrangements shall be utilised.

The criteria and the extent of the inspection shall be as agreed between the Structure Inspection Engineer and the Principal.

5.4.2 Posted bridge inspection

This is for posted bridges, including those with limits for 50MAX and HPMV, and for those which have been identified as able to operate without a posted restriction, but at a stress level or load factor other than the standard values specified in the *Bridge manual*[2]. It shall be undertaken at a frequency to be determined by the Structure Inspection Engineer.

The inspection shall include close-quarter observation of locations likely to sustain damage under traffic overload. Any deterioration in such locations shall be noted.

The inspection shall be carried out by a Structure Inspector and/or such other specialist staff as the Structure Inspection Engineer may direct.

5.4.3 Evaluation inspection

The information gathered during this inspection is used to inform a load capacity evaluation of a bridge. The Structure Inspection Engineer and/or the Design Engineer must undertake the close-quarter inspection.

The dimensions of as-built drawings shall be verified, or in the absence of as-built drawings, sufficient dimensions must be captured to develop basic structural sketches. Along with verifying structural

geometry, any section loss or material degradation, which may affect the load capacity, shall also be recorded.

5.4.4 Bailey bridge inspection

This is in addition to the general inspection, and shall be carried out annually by the Transport Agency's Bailey bridge contractor.

The inspection shall be carried out in accordance with appendix B and the SM061 *Bailey bridge manual*[9].

The Structure Inspection Engineer shall liaise with the Principal to agree responsibilities for inspection.

5.4.5 Large or complex structure inspection

For large or complex structures, where unusual elements or load paths exist the Structure Inspection Engineer and/or the Design Engineer with relevant competencies must undertake the close-quarter inspection. Such structures may have one or more of the following features:

- high skew
- unconventional or novel design
- half or hinge joints
- segmental post-tensioned bridges
- box girder structures
- structures with very long spans
- movable bridges
- suspension systems
- movable inspection gantries.

These special inspections may complement general or principal inspections.

5.4.6 Earthquake event inspection

This shall be carried out following an earthquake which is likely to have caused damage to structures in the affected area. The inspection shall be carried out as for a general inspection, on those structure members susceptible to earthquake damage.

The criteria and the extent of the inspection shall be agreed between the Structure Inspection Engineer and the Principal.

The inspection shall be carried out by a Structure Inspector and/or such other specialist staff as the Structure Inspection Engineer may direct.

For geotechnical structures the use of drones and other aerial devices maybe used subject to prior agreement with the NZ Transport Agency's Lead Advisor Geotechnical.

5.4.7 Flood event inspection

This shall be carried out following a flood which is likely to have caused damage to structures at sites known to have a history of instability or are likely to have been at significant risk. The criteria and the extent of the inspection shall be agreed between the Structure Inspection Engineer and the Principal.

The inspection shall be as for a general inspection of the waterway and all members susceptible to flood damage.

The inspection shall be carried out by a Structure Inspector and/or such other specialist staff as the Structure Inspection Engineer may direct.

The Structure Inspection Engineer shall maintain details of structures with known significant waterway vulnerabilities requiring flood event inspections in HSIMS.

5.4.8 Fire or chemical spillage inspection

This shall be carried out on any structure that has been involved in a fire or chemical spillage. The criteria and the extent of the inspection shall be agreed between the Structure Inspection Engineer and the Principal.

5.4.9 Overload damage inspection

This shall be carried out on any bridge during passage of an overload vehicle which may cause damage to the structure. It shall also be carried out on any bridge where it is known or suspected that an illegal overload vehicle has caused damage to the structure. The criteria and the extent of the inspection shall be as agreed between the Structure Inspection Engineer and the Principal.

The inspection shall concentrate on those members susceptible to damage by traffic overload.

The inspection shall be carried out by a Structure Inspector and/or such other specialist staff as the Structure Inspection Engineer may direct.

5.4.10 Vulnerable structure inspection

This is required for structures and structure types which are known from previous performance to be at higher than normal risk of failure, that have known potential structural defects, or require specialist inspection, where the frequency or the scope of the general or principal inspections are not appropriate.

Examples:

- steel structures susceptible to fatigue
- timber bridges with decay
- bridges with foundation scour or shallow foundations
- concrete structures with corroded reinforcement

- concrete structures in a saline wetting/drying environment that have been identified as potentially having excessive chloride contamination.

The Structure Inspection Engineer shall prepare a specific inspection brief outlining the inspection requirements. The inspection shall be carried out by the Structure Inspection Engineer and/or the Design Engineer. The Structure Inspection Engineer shall maintain details of structures requiring a vulnerable structures inspection in HSIMS.

5.4.11 Inspection of structure with uncommon materials

This is required for structures that incorporate uncommon materials, such as laminated timber or fibre composite materials, where specialist knowledge and experience of those materials and mechanisms of deterioration is required. The inspection shall be carried out by a Design Engineer and/or such other specialist staff as the Structure Inspection Engineer may direct.

5.4.12 Tunnel structure inspection

The Structure Inspection Engineer shall develop specific special inspection procedures appropriate to each tunnel, outlining the scope and frequency of the inspections and the personnel required. These procedures shall be agreed with the Principal and Tunnel Manager and shall be updated as necessary to ensure that the special inspections continue to be appropriate to maintain the tunnel in a safe condition.

A special inspection shall be carried out:

(a) to investigate a specific problem, either found during an inspection or known to have occurred on other similar road tunnels

(b) if subsidence occurs

(c) if settlement, heave, movement or deflection occurs greater than that which has been allowed for in the design, or signs of distress are observed. Steps shall be taken to monitor the rate of any settlement etc and to assess the urgency of any remedial measures required

(d) after flooding

(e) after a major accident or a fire within or adjacent to the road tunnel to investigate possible damage to the tunnel

(f) following an earthquake which is likely to have caused damage to any tunnels in the affected area. The inspection shall be carried out as for a general inspection, on those tunnel elements susceptible to earthquake damage.

The criteria and the extent of the inspection shall be agreed between the Structure Inspection Engineer and the Tunnel Manager.

6 Reporting

6.1 Bridge inspection

Each inspection shall be reported on the bridge inspection report (refer to appendix C for the pro forma), accompanied by a written engineering report as necessary to describe specific defects. Maintenance work, further detailed investigation or changes to the inspection regime shall be recommended as appropriate.

Where a posted bridge, or bridge which operates at a stress level or load factor other than the standard values specified in the *Bridge manual*[2], shows deterioration, the report shall make recommendations on action needed, taking account of previous reports and current condition.

Each report and recommendations must be sent to the Principal.

If the results of any inspection show that emergency action is required to temporarily strengthen or to close a bridge or perform any other work, the Structure Inspection Engineer must immediately advise the Principal, who shall implement appropriate action as necessary.

6.2 Geotechnical structures inspection

Each inspection shall be reported on the inspection report adapted for the specific structure in a format agreed with the NZ Transport Agency's Lead Advisor Geotechnical (refer to appendix C for the pro forma example for rockfall and debris protection structure), accompanied by a written engineering report as necessary to describe specific defects. Maintenance work, further detailed investigation or changes to the inspection regime shall be recommended as appropriate.

Each report and recommendations must be sent to the Principal.

If the results of any inspection show that emergency action is required, the Structure Inspection Engineer must immediately advise the Principal, who shall implement appropriate action as necessary.

6.3 Other significant highway structures inspection

Each inspection shall be reported on an inspection report adapted to the specific structure configuration as appropriate (refer to appendix C for examples for retaining walls and large cantilever and gantry signs/signals), accompanied by a written engineering report as necessary to describe specific defects. Maintenance work, further detailed investigation or changes to the inspection regime shall be recommended as appropriate.

Each report and recommendations must be sent to the Principal and Tunnel Manager, if applicable.

If the results of any inspection show that emergency action is required, the Structure Inspection Engineer must immediately advise the Principal and Tunnel Manager, if applicable, who shall implement appropriate action as necessary.

6.4 Structures database

Changes required to the NZ Transport Agency's structures database (*Highway structures information management system* – HSIMS), including the addition of structures, shall be reported to the Principal on the necessary input forms. The Principal shall be responsible for approving the addition of structures to the database. Inspections shall be used to verify the data fields in the structures database and also complete any missing data fields.

7 Alternative means of access

There is provision in 5.3 for the use of alternative means of access for areas of difficult or dangerous access with the prior agreement of the Principal.

Equipment and methods that may provide acceptable alternatives to close quarter inspection, provided they are suitable for the proposed use, and only with the recommendations of the Structure Inspection Engineer, include:

- cameras on long reach poles
- binoculars
- high resolution and telephoto photography from ground level
- thermal imaging
- remote controlled vehicles (or propelled by winch) with mounted video equipment
- unmanned underwater vehicles (UUV)
- small unmanned aircraft (SUA) or other such systems.

While such remote systems can be useful tools in the range of inspection techniques available to inspectors, they can have significant shortfalls and any proposal to use them must address their limitations as compared to a close-quarter inspection undertaken by an inspector or engineer. As such, alternative means of access and inspection must not be proposed to replace close-quarter inspections carried out under a principal inspection unless it eliminates a significant safety hazard, while avoiding or mitigating the shortfalls of remote inspection.

8 Records

The Structure Inspection Engineer shall maintain records of inspections and maintenance in HSIMS, so that a continuous history of each structure is available.

The Structure Inspection Engineer shall also maintain a schedule of structure inspections covering in particular principal inspection requirements and special inspection requirements, including specific access requirements, features requiring specific inspection and frequency of inspection.

9 Verification of maintenance

A system shall be instituted to verify that approved maintenance work has been carried out as programmed. The cost, description, quantity and timing of the completed work, other than routine maintenance, shall be recorded in HSIMS.

10 Traffic control

At all times during the work or activities associated with or arising from the exercise of this specification, the Structure Inspection Engineer shall take responsibility to ensure all traffic control is carried out in accordance with the *Code of practice for temporary traffic management (CoPTTM)*[10].

11 References

(1) NZ Transport Agency (2017) NZTA S8 *Tunnels management and inspection policy.* Wellington.

(2) NZ Transport Agency (2013) SP/M/022 *Bridge manual*. Wellington. (Incorporating amendment no. 3: 2018)

(3) Highways England (2007) *Inspection manual for highway structures*. TSO, London, United Kingdom.

(4) Federal Highway Administration (2015) FHWA-HIF-15-005 *Tunnel operations, maintenance, inspection, and evaluation (TOMIE) manual*. Washington, DC, USA.

(5) Highways England (1995) BD 53/95 *Inspection and records for road tunnels*. TSO, London, United Kingdom.

(6) Highways England (2003) BA 72/03 *Maintenance of road tunnels*. TSO, London, United Kingdom.

(7) Highways England (2017) BD 63/17 *Inspection of highway structures*. TSO, London, United Kingdom.

(8) NZ Transport Agency (2015) SM032 *State highway maintenance contract proforma manual.* Wellington.

(9) NZ Transport Agency (2009) SM061 *Bailey bridge manual*. Wellington.

(10) NZ Transport Agency (2012) *Code of practice for temporary traffic management* (CoPTTM): Part 8 of the Traffic control devices manual (TCD manual). Wellington.

Appendix A

Structure inspection requirements

Table 1: Bridge inspection requirements

Category of inspection	Minimum frequency for inspection	Personnel involved (minimum requirements)	Reporting
Routine surveillance inspection	1 year	See 4.1	Bridge routine surveillance inspection report (see appendix C for pro forma)
General inspection	2 years	Structure Inspector	Bridge inspection report (see appendix C for pro forma)
Principal inspection	6 years	Structure Inspector	Bridge inspection report (see appendix C for pro forma) and engineering report as necessary
Special inspections:			
Acceptance inspection	Changeover of responsibility	As agreed with the Principal	As required
Posted bridges inspection	1 year	Structure Inspector	Bridge inspection report and engineering report as necessary
Assessment inspection	As agreed with the Principal	Structure Inspection Engineer and/or Design Engineer	As required
Bailey bridge inspection	1 year	Structure Inspector	Bridge inspection report and NZTA 802
Large or complex bridge inspection	As agreed with the Principal	Structure Inspection Engineer and/or Design Engineer	As required
Earthquake event inspection	Immediately following an earthquake likely to have caused damage	Structure Inspector	As required
Flood event inspection	Immediately following a flood event likely to have caused damage	Structure Inspector	As required
Fire or chemical spillage inspection	Immediately following the event	Structure Inspector	As required
Overload damage inspection	Immediately following the event	Structure Inspector	As required
Vulnerable structure inspection	As determined by Structure Inspection Engineer and agreed with the Principal	Structure Inspection Engineer and/or Design Engineer	As required
Inspection of structure with uncommon material	As determined by Structure Inspection Engineer and agreed with the Principal	Structure Inspection Engineer and/or Design Engineer	As required

Table 2: Other significant highway structure inspection requirements

Category of inspection	Minimum frequency for inspection	Personnel involved (minimum requirements)	Reporting
Routine surveillance inspection	1 year	See 4.1	Relevant other structures routine surveillance inspection report (see appendix C for pro forma)
General inspection:			
Footbridges, cycle bridges, redundant bridges (accessible), large cantilever and gantry signs/signals, non-road bridges within the road corridor, large lighting masts, CCTV masts, very high retaining walls (>6m)	2 years	Structure Inspector	Relevant inspection report (see appendix C for pro forma)
Retaining walls, noise walls, large drainage structures, slope protection works, critical river protection works, major coastal protection works, critical small culverts, large stabilised slopes/batters	4 years when determined appropriate through risk analysis and agreed between the Structure Inspection Engineer and the Principal (see 5.), otherwise 2 years	Structure Inspector	Relevant inspection report (see appendix C for pro forma)
Principal inspection:			
Footbridges, cycle bridges, redundant bridges (accessible), large cantilever and gantry signs/signals, non-road bridges within the road corridor, large lighting masts, CCTV masts, very high retaining walls (>6m)	6 years	Structure Inspector	Relevant inspection report (see appendix C for pro forma) and engineering report as necessary
Retaining walls, noise walls, large drainage structures, slope protection works, critical river protection works, major coastal protection works, critical small culverts, large stabilised slopes/batters	8 years when determined appropriate through risk analysis and agreed between the Structure Inspection Engineer and the Principal (see 5.), otherwise 6 years	Structure Inspector	Relevant inspection report (see appendix C for pro forma) and engineering report as necessary
Special inspection	As agreed by Structure Inspection Engineer and Principal	As determined by Structure Inspection Engineer	Inspection report and engineering report as necessary

Table 3: Tunnel structure inspection requirements

Category of inspection	Minimum frequency for inspection	Personnel involved (minimum requirements)	Reporting
Routine Surveillance inspection			
Structural elements (eg tunnel wall, lining, cladding, portal walls)	Sufficient (as determined by the Structure Inspection Engineer) to ensure timely identification of safety defects but not less than annually.	See 4.1	As required
General inspection	2 years	Structure Inspector	In a format agreed with the Tunnel Manager
Principal inspection	6 years	Structure Inspector	In a format agreed with the Tunnel Manager and engineering report as necessary
Special inspections:			
For specifically identified problems	As required	As determined by Structure Inspection Engineer	As required
Following subsidence, settlement, heave etc.	Immediately once identified	Structure Inspector and specialist staff as determined by Structure Inspection Engineer	As required
Flood inspection	Immediately following a flood	Structure Inspector	As required
Following major accident or fire	Immediately following the event	Structure Inspector	As required
Earthquake inspection	Immediately following a significant earthquake	Structure Inspector	As required

Table 4: Geotechnical structure inspection requirements

Category of inspection	Minimum frequency for inspection	Personnel involved (minimum requirements)	Reporting
General inspection	2 years*	Structure Inspector	Geotechnical inspection report (see appendix C for pro forma)
Principal inspection	6 years*	Structure Inspector	Geotechnical inspection report (see appendix C for pro forma) and engineering report as necessary
Special inspections:			
Acceptance inspection	Changeover of responsibility	As agreed with the Principal	As required
Earthquake event inspection	Immediately following an earthquake likely to have caused damage	Structure Inspector	As agreed with Lead Advisor Geotechnical
Flood event inspection	Immediately following a flood event likely to have caused damage	Structure Inspector	As agreed with Lead Advisor Geotechnical
Fire or chemical spillage inspection	Immediately following the event	Structure Inspector	As agreed with Lead Advisor Geotechnical

* Period may vary as detailed in the geotechnical asset list

Appendix B

Inspection of in-service Bailey bridges

B1 General

A thorough inspection must be carried out by a Structure Inspector at least once per year.

B2 Inspection

Inspection of Bailey bridges shall cover the following points:

(a) Check for tightness of all raker, bracing frame, tie plate and riband bolts.

(b) Check tightness of transom clamps.

(c) Check sway braces are taut.

(d) Check that all panel pins have safety wires installed.

(e) Examine bearing foundations with particular emphasis on erosion, foundation shear failure and uneven settlement which, if present, must be corrected immediately.

(f) Check all packing is tight and if timber is used to retain approach fill, make sure timber is sound and approach fill is not spilling through.

(g) Check the condition of the decking.

(h) Ensure that all pins are greased to prevent water entering the joints. Ensure that all exposed threads of bolts, clamps and swaybraces are greased.

(i) Inspect protective coatings. Where significant damage to the coatings has occurred, the damaged areas shall, as soon as practicable, be first washed to remove any contamination from air-borne salts and then thoroughly cleaned by wire brushing, and reprimed with an approved epoxy zinc-rich paint. (A burnished surface should be avoided as it gives a very poor surface for bonding of the new coating.)

(j) Check visually for signs of cracking in both welds and parent metal, particular attention must be paid to the swaybrace slot and male lug areas illustrated in Figure B1. Where cracking is suspected, magnetic particle or dye penetrant tests shall be carried out.

B3 Crack monitoring and recording

(a) When cracks are located their ends shall be centre-punched to allow monitoring of crack growth during subsequent inspections.

(b) Where cracks have been located, repeat inspections shall be carried out and Bailey bridge crack testing reports NZTA 802 (figure B2) completed. All identified cracks shall be recorded on the NZTA 802 report by showing their location and length and whether they occur in welds (W) or parent metal (PM).

(c) If significant crack growth is observed the defective component shall be replaced, subject to Structure Inspection Engineer approval.

B4 Reporting

Inspections shall be reported using the bridge inspection report and the Bailey bridge crack test report form NZTA 802 as appropriate.

Figure B1 – Swaybrace slots and male lugs: crack locations

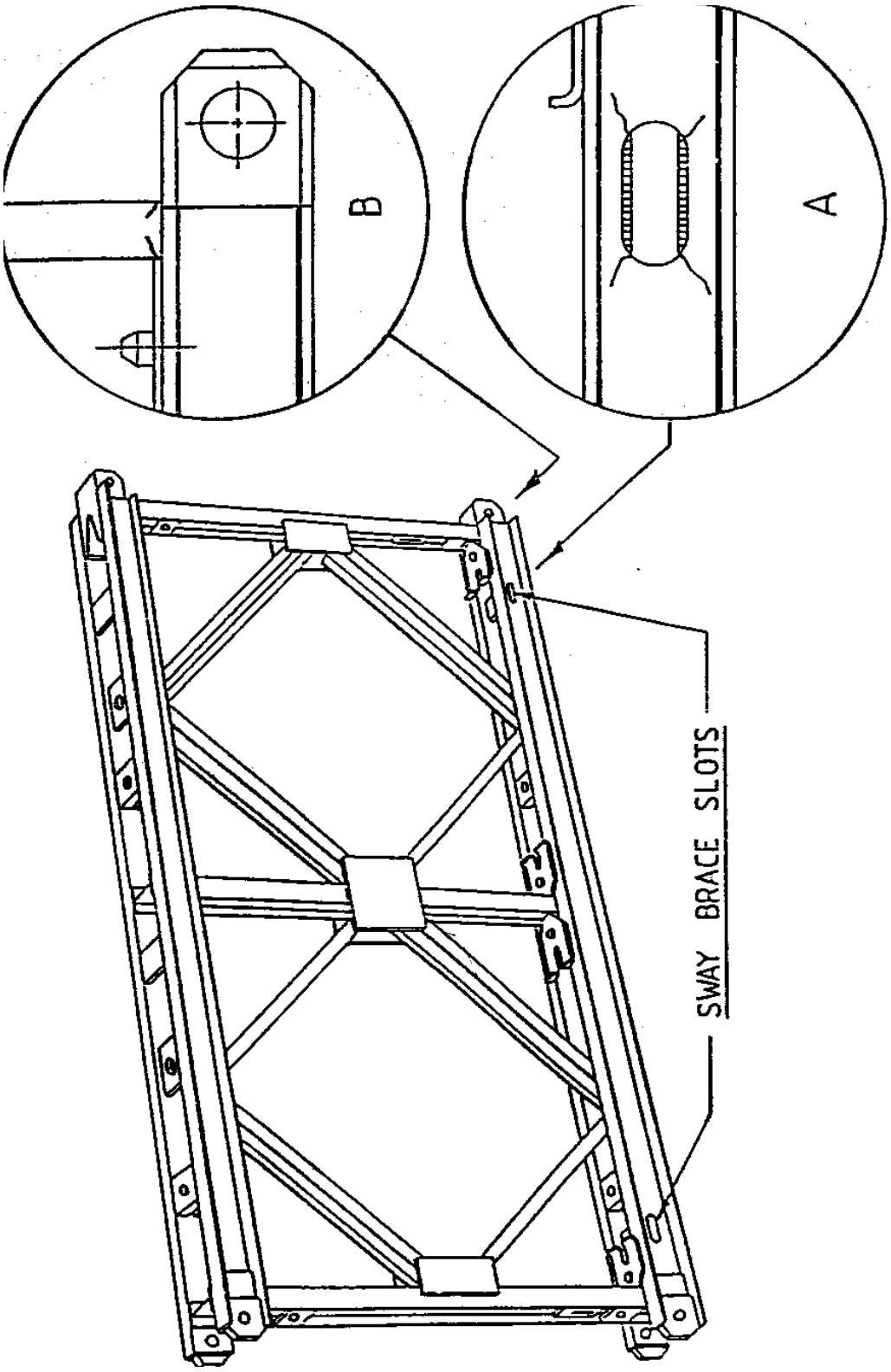
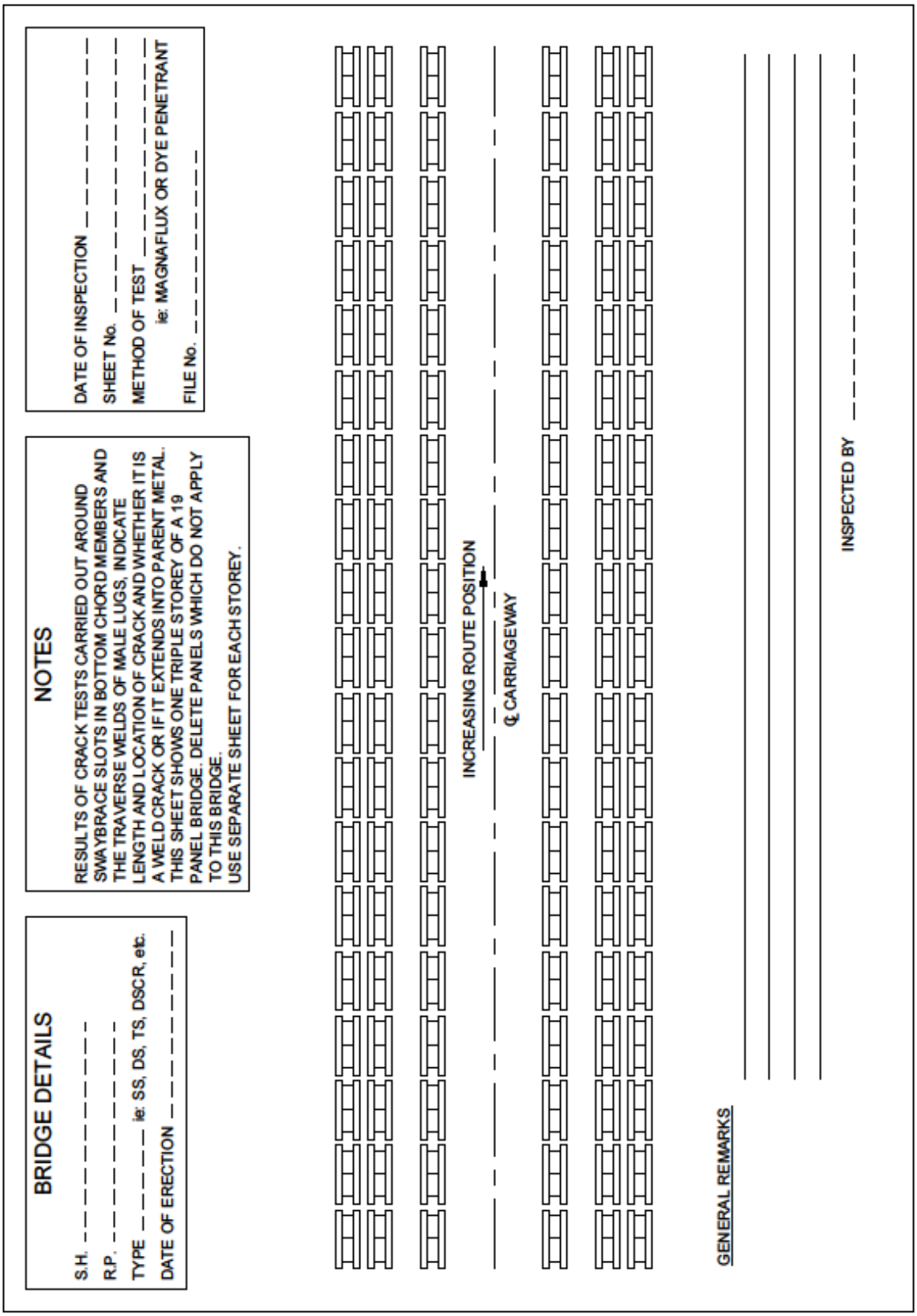


Figure B2 - Bailey bridge crack testing report NZTA 802



Appendix C

Bridge routine surveillance inspection report

NZ TRANSPORT AGENCY WAKA KOTAHI	Bridge routine surveillance inspection report		Supplier logo		
Network area:	**Bridge name:**		**Highway:**	**RP:**	**BSN:**
Marking code 0 = Not inspected 1 = Satisfactory 2 = Monitor next inspection R = Routine maintenance *(provide comment)* S = Structural maintenance *(provide comment & photo)* N = Not applicable	**Bridge type:**		**Map ref. (easting):**		
	Deck width:		**Map ref. (northing):**		
	Total bridge length:		**Owner:**		
	Spans:		**RCA:**		
Inspector:		**Reviewer:**			
Date (mth/yr):		**Date (mth/yr):**			

Item	Description	Mark	Defect Description/Remedial Work	Priority (H/M/L)	Estimated Cost
1	Signs				
2	Superstructure/deck drainage				
3	Movement/expansion joints				
4	Carriageway and deck surfacing				
5	Approach adequacy				
6	Guardrail/handrail				
7	Road marking				
8	Flood debris/vegetation				
9	Scour/erosion				
10	Other defects				

NOTE: In addition to the categories above, routine surveillance inspections shall identify any obvious defects which may affect the safety of road users or anything else needing urgent attention (as required by NZTA S6). Photographs of key defects should be taken. These shall be supplied to the Structures Management Consultant where the defect is structural in nature.

Bridge general inspection report – page 1 of 2

NZ TRANSPORT AGENCY WAKA KOTAHI	Bridge general inspection report	Supplier logo

Network area:	Bridge name:	Highway:	RP:	BSN:

Bridge type:		Superstructure material:	
Year constructed:		Deck material:	

Marking code
0 = Not inspected
1 = Satisfactory
2 = Monitor next inspection *(provide comment & photo)*
R = Routine maintenance (*provide comment & photo*)
S = Structural maintenance (*provide comment & photo*)
N = Not applicable

Deck width:		Map ref. (easting):	
Total bridge length:		Map ref. (northing):	
No. of spans:		Owner:	
Span lengths (m):		RCA:	

Inspector:		Next inspection type:		Previous inspection type:	
Date:		Next inspection date:		Previous inspection date:	

Element				Mark	Brief description of defect and comments
Set	No	Description			
Superstructure elements	1	Primary load carrying element			
	2	Secondary element(s)	Transverse beams		
	3		Other (incl. deck)		
	4	Half joints			
	5	Seismic linkages/holding down bolts			
	6	Parapet beam or cantilever			
	7	Cross bracing			
Load-bearing substructure	8	Foundations			
	9	Abutments			
	10	Head wall			
	11	Pier / column			
	12	Cross-head / capping beam			
	13	Bearings			
	14	Bearing plinth / shelf			
Durability elements	15	Superstructure drainage			
	16	Substructure drainage			
	17	Movement / expansion joints			
	18	Painting: superstructure elements			
	19	Painting: substructure elements			
	20	Painting: barriers/guardrails			
Safety elements	21	Access / walkways / gantries			
	22	Guardrail / handrail / safety fences			
	23	Carriageway surfacing			
	24	Footway / verge / footbridge surfacing			
Waterway elements	25	Invert / river bed			
	26	Aprons			
	27	River bed upstream			
	28	River bed downstream			
	29	Scour			
	30	River banks			
Retaining elements	31	Revetment / batter slope paving			
	32	Wing walls			
	33	Retaining walls			
	34	Embankments			
Other	35	Approach rails / barriers / walls			
	36	Approach adequacy			
	37	Signs			
	38	Lighting			
	39	Services			
	40	Appearance			

Bridge general inspection report – page 2 of 2

NZ TRANSPORT AGENCY WAKA KOTAHI	**Bridge general inspection report**	**Supplier logo**		
Network area:	**Bridge name:**	**Highway:**	**RP:**	**BSN:**

Comments and recommendations for maintenance/repairs

Item no.	Element no.	Suggested remedial work	Routine/ structural	Priority (Crit/H/M/L)	Estimated cost
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
				Total cost	$ -

Reason remedial structural work recommended in last inspection has not been completed

Database changes required

Maintenance strategy

General comments and recommendations relating to future management

Inspected by (print name):	**Signature:**	**Date:**
Reviewed by (print name):	**Signature:**	**Date:**
Approved by (print name):	**Signature:**	**Date:**

Bridge principal inspection report – page 1 of 2

NZ TRANSPORT AGENCY WAKA KOTAHI	Bridge principal inspection report	Supplier logo

Network area:	Bridge name:	Highway:	RP:	BSN:

Bridge type:		Superstructure material:	
Year constructed:		Deck material:	

Marking code
0 = Not inspected
1 = Satisfactory
2 = Monitor next inspection *(provide comment & photo)*
R = Routine maintenance (*provide comment & photo*)
S = Structural maintenance (*provide comment & photo*)
N = Not applicable

Deck width:		Map ref. (easting):	
Total bridge length:		Map ref. (northing):	
No. of spans:		Owner:	
Span lengths (m):		RCA:	

Inspector:		Next inspection type:		Previous inspection type:	
Date:		Next inspection date:		Previous inspection date:	

Element				Mark	Brief description of defect and comments
Set	No	Description			
Superstructure elements	1	Primary load carrying element			
	2	Secondary element(s)	Transverse beams		
	3		Other (incl. deck)		
	4	Half joints			
	5	Seismic linkages/holding down bolts			
	6	Parapet beam or cantilever			
	7	Cross bracing			
Load-bearing substructure	8	Foundations			
	9	Abutments			
	10	Head wall			
	11	Pier / column			
	12	Cross-head / capping beam			
	13	Bearings			
	14	Bearing plinth / shelf			
Durability elements	15	Superstructure drainage			
	16	Substructure drainage			
	17	Movement / expansion joints			
	18	Painting: superstructure elements			
	19	Painting: substructure elements			
	20	Painting: barriers/guardrails			
Safety elements	21	Access / walkways / gantries			
	22	Guardrail / handrail / safety fences			
	23	Carriageway surfacing			
	24	Footway / verge / footbridge surfacing			
Waterway elements	25	Invert / river bed			
	26	Aprons			
	27	River bed upstream			
	28	River bed downstream			
	29	Scour			
	30	River banks			
Retaining elements	31	Revetment / batter slope paving			
	32	Wing walls			
	33	Retaining walls			
	34	Embankments			
Other	35	Approach rails / barriers / walls			
	36	Approach adequacy			
	37	Signs			
	38	Lighting			
	39	Services			
	40	Appearance			

Bridge principal inspection report – page 2 of 2

NZ TRANSPORT AGENCY WAKA KOTAHI	Bridge principal inspection report	Supplier logo		
Network area:	Bridge name:	Highway:	RP:	BSN:

Inspection questions	Yes/No	Special access requirements	
Special access needed?			
Are there hidden critical components ?		Hidden Critical Components	Description
Has the structure been viewed under load?			
Has the previous inspection been consulted?			
Has all the structure been examined?		Parts not examined (excluding buried foundations)	Description
Database changes required?			
Remedial work in the last inspection completed?			

Comments and recommendations for maintenance/repairs

Item no.	Element no.	Suggested remedial work	Routine/ structural	Priority (Crit/H/M/L)	Estimated cost
1					
2					
3					
4					
5					
6					
7					
8					
				Total cost	$ -

Reason remedial structural work recommended in last inspection has not been completed

Database changes required

Maintenance strategy

General comments and recommendations relating to future management

Inspected by (print name):	Signature:	Date:
Reviewed by (print name):	Signature:	Date:
Approved by (print name):	Signature:	Date:

Bridge special inspection report

NZ TRANSPORT AGENCY WAKA KOTAHI	Bridge special inspection report	Supplier logo

Network area:	Bridge name:	Highway:	RP:	BSN:

Bridge type:		Superstructure material:		Inspection frequency:	
Year constructed:		Deck material:			

Marking code **0** = Not inspected 1 = Satisfactory 2 = Monitor next inspection *(provide comment & photo)* R = Routine maintenance (*provide comment & photo*) S = Structural maintenance (*provide comment & photo*) N = Not applicable	Deck width:		Map ref. (easting):	
	Total bridge length:		Map ref. (northing):	
	No. of spans:		Owner:	
	Span lengths (m):		RCA:	

Inspector:		Next inspection type:		Previous inspection type:	
Date:		Next inspection date:		Previous inspection date:	

Special inspection details

Item no.	Component	Reason for inspection	Methodology
1			
2			
3			
4			
5			
6			

Inspection questions	Yes/No	Description
Special access needed?		
Has the structure been viewed under load?		
Has the previous inspection been consulted?		
Database changes required?		
Remedial work in the last inspection completed?		
Any change of status?		
Special inspection still needed?		
Change of inspection frequency required?		

Special inspection results

Item no.	Component	Brief description of inspection results	Routine/ structural	Priority (Crit/H/M/L)	Estimated cost
1					
2					
3					
4					
5					
6					
				Total cost	$ -

Maintenance strategy

General comments and recommendations relating to future management

Inspected by (print name):	Signature:	Date:
Reviewed by (print name):	Signature:	Date:
Approved by (print name):	Signature:	Date:

Retaining wall routine surveillance inspection report

NZ TRANSPORT AGENCY WAKA KOTAHI	Retaining wall routine surveillance inspection report		Supplier logo		
Network area:	**Retaining wall name:**		**Highway:**	**RP:**	**OSN:**
Marking code 0 = Not inspected 1 = Satisfactory 2 = Monitor next inspection R = Routine maintenance *(provide comment)* S = Structural maintenance *(provide comment & photo)* N = Not applicable	**Wall type:**		**Map ref. (easting):**		
	Length:		**Map ref. (northing):**		
	Max height:		**Owner:**		
	Average height:		**RCA:**		
Inspector:		**Reviewer:**			
Date (mth/yr):		**Date (mth/yr):**			

Item	Description	Mark	Defect Description/Remedial Work	Priority (H/M/L)	Estimated Cost
1	Signs				
2	Drainage				
3	Carriageway - top of wall				
4	Carriageway - foot of wall				
5	Guardrail/handrail				
6	General appearance				
7	Scour/erosion				
8	Other defects				

NOTE: In addition to the categories above, routine surveillance inspections shall identify any obvious defects which may affect the safety of road users or anything else needing urgent attention (as required by NZTA S6). Photographs of key defects should be taken. These shall be supplied to the Structures Management Consultant where the defect is structural in nature.

Retaining wall general/principal/special inspection report

NZ TRANSPORT AGENCY WAKA KOTAHI	**Retaining wall inspection report**	**Supplier logo**

Network area:	**Wall name:**	**Highway:**	**RP:**	**OSN:**

Wall type:		**Retained material:**		**Inspection type:**	
Year constructed:					

Marking code
0 = Not inspected
1 = Satisfactory
2 = Monitor next inspection *(provide comment & photo)*
R = Routine maintenance *(provide comment & photo)*
S = Structural maintenance *(provide comment & photo)*
N = Not applicable

Length:		**Map ref. (easting):**	
Max height:		**Map ref. (northing):**	
Average height:		**Owner:**	
Angle to vertical:		**RCA:**	
Offset distance from highway centre line:			

Inspector:		**Next inspection type:**		**Previous inspection type:**	
Date:		**Next inspection date:**		**Previous inspection date:**	

Element				**Mark**	**Brief description of defect and comments**
Set	**No**	**Description**			
Main elements	1	Foundations			
	2	Retaining wall	Primary		
	3		Secondary		
	4	Guardrail beam			
Durability elements	5	Drainage			
	6	Movement / expansion joints			
	7	Surface finishes : wall			
	8	Surface finishes: guardrail			
Safety elements	9	Guardail/handrail			
	10	Carriageway	Top of wall		
	11		Foot of wall		
	12	Footway/ shoulder	Top of wall		
	13		Foot of wall		
Ancillary elements	14	Embankment	Top of wall		
	15		Foot of wall		
	16	Invert / river bed			
	17	Aprons			
Other elements	18	Signs			
	19	Lighting			
	20	Services			
	21	General appearance			
	22	Other (specify)			

Comments and recommendations for maintenance/repairs

Item no.	**Element no.**	**Suggested remedial work**	**Priority (Crit/H/M/L)**	**Estimated cost**
1				
2				
3				
			Total cost	$ -

Reason remedial structural work recommended in last inspection has not been completed

Database changes required

Maintenance strategy

General comments and recommendations relating to future management

Inspected by (print name):	**Signature:**	**Date:**
Reviewed by (print name):	**Signature:**	**Date:**
Approved by (print name):	**Signature:**	**Date:**

Large cantilever or gantry sign/signal routine surveillance inspection report

NZ TRANSPORT AGENCY WAKA KOTAHI	Large cantilever or gantry sign/signal routine surveillance inspection report		Supplier logo		
Network area:	**Large cantilever or gantry sign/signal name:**		**Highway:**	**RP:**	**OSN:**
Marking code 0 = Not inspected 1 = Satisfactory 2 = Monitor next inspection R = Routine maintenance *(provide comment)* S = Structural maintenance *(provide comment & photo)* N = Not applicable	**Cantilver or gantry type:**		**Map ref. (easting):**		
			Map ref. (northing):		
	Clear span or cantilever length:		**Owner:**		
	Max height:		**RCA:**		

Inspector:		**Reviewer:**	
Date (mth/yr):		**Date (mth/yr):**	

Item	Description	Mark	Defect Description/Remedial Work	Priority (H/M/L)	Estimated Cost
1	Signs/signals				
2	Access walkway/deck				
3	Access ladder				
4	Handrails				
5	Base connections				
6	Lighting/services				
7	Surface finishes/general appearance				
8	Other defects				

NOTE: In addition to the categories above, routine surveillance inspections shall identify any obvious defects which may affect the safety of road users or anything else needing urgent attention (as required by NZTA S6). Photographs of key defects should be taken. These shall be supplied to the Structures Management Consultant where the defect is structural in nature.

Large cantilever or gantry sign/signal general/principal/special inspection report

NZ TRANSPORT AGENCY WAKA KOTAHI	Large cantilever or gantry sign/signal inspection report	Supplier logo

Network area:	Large cantilever or gantry sign/signal name:	Highway:	RP:	OSN:

Cantilever or gantry type:		Year constructed:		Inspection type:	
Marking code 0 = Not inspected 1 = Satisfactory 2 = Monitor next inspection *(provide comment & photo)* R = Routine maintenance *(provide comment & photo)* S = Structural maintenance *(provide comment & photo)* N = Not applicable		Clear span or cantilever length:		Map ref. (easting):	
		Max height:		Map ref. (northing):	
		Access ladders (Y/N):		Owner:	
		Machine aided access (Y/N):		RCA:	

Inspector:		Next inspection type:		Previous inspection type:	
Date:		Next inspection date:		Previous inspection date:	

Element			Mark	Brief description of defect and comments
Set	No	Description		
Load bearing elements	1	Foundations		
	2	Truss/beam/cantilever		
	3	Transverse members		
	4	Columns/supports/legs		
Durability elements	5	Surface finishes: truss/beam/cantilever		
	6	Surface finishes: columns/supports		
	7	Surface finishes: other elements		
Access	8	Access walkway/deck		
	9	Access ladder		
	10	Handrails		
Other	11	Base connections		
	12	Support to longitudinal connection		
	13	Sign and signal supports		
	14	Other specify)		
Ancillary	15	Signs/Signals		
	167	Lighting		
	17	Services		

Comments and recommendations for maintenance/repairs

Item no.	Element no.	Suggested remedial work	Priority (Crit/H/M/L)	Estimated cost
1				
2				
3				
4				
			Total cost	$ -

Reason remedial structural work recommended in last inspection has not been completed

Database changes required

Maintenance strategy

General comments and recommendations relating to future management

Inspected by (print name):	Signature:	Date:
Reviewed by (print name):	Signature:	Date:
Approved by (print name):	Signature:	Date:

NOTE: A close-quarter inspection of the sign connections is required as part of the principal inspection

Geotechnical structure general / principal inspection report (rockfall and debris protection structure example)

NZ TRANSPORT AGENCY WAKA KOTAHI	Rockfall and debris protection structure inspection report	Supplier logo

Network area:	Structure name:	Highway:	RP:	OSN:

Structure type:		Year constructed:		Inspection type:	

Marking code
0 = Not inspected
1 = Satisfactory
2 = Monitor next inspection *(provide comment & photo)*
R = Routine maintenance *(provide comment & photo)*
S = Structural maintenance *(provide comment & photo)*
N = Not applicable

Length:		Map ref. (easting):	
Max height:		Map ref. (northing):	
Owner:		Structure location (in relation to the highway):	
RCA:		Offset distance from highway centre line:	

Inspector:		Next inspection type:		Previous inspection type:	
Date:		Next inspection date:		Previous inspection date:	

Element Set	No	Description		Mark	Brief description of defect and comments
Main elements	1	Foundations			
	2	Barrier/structure elements	Primary (eg posts)		
	3		Secondary (eg upslope/lateral cables)		
	4	Mesh			
	5	Anchors			
	6	Wire rope clamps			
Durability elements (componentry)	7	Shackles			
	8	Anchor head			
	9	Base plates			
	10	Energy dissipators (eg brake elements)			
	11	Other (eg spike plates, steel pins)			
Environmental elements	12	Drainage			
	13	Erosion			
	14	Debris accumulation			
	15	Upslope condition			
	16	Vegetation			
Safety elements	17	Maintenance / inspection access			
	18	Guardrail / handrail / safety fences			
Other elements	19	General appearance			
	20	Monitoring system			
	21	Other (specify)			

Comments and recommendations for maintenance/repairs

Item no.	Element no.	Suggested remedial work	Priority (Crit/H/M/L)	Estimated cost
1				
2				
			Total cost	$ -

Reason remedial structural work recommended in last inspection has not been completed

Database changes required

Maintenance strategy

General comments and recommendations relating to future management

Inspected by (print name):	Signature:	Date:
Reviewed by (print name):	Signature:	Date:
Approved by (print name):	Signature:	Date: