

Sydney Metro North West

Design and Construction of Surface
and Viaduct Civil Works



Monitoring and Protection Plan

**(Including WAD Prescribed Monitoring Plan & Maintenance
Plan Requirements)**

NWRLSVC-ISJ-SVC-PM-PLN-121500

Revision 8.0

24 June 2017

Document Control

A controlled copy of the Monitoring and Protection Plan (the Plan) will be distributed to the Principal's Representative, Independent Certifier and other relevant stakeholders and will be available to all ISJV employees in soft copy format through the digital document control management system.

The Plan if printed will be uncontrolled and it will be the responsibility of each user to confirm the currency of the plan through the digital document control management system.

Document distribution will be controlled in accordance with ISJV-SVC-PMS procedure MSP18 Document & Data Control.

Document Revision History

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Definitions and Abbreviations

CEMP	Construction Environmental Management Plan
EIS	Environmental Impact Statement
ESR	Environmental Site Representative/Project Environmental Manager
SI-BMS	Salini Impregilo– Business Management System
IC	Independent Certifier
ISJV	Impregilo S.p.A. (Australia) and Salini (Australia) Joint Venture
ISJV SVC-PMS	ISJV SVC – Project Management System
IPIAP	Independent Property Impact Assessment Panel
PD	Project Director
PIMP	Project Interface Management Plan
PMP	Project Management Plan (i.e. Workplace Management Plan)
PMS	Project Management System
PRMP	Project Records Management Plan
PTMP	Project Training Management Plan
PWHSMP	Project Work Health & Safety Management Plan
SS	Site Supervisor/General Foreman/Foreman
SSI	State Significant Infrastructure
SWMP	Soil and Water Management Plan
SSR	Site Safety Representative/Project Safety Manager
SVC	Surface and Viaduct Civil Works
SWMS	System Works Methods Statement (incorporating the Safe Work Method)
TfNSW	Transport for New South Wales

1 Introduction

1.1 Purpose

The Plan sets out the framework for identifying existing ground conditions and existing infrastructure within the defined vicinity of the SVC Project Works and Temporary Works (the site) that are susceptible to movement, dilapidation and/or failure due to the construction works. Monitoring of permanent project works is not covered by this plan and will be covered by the relevant design specifications for such works.

ISJV will ensure that the Project Works, the Temporary Works and ISJV's Activities will have no material adverse impacts on any existing ground conditions or on the performance of any infrastructure (including roads, parks and other publicly accessible areas, footpaths and cycleways, Utility Services, railways, buildings and other structures).

The Plan provides details of the monitoring and protection system, the processes and methodologies to be utilised, the management and reporting of monitoring data and the procedures for comparing effects on assets, testing equipment and measurement frequencies.

The Plan will be reviewed and updated where required.

1.2 Scope

The Plan covers the SVC Project Works and Temporary Works (the Site) corridor and those structures in the vicinity of the Site identified as being susceptible to movement, dilapidation and/or failure due to the construction works. The Plan also includes the RMS - TfNSW Works Authorisation Deed requirements (for the SVC Works) in relation to the Maintenance Plan and Monitoring Plan covering RMS Assets.

1.3 Plan Preparation and Review

Monitoring and Protection Plan

The Monitoring and Protection Plan must be prepared and initially submitted to the Principal's Representative and Independent Certifier as required within 90 Business Days of the date of the deed.

In addition to complying with the requirements of ISJV SVC-PMS the plan will comply with the project Deed, CoA, SWTC including Appendix 24, and TfNSW policy requirements.

Ongoing review and updating of the Plan will be undertaken, taking into account:

- i) Changes in design or construction process, including the use of and development of new designs and materials
- ii) New design and construction processes requiring documentation which the existing Monitoring and Protection Plan does not address.

The Monitoring and Protection Plan will be reviewed in accordance with MSP47 Project Reviews.

Plan revision details will be maintained in accordance with MSP18 Document & Data control.

All revisions including amendments of this plan will be approved by the Project Director.

1.4 Interface with other Project Plans

The Plan is a subplan to the overarching Project Management Plan and part of the broader Project Management Plan set and also interacts with the Construction Environmental Management Plan, Construction Plan and the Construction Noise and Vibration Management Plan and should be read in conjunction with these plans.

The relationship of the Monitoring and Protection Plan to other plans within the ISJV Management System and overarching documentation framework is shown in Figure 1.

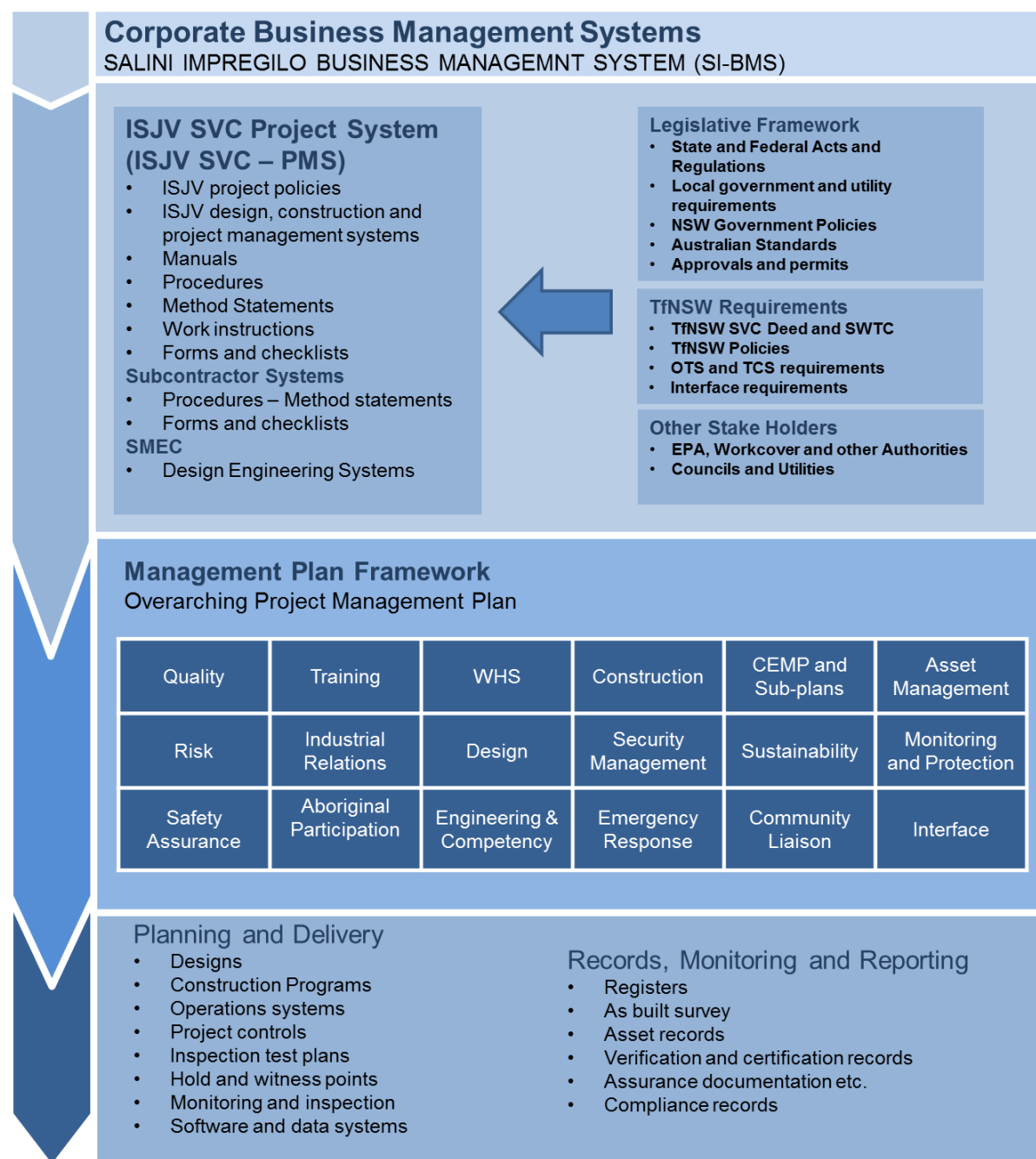


Figure 1 - ISJV SVC Management Systems and Document Framework

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The relationship of this plan to the other plans is indicated in the Figure 2 and the relationship to the CEMP in Figure 3.

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Project Management Plan			
Risk Management Plan including Technical Risk Management Plan	Design Plan	Construction Plan	Construction Environmental Management Plan
Project Quality Plan	Engineering and Competency Management Plan	Earthworks Plan	inputs to Compliance Tracking Procedure
Project Records Management Plan including Technical Data Management Plan and Project Purchasing Plan	Engineering Management Plan	Spoil Management Plan	Construction Compound Ancillary Facilities Management Plan
	Requirements Management Plan	Waste Management and Recycling Plan	Construction Noise and Vibration Management Plan
Safety Assurance Plan including RAMs	Competency Management Plan	Sustainability Plan	Construction Noise Impact Statement
Assurance Documentation Management Plan	Urban Design & Corridor Landscape Plan	Carbon and Energy Management Plan	Construction Traffic Management Plan Including
Project Training Management Plan	Services Management Plan	Stormwater and Flooding Management Plan	Construction Soil and Water Management Plan
Workplace Relations Management Plan	Community Liaison Implementation Plan	Pollution Incident Response Management Plan	Soil Salinity Management Plan
Project Aboriginal Participation Plan	Stakeholder and Community Involvement Plan	Monitoring and Protection Plan	Water Quality Monitoring Program
	Business Management Plan	Visual Amenity Management Plan	Construction Heritage Management Plan
		Security Management Plan	Construction Flora and Fauna Management Plan
		Project WHS Management Plan Including Site Specific WHS Management Plan and Project WHS Development Plan	Nest Box Management Plan
			Ecological Monitoring Program
		Site Specific Emergency Response Plan	Construction Air Quality Plan
	Asset Management Information Delivery Plan		
	Technical Maintenance Plan	BIM Execution Plan	
	Interface Management Plan		
	KEY:		
Plan	Sub Plan	This Plan	
TfNSW Plan	Sub - Sub Plan		

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Figure 2 - Hierarchy of SVC Management Plans



Figure 3 – CEMP Structure

2 Plan Compliance

Cl.	Description	Where Addressed
SWTC Appendix 24		
24.8 (f)	The Plan must, as a minimum, address and detail:	
24.8 (f) (i)	the monitoring and protection management team structure, including key personnel, authority and roles of key personnel, lines of responsibility and communication, minimum skill levels of each role and interfaces with the overall project organisation structure;	Refer to PMP
24.8 (f) (ii)	processes and methodologies for monitoring the actual effects of the Project Works and Temporary Works on existing ground conditions and infrastructure (including early identification of potential construction-induced impacts);	Section 4
24.8 (f) (iii)	the development and implementation of a monitoring and protection system for ground conditions and infrastructure;	Section 4
24.8 (f) (iv)	processes for the management of monitoring data and information.	Section 1.3
24.8 (f) (v)	processes and procedures for the ongoing review of the effectiveness of the monitoring and protection system as well as the development and modification of the monitoring and protection system.	Section 1.3
24.8 (f) (vi)	Processes and procedures to identify and protect existing infrastructure during construction of the Project Works and Temporary Works.	Section 4
24.8 (f) (vii)	the predicted effects of the Project Works and Temporary Works on existing ground conditions and infrastructure.	Section 4.3
24.8 (f) (viii)	the acceptable effects of the Project Works and Temporary Works on existing ground conditions and infrastructure.	Section 4.3
24.8 (f) (ix)	processes and procedures for comparing actual effects of the Project Works and Temporary Works on existing ground conditions and infrastructure against the predicted effects and acceptable effects.	Section 4.3
24.8 (f) (x)	the development and identification of monitoring periods, frequency of readings and trigger levels for all equipment, devices and instrumentation.	Section 4.6
24.8 (f) (xi)	response planning for each trigger level	Section 4
24.8 (f) (xii)	processes for pre-construction and post-construction condition surveys for ground conditions and existing infrastructure.	Section 4.1
24.8 (f) (xiii)	the equipment, devices and instrumentation types and installation locations as well as processes to be used for monitoring ground	Section 4.5

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Cl.	Description	Where Addressed
	conditions and infrastructure (including settlement and movement)	
24.8 (f) (xiv)	the equipment, devices, locations and processes to be used for monitoring the construction and the performance of the Works.	Section 4.5
24.8 (f) (xv)	equipment, device and instrumentation specifications including specifications for installation.	Section 4.5
24.8 (f) (xvi)	methodology for identifying and replacing damaged or non-functioning equipment, devices and instrumentation.	Section 4.5
24.8 (f) (xvii)	how existing infrastructure will be protected from the impact of the Project Works, the Temporary Works and the SVC Contractor's Activities.	Section 4.2
24.8 (f) (xviii)	interfaces with other Project Plans.	Throughout this plan

SWTC Appendix 7

7.1	Notwithstanding references to the "contractor" or the "proponent" in some of the other Environmental Documents, the SVC Contractor must undertake all the obligations, including monitoring, mitigation, safeguards, procedures, measures, controls and commitments, arising from the Environmental Documents unless specifically stated otherwise in Schedules 15 and 16 of the deed.	Throughout this plan
7.2.1	<p>Roads to be included in Road Dilapidation Report</p> <p>Further to condition E38 of the Project Planning Approval 1 and in addition to the haulage routes for construction vehicles determined by the Contractor, the following roads must be included in the Road Dilapidation Report undertaken by an independent and qualified person or team:</p> <ul style="list-style-type: none"> (a) Balmoral Road – between Old Windsor Road and the construction site access; (b) Memorial Avenue – between Old Windsor Road and the construction site access; (c) Samantha Riley Drive – Between Old Windsor Road and the construction site access; (d) Old Windsor Road – between Windsor Road and the construction site access; (e) White Hart Drive – between Windsor Road and the construction site access; (f) Rouse Hill Drive – between Windsor Road and the construction site egress; (g) Schofields Road – between Windsor Road and the construction site access; and (h) Transitway – sections of Transitway near construction 	Section 4.5.2

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Cl.	Description	Where Addressed
	accesses at Windsor Road, Memorial Avenue, Sanctuary Drive and Samantha Riley Drive.	
7.2.2	<p>Damage Assessment and Reporting, Restoration and Reinstatement of Roads</p> <p>Further to condition E38 of the Project Planning Approval, the roads identified in subsection 7.2.1 of this Appendix 7 must be included in the damage assessment and reporting following completion of construction and any restoration and reinstatement measures</p>	Section 4.5.2
SWTC Appendix 8		
8.2 (a)	The SVC Contractor must develop, implement and maintain a ground condition and infrastructure monitoring and protection system that incorporates all the monitoring equipment, devices and instrumentation installed by the SVC Contractor.	Section 4.2 and 4.5
8.2 (b)	The monitoring and protection system must allow the SVC Contractor to continuously monitor over time the actual effects of the Project Works, the Temporary Works and the SVC Contractor's Activities on ground conditions and infrastructure.	Section 4.1
8.2 (c)	The SVC Contractor must develop trigger levels ("Alert", "Action" and "Alarm") for all monitoring equipment, devices and instrumentation based on the Predicted Effects and Acceptable Effects for the ground conditions and infrastructure determined by the SVC Contractor.	Section 4.5.3
8.2 (d)	The SVC Contractor must develop response plans based on the "Alert", "Action" and "Alarm" trigger levels. The response plans must clearly and comprehensively identify all adjustments to the SVC Contractor's Activities that are necessary to ensure that Acceptable Effects are not exceeded.	Section 4.5.3
SWTC Appendix 9 G71		
1.3.1 (d)	<p>Work Process Control</p> <p>Survey must be treated as a separate application of work process control and the Contractor must prepare documented procedures covering all equipment, measurement, calculation and records necessary to:</p> <p>monitor movements and settlements of the Project Works and Temporary Works.</p>	Section 4.1
1.3.2(b)	monitoring surveys are carried out by qualified surveyor(s) who possess at least five (5) years satisfactory practical experience in monitoring surveys;	PMP and Construction Plan has min

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Cl.	Description	Where Addressed
		qualifications
1.3.3 (a)	<p>All monitoring and measuring devices must comply with Principal's General Specification Q6 and the Surveyor General's Directions in relation to survey equipment used for the Project Works and Temporary Works. The term, "monitoring and measuring devices" in Principal's General Specification Q6 applies to all survey instruments and ancillary equipment. The Quality Plan must demonstrate how these devices meet the accuracy and precision requirements for their intended applications.</p> <p>All other survey equipment used for the Project Works and Temporary Works must have a calibration procedure and be in calibration at all times.</p>	Section 4.5
2.2.4	<p>Monitoring Surveys</p> <p>Survey controls for monitoring of vertical settlement and / or horizontal movement must be established to an accuracy conforming to the requirements of Table G71.1 for "Specialised Construction Activities".</p>	
5.5.1	<p>Monitoring Plan</p> <p>The Contractor must detail the methodology and procedures for monitoring vertical and horizontal settlements and movements in the Quality Plan. The methodology and procedures for monitoring various structures must contain, as a minimum, the following:</p> <ul style="list-style-type: none"> (a) a drawing setting out clearly the purpose and locations of the monitoring points; (b) proposed method of installing these monitoring points to ensure that they will survive the intended monitoring period; (c) methods of re-establishing the surface monitoring points in the event of accidental obliteration of such point(s); (d) Survey Techniques to achieve the stated order of accuracies; (e) frequency of monitoring surveys; and (f) method to provide an early warning of out of tolerance structural movement to demonstrate magnitude and direction. 	Section 4.3
RFT SWTC Exhibit A: 3.3 Condition Surveys		
(b)	<p>The pre-construction ground and infrastructure condition surveys must be conducted with the agreement of the property owner and any occupier and be completed at least 30 days prior to the SVC Contractor commencing the relevant activity. The SVC Contractor must prepare a detailed record that, as a minimum, includes dated photographs of the pre-construction conditions of all ground and infrastructure which may be affected and a summary description of the pre-construction condition of the ground and infrastructure.</p>	Section 4.1

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Cl.	Description	Where Addressed
(c)	The SVC Contractor must provide the Principal's Representative, the Independent Certifier and the owner and/or occupier with a hard copy and an electronic copy in .pdf format of the survey report promptly, and in any event within 5 Business Days of the SVC Contractor receiving such a report	Section 4.1
(d)	The SVC Contractor must provide property owners or occupiers with a notice proposing at least two alternative dates for the completion of pre-construction ground and infrastructure surveys. If a property owner or occupier does not provide the SVC Contractor with sufficient access to carry out a pre-construction ground and infrastructure survey within 21 days of the latest date which the SVC Contractor included in the notice, the SVC Contractor must give the Principal's Representative a copy of the notice and a signed statement by the SVC Contractor to the effect that the property owner or occupier has not provided sufficient access to carry out the pre-construction ground and infrastructure survey.	Section 4.1
(e)	The SVC Contractor must undertake post-construction ground and infrastructure surveys to establish the condition of all ground and infrastructure (including the existing infrastructure subject to pre-construction ground and infrastructure condition surveys) which may have been affected by the SVC Contractor's Activities.	Section 4.1
(f)	The SVC Contractor must provide the Principal's Representative, the Independent Certifier and the owner and/or occupier with a hard copy and an electronic copy in .pdf format of the survey report promptly, and in any event within 5 Business Days of the SVC Contractor receiving such a report. The post-construction ground and infrastructure surveys must be:	Section 4.1
	carried out after the completion of all activities which may affect ground conditions and infrastructure; and	Section 4.1
	conducted with the agreement of the property owner and any occupier and must include a detailed record (including dated photographs) of the post-construction conditions of the ground and infrastructure	Section 4.1
(g)	The SVC Contractor must provide property owners or occupiers with a notice proposing at least two alternative dates for the completion of post-construction ground and infrastructure surveys. If a property owner or occupier does not provide the SVC Contractor with sufficient access to carry out a post-construction ground and infrastructure survey within 21 days of the latest date which the SVC Contractor included in the notice, the SVC Contractor must give the Principal's Representative a copy of the notice and a signed statement by the SVC Contractor to the effect that the property owner or occupier has not provided sufficient access to carry out the post-construction ground and infrastructure survey.	Section 4.1

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Cl.	Description	Where Addressed
(h)	As a condition precedent to Construction Completion of each Portion, the SVC Contractor must issue to the Principal's Representative, the Independent Certifier and the property owner and/or occupier a hard copy and an electronic copy in .pdf format of the pre-construction and post-construction survey report except where the property owner or occupier does not provide sufficient access to complete the pre-construction ground and infrastructure survey or the post-construction ground and infrastructure survey in which case the SVC Contractor must issue to the Principal's Representative and the Independent Certifier a hard copy and an electronic copy in .pdf format of the notice and statement referred to in subsections (d) and (g) above.	Section 4.1
(i)	The pre-construction and post-construction ground and infrastructure condition surveys detailed in this section 3.3 must be carried out by an independent and appropriately qualified and experienced assessor for the specific element of ground or infrastructure being surveyed.	Section 4.1
(l)	Infrastructure condition surveys detailed in this section 3.3 must be undertaken in accordance with the requirements in AS 4349.1 Inspection of buildings – General requirements.	Section 4.1

RFT SWTC Exhibit A Appendix 8 requirements

(a)	The SVC Contractor must develop, implement and maintain a ground condition and infrastructure monitoring and protection system that incorporates all the monitoring equipment, devices and instrumentation installed by the SVC Contractor	Section 4
(b)	The monitoring and protection system must allow the SVC Contractor to continuously monitor over time the actual effects of the Project Works, the Temporary Works and the SVC Contractor's Activities on ground conditions and infrastructure	Section 4.3
(c)	The SVC Contractor must develop trigger levels ("Alert", "Action" and "Alarm") for all monitoring equipment, devices and instrumentation based on the Predicted Effects and Acceptable Effects for the ground conditions and infrastructure determined by the SVC Contractor	Section 1.1.1
(d)	The SVC Contractor must develop response plans based on the "Alert", "Action" and "Alarm" trigger levels. The response plans must clearly and comprehensively identify all adjustments to the SVC Contractor's Activities that are necessary to ensure that Acceptable Effects are not exceeded	Section 1.1.1

WAD requirements

1.1	Prescribed Plan Definition	Included in the NWRL-SVC MPP title page
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Cl.	Description	Where Addressed
	Monitoring Plan Definition	NWRL-SVC MPP
14.5	General Requirements	NWRL-SVC MPP
Annexure A Cl 6.1	Condition Surveys	Section 5.5.2 &
2Annexure A Cl 6.2	Condition Reports	NWRLSVC-ISJ-SVC-CN-RPT-100500 Initial Road Condition Report – Project
Annexure A Cl 6.3	Monitoring Plan	Wide
Annexure A Cl 6.3 (a)	identify the haulage routes, including potential alternative routes;	Section 5.5.2 &
Annexure A Cl 6.3 (b)	include a map and a list of identified impacted roads;	NWRLSVC-ISJ-SVC-CN-RPT-100500 Initial Road Condition Report – Project
Annexure A Cl 6.3 (c)	list the current base level of heavy vehicle volumes / ESA's on identified routes;	Wide
Annexure A Cl 6.3 (d)	cover the area of pavement to be monitored, including kerbs, kerb ramps, verge (back of kerb to property boundary), bridges;	NWRL-SVC MPP
Annexure A Cl 6.3 (e)	identify the initial routes to be surveyed and schedule of the planned future surveys;	Section 5.5.2 & NWRLSVC-ISJ-SVC-PM-PLN-120202 Construction Traffic Management Plan, Section 4.11
Annexure A Cl 6.3 (f)	include a schedule of Condition Surveys, with at least one survey to be conducted not more than three months and not less than one month before the commencement of use of the respective haulage route;	

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Cl.	Description	Where Addressed
Annexure A Cl 6.3 (g)	estimate remaining pavement life under existing traffic flow for each haulage route;	Sections 5.5.2, 5.6.1 & Appendix D & NWRLSVC-ISJ-SVC-PM-PLN-120202 Construction Traffic Management Plan, Section 4.11
Annexure A Cl 6.3 (g)	estimate remaining pavement life under proposed increased traffic flows as a result of construction traffic for each haulage route;	
Annexure A Cl 6.3 (h)	include recommendation to protect and manage the structural integrity of the pavement during the period of construction works;	Section 5.5.2 & NWRLSVC-ISJ-SVC-PM-PLN-120202 Construction Traffic Management Plan, Section 4.2, 4.11
Annexure A Cl 6.3 (i)	determine actions if the end of the pavement life is reached during the predicted construction traffic usage; and	Section 5.5.2
Annexure A Cl 6.3 (j)	recommend restoration methodology and/or method to measure pavement dilapidation in monetary terms.	Sections 5.5.2, 5.6.1 & Appendix D & NWRLSVC-ISJ-SVC-CN-RPT-100500 Initial Road Condition Report – Project

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2.1 Conditions Of Approval Requirements

2.1.1 Major Civil Construction Works – North West Rail Link (SSI-5100)

No.	Ref.	Relevant Requirement	Where Addressed															
1.	C17	A geotechnical model of representative geological and groundwater conditions has been prepared prior to excavation and tunnelling in subject area(s) to identify geological structures and groundwater features. This model includes details of proposed excavations and tunnels, construction staging, and identify surface and sub-surface structures and infrastructure which may be impacted by the SSI, including the specific attributes of those structures. The Proponent uses this model to assess the predicted settlement, ground movement, stress redistribution and horizontal strain profiles caused by excavation and tunnelling on adjacent property and infrastructure.	Section 4.3															
2.	C18	The Proponent has undertaken an assessment of property and infrastructure at risk from damage to determine appropriate settlement criteria to prevent damage.	Section 4.1.1															
3.	C19	<p>Should the geotechnical model in condition C17 indicate that exceedances of the criteria established in condition C20 or in Table 1 (whichever is the lower), the Proponent has identified and implemented mitigation measures such as appropriate support and stabilisation structures in consultation with the relevant land and/or infrastructure owners prior to the commencement of construction to ensure where possible that underground services, infrastructure and adjacent buildings will not experience settlements exceeding the criteria.</p> <p>Table I - Settlement Criteria</p> <table><tr><th>Beneath Structure/Facility</th><th>Maximum Settlement</th><th>Maximum Angular Distortion</th></tr><tr><td>Buildings - Low or non sensitive properties (i.e. < 2levels and carparks)</td><td>30 mm</td><td>1 in 350</td></tr><tr><td>Buildings - High or sensitive properties (i.e. > 3 levels and heritage items)</td><td>20 mm</td><td>1 in 500</td></tr><tr><td>Roads and Parking areas</td><td>40 mm</td><td>1 in 250</td></tr><tr><td>Parks</td><td>50 mm</td><td>1 in 250</td></tr></table> <p>The above criteria does not remove any responsibility from the Proponent for the protection of existing structures or for rectifying any damage resulting from the SSI.</p>	Beneath Structure/Facility	Maximum Settlement	Maximum Angular Distortion	Buildings - Low or non sensitive properties (i.e. < 2levels and carparks)	30 mm	1 in 350	Buildings - High or sensitive properties (i.e. > 3 levels and heritage items)	20 mm	1 in 500	Roads and Parking areas	40 mm	1 in 250	Parks	50 mm	1 in 250	Section 4.6.2
Beneath Structure/Facility	Maximum Settlement	Maximum Angular Distortion																
Buildings - Low or non sensitive properties (i.e. < 2levels and carparks)	30 mm	1 in 350																
Buildings - High or sensitive properties (i.e. > 3 levels and heritage items)	20 mm	1 in 500																
Roads and Parking areas	40 mm	1 in 250																
Parks	50 mm	1 in 250																
4.	C20	Settlement criteria for individual utility structures and infrastructure has been determined in consultation with the relevant authorities prior to the commencement of construction.	Section 4.3															
5.	E11	<p>Prior to construction, a detailed land use survey to identify potentially critical areas that are sensitive to construction vibration and construction ground-borne noise impacts, has been undertaken. The results of the survey have been incorporated into the Construction Noise and Vibration Management Plan (condition E45 (b)).</p> <p>Note: Due to the timing of the project schedule high-level surveys were carried out to inform this document, and any additional information that arises from more detailed surveys will be covered by CNVIS's.</p>	Section 4, opening section															

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No.	Ref.	Relevant Requirement	Where Addressed
6.	E25	The Proponent has designed and constructed the SSI with the objective of minimising impacts to, and interference with, third party property and infrastructure, and that such infrastructure and property is protected during construction and operation.	Section 4.2
7.	E26	<p>The Proponent has, prior to the commencement of construction (including demolition and excavation works), or each part of the SSI that may impact on surrounding properties at risk from damage:</p> <p>(a) where agreed with the property owner, undertaken independent inspections of these properties prior to construction in accordance with AS 4349.1 'Inspection of Buildings'. This inspection has been undertaken by appropriately qualified and experienced geotechnical and construction engineering experts, and report on property features that may be affected by construction;</p> <p>(b) contacted the owners of all buildings on which property inspections are to be conducted before the inspection, or as otherwise agreed by the affected property owner, and advised of the scope and methodology for the inspection, and of the process for making a property damage claim; (c) provided a copy of the property inspection report to the owner of each property inspected prior to construction that could affect the property; (d) determined an appropriate property vibration criteria and management and protection measures to ensure that property damage (including cosmetic damage) will be avoided; and</p> <p>(e) maintained a register of all properties inspected by the Proponent, indicating whether the owner accepted or refused the property inspection offer, and provided a copy of the register to the Director General upon request.</p> <p>Reports from the geotechnical engineer advising on the risk of damage to properties are available upon request to the Director General and the Independent Property Impact Assessment Panel (condition E29).</p>	<p>(a) Section 4 and Appendix A (b) Section 4 and Appendix B (c) Section 4 (d) Section 4.6.1 (e) Appendix A</p> <p>Reports from Geotechnical Engineer – Section 4</p>
8.	E27	For the purpose of condition E26 properties at risk from damage include, but are not necessarily limited to: (a) buildings and structures determined following geotechnical and vibration analysis as certified by a qualified geotechnical engineer; and (b) other sensitive structures within 60 metres from the edge of the works unless otherwise determined following geotechnical and vibration analysis as certified by a qualified geotechnical engineer as not likely to be adversely affected.	Section 4, opening section
9.	E28	The Proponent has installed appropriate equipment to monitor construction sites and the tunnel route during construction and for a period of not less than six months after settlement has stabilised with particular reference to risk areas identified in the building and infrastructure condition surveys required by condition E26 and/or the geotechnical analysis required by condition C17. If monitoring during construction indicates exceedance of the criteria then all work affecting settlement ceases immediately and doesn't resume until fully rectified or a revised method of work has been established that will ensure protection of affected structures.	Section 4, opening section
10.	E29	<p>The Proponent has established an Independent Property Impact Assessment Panel prior to relevant construction or demolition works commencing. The Panel has been approved by the Director General and comprise geotechnical and engineering experts independent of the design and construction team, unless otherwise agreed by the Director General. The Panel has been responsible for independently verifying assessments undertaken under conditions C17 and E26, the resolution of property damage disputes and the establishment of ongoing settlement monitoring requirements.</p> <p>Either the affected property owner or the Proponent may refer unresolved disputes arising from potential and/or actual property impacts to the Panel for resolution. All costs incurred in establishing and implementing the Panel shall be borne by the Proponent.</p>	Section 4.4
11.	E30	Notwithstanding the requirements of condition E27, the Proponent monitors settlement for any period as may be specified through the Independent Property Impact Assessment Panel referred to in condition E28. The results of this monitoring are made available to the Director General upon request.	Section 4.4

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No.	Ref.	Relevant Requirement	Where Addressed
12.	E31	Any damage caused to property as a result of the SSI is rectified or the property owner compensated, within a reasonable timeframe, with the costs borne by the Proponent. This condition is not intended to limit any claims that the property owner may have against the Proponent.	Section 4.4
13.	E38	<p>Upon determining the haulage route(s) for construction vehicles associated with the SSI, and prior to use of the haulage route(s) by heavy vehicles, an independent and qualified person or team has undertaken a Road Dilapidation Report on local roads from the construction access/ egress point(s) to the arterial road network. The report assesses the current condition of the road and describes mechanisms to restore any damage that may result due to traffic and transport related to the construction of the SSI, during construction. The Report has been submitted to the relevant road authority for review prior to use of the haulage routes(s).</p> <p>Following completion of construction, a subsequent report is prepared to assess any damage that may have resulted from the construction of the SSI.</p> <p>Measures undertaken to restore or reinstate roads affected by the SSI are undertaken in a timely manner, in accordance with the reasonable requirements of the relevant road authority, and at the full expense of the Proponent.</p>	Section 4.5.2

2.1.2 Stations, Rail Infrastructure and Systems – North West Rail Link (SSI-5414)

No.	Ref.	Relevant Requirement	Where Addressed
14.	C15	<p>Prior to construction of the SSI, a detailed land use survey to identify potentially critical areas that are sensitive to construction and operational noise (air and ground borne) and vibration impacts, has been undertaken having regard to the type of land use. The results of the survey have been incorporated into the Construction Noise and Vibration Management Plan (condition E34(b)) and the Operational Noise and Vibration Review (condition C20). The land survey, prepared to meet condition E11 of State significant Infrastructure Approval SSI 5100, has been revised, if necessary and resubmitted.</p> <p>Note: Due to the timing of the project schedule high-level surveys were carried out to inform this document, and any additional information that arises from more detailed surveys will be covered by CNVIS's.</p>	Section 4, opening section
15.	C48	The Proponent has prepared dilapidation surveys and reports (including movement prediction studies) on the condition of roads, footpaths, services and utilities affected by construction. The Proponent has carried out rectification work at the Proponent's expense and to the reasonable requirements of the owners.	Section 4.1.1
16.	E5	Upon determining heavy vehicle routes associated with the SSI, and prior to use of these route(s) by heavy vehicles, an independent and qualified person or team has undertaken a Road Dilapidation Report on local roads from the construction access/ egress point(s) to the arterial road network. The report assesses the current condition of the road and describes mechanisms to restore any damage that may result due to traffic and transport related to the construction of the SSI, during construction. The Report has been submitted to the relevant road authority for review prior to use of the haulage routes(s).	Section 4.1.1

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No.	Ref.	Relevant Requirement	Where Addressed
		Following completion of construction, a subsequent report is prepared to assess any damage that may have resulted from the construction of the SSI. Measures undertaken to restore or reinstate roads affected by the SSI are undertaken in a timely manner, in accordance with the reasonable requirements of the relevant road authority, and at the full expense of the Proponent.	
17.	E24	The Proponent has designed and constructed the SSI with the objective of minimizing impacts to, and interference with, third party property and infrastructure, and that such infrastructure and property is protected during construction and operation.	Section 4.2

2.1.3 Stage 1 Submissions Report (SSI-5100) –

No.	Ref.	Relevant Requirement	Where Addressed
18.	NV8	Attended vibration monitoring is undertaken at the nearest commercial building during high vibration activities to ensure vibration levels remain below safe limits.	Section 4
19.	NV9	Attended vibration monitoring is undertaken at the nearest residential buildings during high vibration activities to ensure vibration levels remain below safe limits.	Section 4
20.	V6	Monitoring of the effectiveness of mitigation measures is undertaken by the relevant construction contractor. This primarily includes regular visual inspection of the condition of the various measures.	Section 4
21.	SG2	Settlement criteria are established in consultation with relevant government agencies.	Section 4.1.2
22.	SG3	A detailed geotechnical model for the alignment and its surroundings has been developed and is progressively updated during design and construction. The detailed geotechnical model includes: <ul style="list-style-type: none"> ▪ Full details of structures, services, basements and other sub-surface elements that may be impacted by the development of NWRL. ▪ Assessment of the predicted settlement and horizontal strain profiles caused by construction. ▪ Assessment of the predicted settlements and strains on buildings and basements. ▪ Condition surveys of buildings and structures in the vicinity of the tunnel and station excavations. Detailed modelling of identified property and infrastructure at risk from damage	Section 4.3
23.	SG4	Where settlement predictions exceed the settlement criteria, feasible and reasonable management measures to minimise potential ground settlement are implemented.	Section 4.4
24.	SG5	Monitoring of ground settlement includes installation and monitoring of instrumentation that could include inclinometers,	Section 4.7 and 4.3.2

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No.	Ref.	Relevant Requirement	Where Addressed
		extensometers and surface settlement points at construction sites and along the alignment during construction and for a period of not less than six months after settlement has stabilised with particular reference to risk areas.	
25.	SG6	Where monitoring during construction indicates exceedance of settlement criteria (or variations to these criteria as agreed through agency consultation), all work affecting settlement ceases immediately and doesn't resume until fully rectified or a revised method of work has been established to ensure protection of affected structures.	Section 4.3.2

2.1.4 Stage 2 Submissions Report (SSI-5414)

No.	Ref.	Relevant Requirement	Where Addressed
26.	NV8	Attended vibration monitoring is undertaken at the nearest commercial building during high vibration activities to ensure vibration levels remain below safe limits.	Section 4
27.	NV9	Attended vibration monitoring is undertaken at the nearest residential buildings during high vibration activities to ensure vibration levels remain below safe limits.	Section 4
28.	V6	Monitoring of the effectiveness of mitigation measures is undertaken by the relevant construction contractor. This primarily includes regular visual inspection of the condition of the various measures.	Section 4

3 Monitoring and Protection Overview

The SVC works extend from approximately Chainage 40 km 100 m, south of the proposed Bella Vista Station to Chainage 47 km 400 m, northwest of the proposed Cudgegong Road Station.

Following Old Windsor / Windsor Roads for the majority of its length, the SVC works interface with existing assets including shopping precincts at Bella Vista and Rouse Hill, Windsor Road and multiple cross roads, footpaths, the T-way and T-way interchanges, residential property, and utility services including high voltage and critical water supply.

Using the design alignment and initial services plans, a register of assets has been compiled by ISJV. These will be monitored and protected as indicated in the Monitoring and Asset Protection Matrix (Appendix A).

The assets are individually itemised in Appendix A and include utilities clashes, movements and the WAD Road Works package items in Annexure G of Exhibit K of the Deed. In accordance with the requirements of the *Risk Management Plan*, prior to construction commencing in any area, a risk workshop is held for the purpose of identifying risks and formulating controls to mitigate and manage the risks. This process serves the purpose of the *Pre-Construction Monitoring and Protection Workshop* referred to in Appendix A of the Plan and as part of the risk workshop the monitoring and protection methods, predicted and acceptable effects and monitoring frequency will be reviewed for any identified assets that could be affected by the proposed works.

4 Monitoring and Protection Process

ISJV has identified the potential for construction-induced impacts to the existing assets. In order to mitigate potential impacts, ISJV has implemented a monitoring and protection system that identifies assets at risk of being impacted and how these are monitored and protected for the duration of the works.

Where appropriate, existing ground conditions and infrastructure are continuously monitored over time using equipment, devices and instrumentation in accordance with RMS specifications. These specifications include RMS QA Specifications R422, R423, R424 and R425. Additional information on detailed equipment, devices and instrumentation to be used is located in Section 5.5. Monitoring and protection requirements for potentially impacted assets is identified in the Monitoring and Asset Protection Matrix (Appendix A). For the purpose of condition E26 properties at risk from damage include, but are not necessarily limited to:

- (a) buildings and structures determined following geotechnical and vibration analysis as certified by a qualified geotechnical engineer; and
- (b) other sensitive structures within 60 metres from the edge of the works unless otherwise determined following geotechnical and vibration analysis as certified by a qualified geotechnical engineer as not likely to be adversely affected.
- (c) buildings and structures outside 60m from the works boundary due to service re-locations required relating to permanent works. These instances are to be assessed on a case by case basis following geotechnical and vibration analysis as certified by a qualified geotechnical engineer as not likely to be adversely affected

Monitoring of the actual effects of the Project Works, the Temporary Works and ISJV's activities on existing ground and infrastructure has been undertaken by qualified and experienced geologists, geotechnical engineers, structural engineers, noise and vibration specialists and environmental specialists.

4.1 Monitoring System

There are three primary monitoring systems that are utilised throughout the works as follows:

- Pre and post construction dilapidation surveys
- Vibration monitoring
- Settlement monitoring.

Further details on these systems are detailed in the following sections of this Plan.

4.1.1 Dilapidation surveys

Dilapidation surveys have been undertaken and reports prepared for potentially impacted third party property, structures and infrastructure as required by the CoA and the Deed, prior to the commencement of construction activities. The surveyed properties, structures and infrastructure are identified in Appendices A and C and roads in Appendices D and E.

A detailed land use survey, having regard to the type of land use, has been undertaken to identify potentially critical areas that are sensitive to construction and operational noise (air and ground borne) and vibration impacts. The results of the survey have been incorporated into the Construction Noise and Vibration Management Plan (NWRLSVC-ISJ-SVC-PM-PLN-120201).

Dilapidation surveys have been undertaken pre and post construction at private and public utilities, structures, and buildings that are sensitive to construction vibration and construction ground-borne noise impacts¹.

The pre-construction ground and infrastructure condition surveys have been conducted with the agreement of property owners and any occupiers prior to ISJV commencing the relevant construction activity. The notification of the property owners has been carried out by ISJV's community liaison team. The surveys have been prepared by appropriately qualified consultants and include a detailed record that, as a minimum, includes dated photographs of the pre-construction and post-construction conditions of all ground and infrastructure which may be affected and a summary description of the pre-construction condition of the ground and infrastructure.

ISJV has arranged for post-construction ground and infrastructure surveys carried out by appropriately qualified consultants to establish the condition of all ground and infrastructure (including the existing infrastructure subject to pre-construction ground and infrastructure condition surveys) which may have been affected by the ISJV construction activities.

The ground and infrastructure surveys have been carried out by an independent and appropriately qualified and experienced assessor for the specific element of ground or infrastructure being surveyed. Infrastructure condition surveys detailed in this section have been undertaken in accordance with the requirements in *AS 4349.1 Inspection of buildings – General requirements*.

ISJV has maintained a register of all properties inspected, indicating whether the owner accepted or refused the property inspection offer and provide a copy of the register to the Director General upon request.

The ISJV has provided the Principal's Representative and the owner and/or occupier with a hard copy and an electronic copy in .pdf format of the survey report promptly and in any event within 5 Business Days of the ISJV receiving such a report.

If an issue is identified either visually or by survey the project works in the area will cease until a solution can be found and any damage caused has been repaired.

The JK Geotechnics Report to the IS Joint Venture on Vibration Risk Assessment for NWRL Viaduct Construction Works, 11 July 2014 advising on the risk of damage to properties has been made available upon request to the Director General and the independent Property Impact Assessment Panel in accordance with condition E29.

4.1.2 Settlement Monitoring

Settlement assessments are documented in the Design Report for each Lot and cover the following

- a drawing setting out clearly the purpose and locations of the monitoring points;
- proposed method of installing these monitoring points;
- methods of re-establishing the surface monitoring points in the event of accidental obliteration of such point(s);
- techniques to achieve the stated order of accuracies;
- frequency of monitoring surveys; and
- method to provide an early warning of out of tolerance structural movement to demonstrate magnitude and direction.

¹ As identified in the *JK Geotechnics Report to the IS Joint Venture on Vibration Risk Assessment for NWRL Viaduct Construction Works, 11 July 2014*

The following order of Settlement measurement accuracy has been set as a minimum

Asset or Asset Component	Horizontal Order of Accuracy	Vertical Order of accuracy
Concrete Structures	1H	2E
Embankments	5H	5E
Adjoining Property structures	3H	4E

Monitoring of ground settlement where it is predicted includes installation and monitoring of instrumentation that could include inclinometers, extensometers and surface settlement points at construction sites and along the alignment during construction and for a period of not less than six months after settlement has stabilised with particular reference to risk areas. The exact equipment and procedure is developed once the geotechnical model that predicts settlement is concluded.

Where monitoring during construction indicates exceedance of the settlement criteria in section 5.6.2 (or variations to the criteria as agreed through agency consultation), all work affecting settlement ceases immediately and doesn't resume until fully rectified or a revised method of work has been established to ensure protection of affected structures.

4.1.3 Vibration Monitoring

Vibration monitoring takes place throughout the project works as per the Monitoring and Asset Protection Matrix (Appendix A). Vibration monitoring is conducted by experienced and qualified technician, including the setup of vibration monitoring and recording the nature of the vibration source and its location with respect to the monitor. Periodic vibration reports are provided by the vibration technician including factual data from the field monitoring and describing observations made during the monitoring period. The levels of vibration are to not exceed the values listed in Appendix A (see also Section 4.6.1).

During construction, ISJV consults with other proponents of construction works in the vicinity of the SVC works and reasonable steps are taken to coordinate works to minimise impacts on and maximise respite for affected sensitive receivers. Upon completion of the monitoring, the instruments are decommissioned and any adverse impacts to the site are restored. As part of this process, data integrity is maintained from the instrument to ensure that no information is lost. This includes all data necessary to ensure successful hand over is achieved.

4.2 Protection system

ISJV has designed and constructed the project to minimise impacts to, and interference with, third party property and infrastructure.

Beyond settlement and vibration monitoring of identified assets, in some areas of the Project Works and Temporary Works protection methods are also required for existing infrastructure such as where the works interface with existing roadways or are adjacent to critical utilities. Key services that require protection include overhead electricity, underground electricity, gas, water and sewer mains.

Typical processes for protection of this infrastructure are:

- Minimising construction activities near adjacent infrastructure
- Maintaining local roads where heavy construction traffic travels
- Reducing any vibrations near adjacent infrastructure

- Monitoring all construction activities by ISJV site personnel
- Excavation permits for all excavation within the site works
- Plan and construct temporary access roads in a way that minimises travel on local roads and over underground services
- Insulate overhead electricity or relocate or raise power lines to increase clearance to site activities
- Provide identification markers and cordon off areas at shallow underground utilities
- Maintenance of footpaths and cycleways
- Minimise any excavation near infrastructure.

4.3 Predicted, Acceptable and Actual Effects

ISJV has undertaken a detailed and rigorous engineering analysis in the Design Reports for each Lot to predict the effects (the “Predicted Effects”) of the Project Works, the Temporary Works and ISJV’s Activities over time on existing ground conditions and infrastructure (including roads, parks and other publicly accessible areas, footpaths and cycleways, Utility Services, railways, buildings and other structures) (Condition E27). This analysis has been undertaken by ISJV’s sub consultant J&K Geotechnics prior to commencement of the construction of the relevant works.

A geotechnical model of representative geological and groundwater conditions has been prepared to identify geological structures and groundwater features. (Condition C17). The model was prepared by ISJV’s consultant SMEC² and includes details of proposed excavations, construction staging and identifies surface and sub-surface structures and infrastructure which may be impacted by the SSI, including the specific attributes of those structures. ISJV has used this model to assess the predicted settlement, ground movement, stress redistribution and horizontal strain profiles caused by excavation and building on adjacent property and infrastructure. Settlement criteria (if predicted) for individual utility structures and infrastructure is determined in consultation with the relevant authorities prior to commencement of construction as well as frequency of monitoring.

Throughout the project groundwater monitoring is conducted. Refer to the Water Quality Monitoring Program and Groundwater Monitoring Plan for more details on this monitoring.

The Monitoring and Asset Protection Matrix (Appendix A), sets out the anticipated effects of construction activities and the acceptable effects assessed for each asset. Any actual effects are recorded and monitored in the asset management matrix where they are compared to the predicted and acceptable effects on an ongoing basis.

In the event that monitoring indicates the actual effects of the Project Works, the Temporary Works and ISJV’s Activities on the existing ground conditions and infrastructure exceed the Predicted Effects or significantly vary over time, ISJV reviews and, if necessary, re-evaluates the Predicted Effects and make any adjustment subsequently necessary to any aspects of the manner in which ISJV’s Activities are undertaken to ensure that the Acceptable Effects are not exceeded and to ensure full compliance with the SWTC documentation and the Environmental Documents.

Notwithstanding the Predicted Effects on infrastructure, ISJV repairs and reinstates infrastructure at the earliest opportunity so that ISJV satisfies the requirements of the SWTC and the Environmental Documents for each item of infrastructure.

² Geotechnical & Hydrogeological Interpretative Report – GHIR, Design Lot 56, for Final Design Documentation, October 2014

ISJV promptly and progressively provides the Principal's Representative and the Independent Certifier with:

- Analysis and determinations, including any revisions, and re-evaluations of the Predicted Effects and the Acceptable Effects
- Results of monitoring the actual effects of the Project Works, the Temporary Works and ISJV's Activities on the existing ground conditions and infrastructure over time, in a form which is directly comparable to the Acceptable Effects and Predicted Effects
- Details of any adjustments to the manner in which ISJV's Activities are carried out which are necessary as a consequence of any re-evaluation of Predicted Effects
- Details of designs and materials for the repair and reinstatement of infrastructure.

Prior to the Date of Construction Completion for each Portion, ISJV has submitted a final updated report detailing the Predicted Effects, Acceptable Effects and actual effects of the Project Works, the Temporary Works and ISJV's Activities on the existing ground conditions and infrastructure.

4.4 Independent Property Impact Assessment Panel (IPIAP)

The IPIAP for the SVC works is the same as that used by TJHD for the TSC works, and was approved by the Director General in December 2014. It comprises:

- Dr Brian Burman (Chair)
- Mr David Plaister
- Mr Philip Butcher

The IPIAP is responsible for independently verifying assessments undertaken under conditions C17 and E26, the resolution of property damage disputes and the establishment of ongoing settlement monitoring requirements.

Notwithstanding the requirements of condition E27, ISJV monitors settlement for any period as may be specified by the IPIAP (condition E28). The results of this monitoring are made available to the Director General upon request.

Refer to Appendix B for ISJV's process for managing property damage claims and disputes.

4.5 Equipment, Devices and Instrumentation

The following section outlines the proposed equipment for the project. As the planning and design of the works progress this plan is updated to reflect requirements of monitoring equipment for activities that are not currently covered or that alternative methods of monitoring.

4.5.1 Vibration Monitoring

Vibration measurements are undertaken using monitors that measure vibrations in three orthogonal directions and computes the vector sum to provide peak particle velocity in mm/s. Each unit incorporates a data logger that records the vibrations and the time at which they were measured.

Vibration monitoring tools including electronic and mechanical vibration switches, continuous online monitoring, surveillance scanning, wireless condition monitoring, proximity probes, as well as the Australian built VMU-3 Vibration Monitoring Unit for continuous monitoring. A selection or combination of any of these tools is used for different applications to achieve the most accurate monitoring achievable.

4.5.2 Road Condition Surveys, Reports and Monitoring

Road Condition Surveys

Road condition surveys have been undertaken for the proposed haulage routes indicated on the attached haulage route maps as well as the list below (SWTC Appendix 7) and include testing which unless otherwise agreed, includes Falling Weight Deflectometer testing, rutting, roughness and texture depth, visual survey and cracking.

All surveys have been conducted in both directions, i.e. for the loaded and returning (empty) haulage routes.

Condition surveys have been carried out by independent and appropriately qualified assessors acceptable to the RMS and TfNSW Representatives.

Proposed testing methods are as follows:

- Falling Weight Deflectometer tests (FWD)
 - FWD test is conducted at 100m intervals in the outer wheel path for both transport route and control sections
 - At least three control locations (test points) are necessary on each section. All sections have the same pavement composition, traffic volume and traffic mix. At every significant change of traffic or pavement type, a new section is created
 - No FWD test required on concrete pavements.
- Rutting, Roughness and Texture depth
 - Contemporary data collection vehicles (network survey vehicles – NSV) moving at or close to traffic speed are used to gather rutting, roughness and texture depth data before and after construction
 - Survey length is extended on the sections adjacent to the construction traffic route to provide reference data for comparison
 - Rutting is reported at 20m intervals
 - Roughness is reported at 100m intervals
 - Texture is reported at 100m intervals.
- Visual Survey
 - Visual survey (video recording) is conducted at the time of collecting Rutting Roughness & Texture depth
 - Adjacent sections is recorded to maintain reference and control data
 - Cracking
 - Cracking data is collected with an automated crack detecting device
 - All detected cracks is reported at 100m intervals
 - Crack detection from visual survey data only is not acceptable as it is less reliable and less sensitive, particularly for narrow cracks.

Road Condition Reports

All survey results are included in Condition Reports (please refer to Condition Survey- Hawkeye Data Viewer Files – NWRLSVC-ISJ-TX-0111). Condition reports cover the ground and infrastructure condition survey outcomes which include detailed records (such as dated photographs) of the pre-construction conditions of the ground and infrastructure which could be affected. For the remaining

pavement life under existing traffic flow for each haulage route is included in the NWRLSVC-ISJ-SVC-PM-PLN-120202-Construction Traffic Management Plan reports as well as remaining useful life data for both current traffic levels and increased flows due to construction.

The Reports include data on deflection and curvature values. This information is used to determine the recommendations for managing the structural integrity of the pavement during the period of construction. Construction works and anticipated pavement loadings are reviewed for each route to ensure that the structural integrity of the pavement is protected. For locations where the anticipated loads are detrimentally impact the structural integrity of the pavement, the roadway is upgraded to meet the requirements. The upgrades are in accordance with the requirements defined within RMS specifications.

In situations where it is determined that the end of the pavement life is reached during the predicted construction traffic usage, it is recommended that these areas undergo increased monitoring to ensure that pavement life is not exceeded. In instances where pavement life is exceeded the pavement structure may need to be remediated in accordance with RMS/Council specifications. This needs to be discussed and agreed directly with TfNSW.

It is recommended that dilapidated pavement sections are restored in accordance with the prescribed methodology within RMS & council specifications. During the construction works temporary restoration measures are used to repair dilapidated areas including locations where potholing is performed. Kerb and gutter (including the verge and kerb ramps) are protected from the construction works. These are repaired in accordance with RMS/Council specifications if damaged.

Additionally, details of all locations and the extent of existing visible failures / cracking including photographs and maps identifying each failure / cracked area kept with a unique number and description as per NWRLSVC-ISJ-SVC-CN-RPT-100500 Initial Road Condition Report.

Haulage Road Condition Monitoring

With regards to the haulage road condition monitoring the following items have been undertaken in accordance with the requirements of this plan:

- Identify the haulage routes, including potential alternative routes
- Include a map and a list of identified impacted roads
- List the current base level of heavy vehicle volumes / ESAs on identified routes
- Cover the area of pavement to be monitored, including kerbs, kerb ramps, verge (back of kerb to property boundary), bridges
- Identify the initial routes to be surveyed and schedule of the planned future surveys
- Include a schedule of Condition Surveys, with at least one survey to be conducted not more than three months and not less than one month before the commencement of use of the respective haulage route
- Estimate remaining pavement life under existing traffic flow for each haulage route (see below)
- Estimate remaining pavement life under proposed increased traffic flows as a result of construction traffic for each haulage route (see below)
- Include recommendation to protect and manage the structural integrity of the pavement during the period of construction works
- Determine actions if the end of the pavement life is reached during the predicted construction traffic usage
- Recommend restoration methodology and/or method to measure pavement dilapidation in monetary terms.

Based on the deflection results, most tested roads have shown average maximum deflection less than 0.4mm. Depending on the design traffic (load condition) sections with maximum deflection exceeding 0.4mm could potentially indicate structural deficiencies and need for rehabilitation. In general, all tested roads with the exception of **Miami Road (Left Turning Lane), Samantha Riley Drive (Carpark), Terry Road, Park Road, Railway Road North, Cudgegong Road and Rouse Rd** have average deflection values of less than 0.4mm, which are indicative of relatively stiff pavement structures with satisfactory pavement performance in terms of permanent deformation. In addition, the measured curvature values are low, pointing at pavement structures with a satisfactory pavement performance in terms of asphalt fatigue. Accordingly, only the abovementioned roads have less than a 20 year remaining life based on deflection results of >0.4 mm. Of the abovementioned roads:

- Cudgegong Road is being re-built by the OTS contractor
- Terry Road will not be used for haulage
- Miami Road (turning lane) will be rebuilt by ISJV as part of our works and is not used for haulage
- Samantha Riley Drive (Carpark) will not be used for haulage
- Park Road & Railway Road North – these are near the Pre-Cast Yard facility – will be maintained / repaired in accordance with the Hawkesbury City Council's conditions of Development Consent (DA0586/14) for the Pre-Cast Yard (held by Hanson Precast Pty Ltd)
- Rouse Rd – will not be used for haulage.

Increases in traffic counts due to our works are <1% and therefore there is no change to remaining pavement life due to our construction traffic counts. i.e. we have no impact to the road network due to our traffic.

Base Levels of Heavy Vehicles

The information presented below is based on information contained in the Environmental Assessment No. 1 – Technical Paper: Construction Traffic and Transport Management.

For the existing road network Balmoral Road is a relatively low volume, 70 km/h narrow two lane rural road. It connects to both Old Windsor Road in the west and Memorial Ave to the east. However, the eastern section of the road has a 3 tonne load limit and is therefore not suitable for accommodating construction traffic. It is also expected that traffic on this road would increase as semi-rural land is converted to residential lots. Residential development and road changes have already been undertaken on the eastern end of the road.

The Old Windsor Road / Balmoral Road intersection is controlled by traffic signals with left in/left out access to Balmoral Road. The right turn into Balmoral Road from Old Windsor Road south and the right turn out of Balmoral Road to Old Windsor Road are therefore not permitted. The Transitway crosses Balmoral Road immediately east of the intersection and this movement is incorporated into the traffic signals. The "Balmoral" bus stop is on the northern side of Balmoral Road.

Memorial Ave is a busy 60 km/h two lane arterial with sealed shoulders. The Old Windsor Road / Memorial Ave / Sunnyside Road intersection is a major junction where all movements are permitted. A separate signalised intersection, immediately east of Old Windsor Road, provides for the Transitway to cross Memorial Ave. A major Transitway bus stop ("Burns") and car park exists at this location. The following table presents current base level of heavy vehicles.

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Table 4-1 - current base level of heavy vehicles

Road	Agency Responsibility	Lanes	AADT	HV (assumed 7%)	2011 Peak Hour Volume
Old Windsor Road	RMS	4	49,004	3,430	Northbound AM 1,241 (7.45-8.45am) PM 2,261 (4.15-5.15pm) Southbound AM 1,771 (7-8am) PM 1,435 (4.30-5.30pm)
Balmoral Road	Hills Shire Council	2	872	61	Eastbound AM 16 (7-8am) PM 14 (5-6pm) Westbound AM 112 (8-9am) PM 66 (3-4pm)
Memorial Road	RMS	2	21,660	1,516	Eastbound AM 1,406 (8-9am) PM 885 (5-6pm) Westbound AM 744 (11-12am) PM 952 (4-5pm)

Note: ESAs are calculated using the National AustStab Guidelines

The following table represents the anticipated levels of heavy vehicles on identified routes during the works.

Table 4-2 - anticipated levels of heavy vehicles on identified routes

	Memorial Con. Area	Kellyville Con. Area No. 1	Kellyville Con. Area No. 2	Beaumont Hills Con. Area	Rouse Hill Con. Area No. 2	Rouse Hill Con. Area No. 1	SPC Con. Area (Cut 2)	Windsor Rd Con. Area No. 1 & 2, & SPC Con. Areas
Clear and grub, and access road construction	25-55	1200	500-600	250-350	250-350	30-60		350-600
Cutting Excavation Works							2800	
Pier excavation works	100	250	200	80	80	100		125
Pile reinforcement deliveries	9	12	8	5	5	6		7
Pile concrete placement	80	280	168	88	88	112		144
Pier reinforcement deliveries	9	30	18	10	10	12		15
Pier concrete placement	200	700	420	220	220	280		360

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Main Sections	Design traffic inputs	Total Heavy Vehicle Movements	Nbr	ESA/HAVG	DESA
Start of works to Memorial Ave	11,111 total truck movements, Class 4, 3 axle 125 precast member deliveries, 7 axle	11236	393260	2.01	7.9E+05
	389 total truck movements, class 4/6, 3 axle 125 precast member deliveries, 7 axle	514	17990	2.01	3.6E+04
Memorial Ave to Windsor Rd	1272 total truck movements, class 4/6, 3 axle 125 precast member deliveries, 7 axle	1397	48895	2.01	9.8E+04
	814 total truck movements, class 4/6, 3 axle 125 precast member deliveries, 7 axle	939	32865	2.01	6.6E+04
Windsor Rd to White Hart Ln / Rouse Hill Town Centre	768 total truck movements, class 4/6, 3 axle 125 precast member deliveries, 7 axle	893	31255	2.01	6.3E+04
	403 total truck movements, class 4/6, 3 axle 125 precast member deliveries, 7 axle	528	18480	2.01	3.7E+04
White Hart Ln / Rouse Hill Town Centre to End of Works	510 total truck movements, class 4/6, 3 axle 125 precast member deliveries, 7 axle	635	22225	2.01	4.5E+04
	2800 total truck movements, Class 4, 3 axle 125 precast member deliveries, 7 axle	2925	102375	2.01	2.1E+05

ISJV has followed RMS Specifications R421, R422, R423, R424 and R425 in relation to monitoring dilapidation surveys. The survey has been done following the attributes at the intervals shown below.

- Roughness – 100m intervals
- Rutting – 20m intervals
- Texture – 100m intervals
- Cracking – 100m intervals

In terms of equipment to be used, the following devices have been used -

- Pavement Condition Assessment Overview (Laser Crack Measurement System Survey – Fully Automatic)

The Laser Crack Measurement System (LCMS) is an advanced automatic crack measurement device that is mounted on a standard Hawkeye 2000 Network Survey Vehicle (NSV). The Hawkeye/LCMS system is flexible in the output it can generate.

- Falling Weight Deflectometer (FWD)

In order to evaluate the physical properties of the pavement, a FWD has been used within a trailer that is towed by a dedicated vehicle. The testing apparatus is easily transportable as a trailer, or vehicle-mounted. Each has been fitted with a magnetic sensor based odometer for linear reference and a Differential Global Positioning System (DGPS) to provide an accurate global reference. The odometer is capable of recording the chainage to an accuracy of 1 metre. The DGPS if working correctly and with clear reception must have an accuracy of less than 1 metre. These units are a non-destructive pavement testing device which provides accurate data on the response of the pavement (specifically the surface deflection bowl) to dynamic loads by simulating actual wheel loads in both response and duration. This allows more accurate and rapid measurement of pavement deflection under load than traditional methods. A dynamic load is generated by the dropping of a mass from a pre-set height onto a 300 mm diameter plate. The magnitude of the load and the pavement response are measured by a load cell and nine geophones. One geophone is located immediately under the load, whilst the others are located at variable offsets from the centre of the load. All testing is controlled by a personal computer which is located in the vehicle towing the FWD/HWD. The test load can be varied between 7 and 240 kN to meet the requirements of the particular task and the pavement response for up to four different magnitudes

of load can be measured during any test sequence. The offsets of the geophones can be set to any distance up to 2400 mm from the centre of the load and a typical sequence can be completed in approximately one minute. Highly accurate deflection bowl measurements are therefore possible and the FWD/HWD is very useful for carrying out large-scale pavement surveys. All data is stored on the computer hard drive and emailed daily to our office and backed up onto CD's or USB drives at the end of each day. The FWD can be equipped with DGPS allowing for accurate location of test locations if required.

Specifically, the testing has been conducted with:

- Nine geophones to record the deflection bowl at 0, 200, 300, 450, 600, 750, 900, 1200 and 1500mm from the centre of the load
- A testing cycle at each location which comprises of a seating drop followed by at least three drop cycles for each target loading. The drop cycles are used to determine the repeatability of the deflection data at a test location
- A load pulse applied through a 300mm diameter loading plate with 5mm of rubber
- An operating system which is capable of being set to a predefined load for testing the pavement, in this case 700 kPa
- Equipment which electronically captures and stores the location, load, deflection and temperature data for test cycle at each test location
- An odometer capable of recording the chainage to an accuracy of 1 metre per kilometre or less
- A DGPS unit with an accuracy of less than 1 metre
- An infra-red thermometer which is used to record the pavement temperature and a thermocouple based sensor that measures air temperature.

Testing has been undertaken in the outer (left) wheel path (OWP) as much as feasible for consistency and safety. Due to the central mounting of the FWD testing device on the trailer, extreme care has been taken to ensure the testing is undertaken in the wheel path, particularly when testing in the OWP of kerb lanes. The recording of location references has been undertaken in accordance with the RMS referencing system. This entails all chainages being recorded as the distance from the start of the link in the prescribed direction.

4.5.3 Identification of Non-Functioning Equipment

The collected field data are validated daily to ensure that they meet the requirements of the Contract plus the requirements of our own internal quality checks. In the event of a file failing to meet these requirements, the results of the daily check are communicated Project Leader and / or the technical expert for clarification of the data quality.

When required, the section of road is rescheduled for collection at an appropriate time in order to minimise the delay in data delivery whilst maximising our efficiency.

The data and survey log sheets are returned to the office where the processing takes place. During this checking the road sections surveyed are also checked against the client supplied maps and lists to ensure that no section is not surveyed.

4.5.4 Equipment Calibration

RMS specifications include relative calibration requirements for equipment. ISJV intends to implement the requirements contained within the specifications. It is noted that these include references to Austroads and RMS Test Methods. All monitoring and measuring devices must comply with Principal's General Specification Q6. The Project Quality Plan section 7.6 outlines how Control of Monitoring and Measuring devices will comply with Q6 and the project Quality Team will confirm the

status of monitoring and measuring devices using ISJVSVC-PMS MSR41-1 Monitoring and Measuring Equipment Register

4.6 Periods and Frequency

Throughout ISJV's Activities, ISJV monitors continuously over time the actual effects of the Project Works, the Temporary Works and ISJV's Activities on the ground conditions and infrastructure and compared the actual effects to both the Predicted Effects and the Acceptable Effects.

4.6.1 Vibration Levels

Little guidance on acceptable ground vibration levels is available for Australian conditions. The Australian Standard on Explosives-Storage, transport and handling part 2: Use of explosives (AS 2187.2-1993) provides a recommended upper limit of 10mm/s for residential structures, and 25mm/s for industrial buildings. A previous version of AS 2187 indicates a limit of 2mm/s for heritage structures.

The methods, locations and processes for vibration monitoring are clarified and agreed with the engagement of specialist sub-contractors to carry out all of the monitoring activities. For more specific information in regards to both vibration and noise management for the project, in particular the requirements associated with the Environment Protection Licence (EPL) and the requirements of CoA E15(g), please refer to Section 7 of the Construction Noise & Vibration Management Plan.

The German standard DIN 4150 - (1999-02) recommends peak particle velocity limits ranging from 3mm/s for historical and ancient buildings to 5mm/s for buildings in poor condition and 10mm/s for structurally sound buildings. Limits of between 10mm/s and 40mm/s are also recommended for industrial buildings.

Experience by vibration monitoring and assessment companies while monitoring vibrations from excavations indicates that no significant discernible damage to residential structures are observed while applying the vibration limits of the order of those proposed in the German standard.

The SSI is constructed with the aim of achieving the following construction vibration goals:

- a) For structural damage, the vibration limits set out in the German Standard DIN 4150-3: Structural Vibration – effects of vibration on structures
- b) For human exposure, the acceptable vibration values set out in the Environmental Noise Management Assessing Vibration: A Technical Guideline (Department of Environment and Conservation, 2006).

Table 4-3 Peak particle velocity criteria

Receiver	Peak particle velocity (mm/s)	Allowable exceedance
Residence on privately owned land	5	5% of total number of blasts over a 12 month period
	10	0%
Historic heritage structures	3	0%

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Monitoring of Mungerie House for vibration damage - Inspection include checking of heritage mitigation measures per CEMF, 10.2 (b), including fencing, signage, and monitoring of structures on the Mungerie site for vibration damage. This includes within and bordering the construction footprint.

Table 4-4 Guideline values of vibration for evaluating the effects of short term vibration DIN 4150

Type of structure	Vibration at the foundation at a frequency of			Vibration at horizontal plane of highest floor at all frequencies
	1 Hz to 10 Hz	10 Hz to 50 Hz	50 Hz to 100 Hz*	
Buildings used for commercial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50	40
Dwellings and buildings of similar design and/or use	5	5 to 15	15 to 20	15
Structures that, because of their sensitivity to vibration, do not correspond to those listed in lines 1 and 2 and are of great intrinsic value (e.g. buildings that are under a preservation order)	3	8 to 10	8 to 10	8

* For frequencies above 100Hz, at least the values specified in this column shall be applied. In this project, structures are likely to be residential or of similar design, with vibration from an impact roller likely to be at a frequency of approximately 10–12 Hz. Hence the corresponding guideline value for evaluation of short term vibration is 5 mm/s

When the “action” vibration levels exceed then the offending source is stopped until an alternative solution is found which does not exceed the vibration requirements. If damage has been caused to infrastructure due to vibration from the ISJV construction activities, then the following occurs:

- All sources of vibration within the work area cease operation immediately
- Any owners or occupants are notified and if required evacuated for safety reasons
- Utilities Service providers are notified where utilities have been damaged
- The affected area is secured to prevent unauthorised access
- A structural assessment is undertaken and the results compared with any previous dilapidation survey
- Where the damage is associated with construction, rectification work is implemented or compensation agreed
- The construction methodology and monitoring procedures is reviewed and updated where required.

4.6.2 Settlement Levels

ISJV will identify and implement mitigation measures such as appropriate support and stabilisation structures in consultation with the relevant land and/or infrastructure owners prior to the commencement of construction to ensure where possible that underground services, infrastructure and adjacent buildings don't experience settlement exceeding the following criteria.

Table 4-5 Settlement Criteria (WAD Exhibit D)

Beneath Structure/Facility	Maximum Settlement (mm)	Maximum Angular Distortion
Buildings – Low or non-sensitive properties (ie ≤ 2 levels and carparks)	30	1 in 350

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Buildings – High or sensitive properties (ie ≥ 3 levels and heritage items)	20	1 in 500
Roads and Parking areas	40	1 in 250
Parks	50	1 in 250

5 Maintenance Plans

Detailed maintenance Plans for RMS Assets are included in Section 10 of the Commissioning / Decommissioning, Operations & Maintenance Considerations for each of the Design Management Plans.

The details of individual maintenance plans are appended to the Design Reports as follows:

- Design report Section 10.1 & 10.2 [WAD1-6, 16-24] or Section 5.4.3, & 11.1 [WAD7-15].
- Design report Appendix H1 [WAD1-6, 16-24]

These maintenance plans incorporate the RMS requirements of the WAD and have been developed in accordance with the RMS QA Maintenance Specifications (unamended) and/or the suppliers' documentation for any propriety products eg. bearings or jelly fish.

6 Data and Information Management

All data are received and continually updated and maintained in ISJV's information management system. This system is made available to the Superintendent.

The input and uploading of information from the road condition surveys, dilapidation surveys and ground monitoring is uploaded in accordance with the Project Document Control Plan.

Appendix A. **Monitoring and Asset Protection Matrix**

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Result from review of MCoFA 5100 E27 (Revised Appendix C) and Geotechnical Risk Assessment (extracted from J&K Refer 26401LP Vibration Risk Assessment)							Pre-construction Monitoring and Protection					Pre-construction survey			Construction Monitoring			
ID	Asset	Address	Chainage	Activity	Likelihood of Predicted Damage Vibrations at Structure	Risk	Monitoring Method	Protection Method	Predicted Effects	Acceptable Effected	Monitoring Frequency	Date	Condition/ Monitoring/ Measurement	Proposed Protection (if required)	Condition/ Monitoring/ Measurement	Trigger Level	Method of trigger level exceedance	Site Personnel Responsible
(1)	T Way Bus Shelters and associated Small Structures and Road Infrastructure		various	Piling, excavation and roadworks	Possible to Unlikely	Low	Visual appraisal	Not Required	Negligible	5mm/s	Refer to CNVIS	23-Aug-14	Visual inspection & documented reports	Not Required				
(2)	Elevated small metal 'shed', possibly 'T-way' toilets		41540	Piling	Rare	Very Low	Visual appraisal	Not Required	Negligible	5mm/s	Refer to CNVIS			Not Required				
61 (4.1)	2 x Two-Storey Brick Houses, new, good condition	1 Bellcast Rd, Rouse Hill	44420	Piling/pad excavation	Rare	Very Low	Visual appraisal	Not Required	Negligible	5mm/s	Refer to CNVIS	22-Aug-14	Visual inspection & documented report	Not Required				
62 (4.2)	2 x Two-Storey Brick Houses, new, good condition	3 Bellcast Rd, Rouse Hill	44420	Piling/pad excavation	Rare	Very Low	Visual appraisal	Not Required	Negligible	5mm/s	Refer to CNVIS	22-Aug-14	Visual inspection & documented report	Not Required				
(5)	Concrete Tennis Court on good condition		44580	Piling/pad excavation	Rare	Very Low	Visual appraisal	Not Required	Negligible	5mm/s	Refer to CNVIS			Not Required				
(6)	Heritage Listed Structure	Mungerie House	44620	Piling/pad excavation	Unlikely	Low to Moderate	Visual appraisal	Adjust method to reduce vibration if vibration exceeds the Acceptable Effected limits	Controlled to be negligible	3mm/s	Refer to CNVIS			Adjust methodology to reduce vibration if vibration exceeds the Acceptable Effected limits				
(7.1)	Rouse Hill Town Centre: 2 to 3 storey retail buildings of brick and concrete with prefabricated panels		44915-45260	Piling/ Vibratory Rolling	Unlikely	Low	Visual appraisal	Not Required	Negligible	5mm/s	Refer to CNVIS	22-Aug-14	Visual inspection & documented reports	Not Required	Vibration monitor	3mm/s	Text message to nominated site personnel	Site Supervisor; Environment Representative; & Community Representative
(7.2)	Rouse Hill Town Centre shade Structures and Tway Bus Shelter Tower, Auxillary Rooms and tower		45040-45060	Piling/ Vibratory Rolling	Rare	Very Low	Visual appraisal	Not Required	Negligible	5mm/s	Refer to CNVIS			Not Required	Structures removed/demolished as part of the works – no visual appraisal required.			
59 (8.1)	Single storey brick house, weatherboard outhouse, concrete water tank and metal barn	798 Windsor Rd, Rouse Hill	45650	Cutting Excavation Rock Nail & Shock crete Piling & demolition	Possible	Moderate	Vibration monitoring at the start of a new activity that involves vibration	Adjust method to reduce vibration if vibration exceeds the Acceptable Effected limits	Controlled to be negligible	5mm/s	Refer to CNVIS			Adjust methodology to reduce vibration if vibration exceeds the Acceptable Effected limits				

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Result from review of MCoFA 5100 E27 (Revised Appendix C) and Geotechnical Risk Assessment (extracted from J&K Refer 26401LP Vibration Risk Assessment)							Pre-construction Monitoring and Protection					Pre-construction survey			Construction Monitoring			
ID	Asset	Address	Chainage	Activity	Likelihood of Predicted Damage Vibrations at Structure	Risk	Monitoring Method	Protection Method	Predicted Effects	Acceptable Effected	Monitoring Frequency	Date	Condition/ Monitoring/ Measurement	Proposed Protection (if required)	Condition/ Monitoring/ Measurement	Trigger Level	Method of trigger level exceedance	Site Personnel Responsible
59 (8.2)	Metal Stables, dilapidated	798 Windsor Rd, Rouse Hill	45780	Cutting Excavation Rock Nail & Shock crete Piling & demolition	Rare	Very Low	Visual appraisal	Not Required	Negligible	5mm/s	Refer to CNVIS			Not Required				
6 – 57 (9 Gen)	Weatherboard and static caravans	OK Caravan Park, Rouse Hill	46000	Cutting Excavation Rock Nail & Shock crete Piling & demolition	Unlikely	Very Low to Low	Visual appraisal	Not Required	Negligible	5mm/s	Refer to CNVIS	25-Aug-14	Visual inspection & documented report	Not Required	Vibration monitor	3mm/s	Text message to nominated site personnel	Site Supervisor; Environment Representative; & Community Representative
58 (9.1)	2 storey brick house/office, shed water tank and in-ground swimming pool	End Graham Drive, OK Caravan Park, Rouse Hill	45860	Cutting Excavation Rock Nail & Shock crete Piling & demolition	Possible	Moderate	Vibration monitoring at the start of a new activity that involves vibration	Adjust method to reduce vibration if vibration exceeds the Acceptable Effected limits	Controlled to be negligible	5mm/s	Refer to CNVIS	25-Aug-14	Visual inspection & documented report	Adjust methodology to reduce vibration if vibration exceeds the Acceptable Effected limits	Vibration monitor	3mm/s	Text message to nominated site personnel	Site Supervisor; Environment Representative; & Community Representative
(9.2)	Park facilities building or house	Graham Road, OKCaravan Park	45910	Cutting Excavation Rock Nail & Shock crete Piling & demolition	Possible	Moderate	Vibration monitoring at the start of a new activity that involves vibration	Adjust method to reduce vibration if vibration exceeds the Acceptable Effected limits	Controlled to be negligible	5mm/s	Refer to CNVIS	25-Aug-14	Visual inspection & documented report	Adjust methodology to reduce vibration if vibration exceeds the Acceptable Effected limits	Vibration monitor	3mm/s	Text message to nominated site personnel	Site Supervisor; Environment Representative; & Community Representative
(9.3)	Single Storey brick facilities block	Graham Road, OK Caravan Park	46080	Cutting Excavation Rock Nail & Shock crete Piling & demolition	Possible	Moderate	Vibration monitoring at the start of a new activity that involves vibration	Adjust method to reduce vibration if vibration exceeds the Acceptable Effected limits	Controlled to be negligible	5mm/s	Refer to CNVIS	25-Aug-14	Visual inspection & documented report	Adjust methodology to reduce vibration if vibration exceeds the Acceptable Effected limits	Vibration monitor	3mm/s	Text message to nominated site personnel	Site Supervisor; Environment Representative; & Community Representative
(9.4)	Single Storey brick facilities block	Corral Drive, OK Caravan Park	46160	Cutting Excavation Rock Nail & Shock crete Piling & demolition	Possible	Moderate	Vibration monitoring at the start of a new activity that involves vibration	Adjust method to reduce vibration if vibration exceeds the Acceptable Effected limits	Controlled to be negligible	5mm/s	Refer to CNVIS	25-Aug-14	Visual inspection & documented report	Adjust methodology to reduce vibration if vibration exceeds the Acceptable Effected limits	Vibration monitor	3mm/s	Text message to nominated site personnel	Site Supervisor; Environment Representative; & Community Representative
(9.5)	Metal Water Tank	Corral Drive, OK Caravan Park	46180	Cutting Excavation Rock Nail & Shock crete Piling & demolition	Unlikely	Very Low	Visual appraisal	Not Required	Negligible	5mm/s	Refer to CNVIS	25-Aug-14	Visual inspection & documented report	Not Required	Vibration monitor	3mm/s	Text message to nominated site personnel	Site Supervisor; Environment Representative; & Community Representative
(9.6)	Single Storey Weatherboard house	Corral Drive, OK Caravan Park	46200	Cutting Excavation Rock Nail & Shock crete Piling & demolition	Possible	Low	Visual appraisal	Not Required	Negligible	5mm/s	Refer to CNVIS	25-Aug-14	Visual inspection & documented report	Not Required	Vibration monitor	3mm/s	Text message to nominated site personnel	Site Supervisor; Environment Representative; & Community Representative
4 (10)	Metal Barn	99 Schofields Rd, Rouse Hill	46170	Track Prep Works	Rare	Very Low	Visual appraisal	Not Required	Negligible	5mm/s	Refer to CNVIS	25-Aug-14	Visual inspection & documented report	Not Required				

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Result from review of MCoFA 5100 E27 (Revised Appendix C) and Geotechnical Risk Assessment (extracted from J&K Refer 26401LP Vibration Risk Assessment)							Pre-construction Monitoring and Protection					Pre-construction survey			Construction Monitoring				
ID	Asset	Address	Chainage	Activity	Likelihood of Predicted Damage Vibrations at Structure	Risk	Monitoring Method	Protection Method	Predicted Effects	Acceptable Effected	Monitoring Frequency	Date		Condition/ Monitoring/ Measurement	Proposed Protection (if required)	Condition/ Monitoring/ Measurement	Trigger Level	Method of trigger level exceedance	Site Personnel Responsible
5 (11)	Derelict Single Storey Weatherboard House	44 Terry Rd Rouse Hill	46390	Piling	Rare	Very Low	Visual appraisal	Not Required	Negligible	5mm/s	Refer to CNVIS	Declined							
(12)	Earth Dam	97 Schofields Rd, Rouse Hill	46470	Piling	Rare	Very Low	Visual appraisal	Not Required	Negligible	5mm/s	ISJV Site								
1 (13)	Single Storey Weatherboard house and metal garage / shed	38 Cudgegong Rd, Rouse Hill	46760	Piling Earthworks	Rare	Very Low	Visual appraisal	Not Required	Negligible	5mm/s	Refer to CNVIS	Declined							
2 (14)	Two Story Brick House	91 Schofields Rd, Rouse Hill	46470	Piling Earthworks	Rare	Very Low	Visual appraisal	Not Required	Negligible	5mm/s	Refer to CNVIS	23-Aug-15	Visual inspection & documented report	Not Required					
3 (15)	Single Story Weatherboard House and garages	95 Schofields Rd, Rouse Hill	46300	Piling Earthworks	Rare	Very Low	Visual appraisal	Not Required	Negligible	5mm/s	Refer to CNVIS	Declined							
60	Two Story Brick House	5 Bellcast Rd, Rouse	44480	Piling Earthworks	Rare	Very Low	Visual appraisal	Not Required	Negligible	5mm/s	Refer to CNVIS			Not Required					
63	Two Story Brick House	26 Sanctuary Drive, Rouse Hill	44420	Piling Earthworks	Rare	Very Low	Visual appraisal	Not Required	Negligible	5mm/s	Refer to CNVIS			Not Required					
64	Two Story Brick House	195 Sanctuary Drive, Rouse Hill	44420	Piling Earthworks	Rare	Very Low	Visual appraisal	Not Required	Negligible	5mm/s	Refer to CNVIS			Not Required					
65 (3)	Residence east of Elizabeth Macarthur Creek Single Story Brick House	23 Landy Pl, Kellyville	42620	Earthworks and pavement construction	Unlikely	Low	Visual appraisal	Not Required	Negligible	5mm/s	Refer to CNVIS		Visual inspection & documented report	Not Required					
66 (3)	Residence east of Elizabeth Macarthur Creek Two Story Brick House	19 Landy Pl, Kellyville	42600	Earthworks and pavement construction	Unlikely	Low	Visual appraisal	Not Required	Negligible	5mm/s	Refer to CNVIS		Visual inspection & documented report	Not Required					

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Result from review of MCoFA 5100 E27 (Revised Appendix C) and Geotechnical Risk Assessment (extracted from J&K Refer 26401LP Vibration Risk Assessment)							Pre-construction Monitoring and Protection					Pre-construction survey			Construction Monitoring			
ID	Asset	Address	Chainage	Activity	Likelihood of Predicted Damage Vibrations at Structure	Risk	Monitoring Method	Protection Method	Predicted Effects	Acceptable Effected	Monitoring Frequency	Date	Condition/ Monitoring/ Measurement	Proposed Protection (if required)	Condition/ Monitoring/ Measurement	Trigger Level	Method of trigger level exceedance	Site Personnel Responsible
67 (3)	Residence east of Elizabeth Macarthur Creek Two Story Brick House	17 Landy Pl, Kellyville	42590	Earthworks and pavement construction	Unlikely	Low	Visual appraisal	Not Required	Negligible	5mm/s	Refer to CNVIS		Visual inspection & documented report	Not Required				
68 (3)	Residence east of Elizabeth Macarthur Creek Two Story Brick House	15 Landy Pl, Kellyville	42580	Earthworks and pavement construction	Unlikely	Low	Visual appraisal	Not Required	Negligible	5mm/s	Refer to CNVIS		Visual inspection & documented report	Not Required				
69	Single Story Brick House	25 Meldon Pl, Stanhope Gardens	41800	Piling Earthworks	Unlikely	Low	Visual appraisal	Not Required	Negligible	5mm/s	Refer to CNVIS		Visual inspection & documented report	Not Required				
70	Single Story Brick House	40 Memorial Ave, Kellyville	41510	Earthworks	Unlikely	Low	Visual appraisal	Not Required	Negligible	5mm/s	Refer to CNVIS		Visual inspection & documented report	Not Required				
71	Derelict Two Story Brick House	21 Balmoral Rd, Kellyville	41080	Excavation	Unlikely	Very Low	Visual appraisal	Not Required	Negligible	5mm/s	Refer to CNVIS		Visual inspection & documented report	Not Required				
72	Derelict Single Storey Weatherboard House	19 Balmoral Rd, Kellyville	41060	Excavation	Unlikely	Very Low	Visual appraisal	Not Required	Negligible	5mm/s	Refer to CNVIS		Visual inspection & documented report	Not Required				
73	Derelict Single Shed	19 Balmoral Rd, Kellyville	41060	Excavation	Unlikely	Very Low	Visual appraisal	Not Required	Negligible	5mm/s	Refer to CNVIS		Visual inspection & documented report	Not Required				
74	Two Story Brick House	3 Miami St, Glenwood	41060	Earthworks & pavement construction	Unlikely	Very Low	Visual appraisal	Not Required	Negligible	5mm/s	Refer to CNVIS		Visual inspection & documented report	Not Required				
75	Two Story Brick House	5 Miami St, Glenwood	41060	Earthworks & pavement construction	Unlikely	Very Low	Visual appraisal	Not Required	Negligible	5mm/s	Refer to CNVIS		Visual inspection & documented report	Not Required				
76	Two Story Brick House	18 Tarwin Ave, Glenwood	41060	Earthworks & pavement construction	Unlikely	Very Low	Visual appraisal	Not Required	Negligible	5mm/s	Refer to CNVIS		Visual inspection & documented report	Not Required				

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Result from review of MCoFA 5100 E27 (Revised Appendix C) and Geotechnical Risk Assessment (extracted from J&K Refer 26401LP Vibration Risk Assessment)							Pre-construction Monitoring and Protection					Pre-construction survey			Construction Monitoring			
ID	Asset	Address	Chainage	Activity	Likelihood of Predicted Damage Vibrations at Structure	Risk	Monitoring Method	Protection Method	Predicted Effects	Acceptable Effected	Monitoring Frequency	Date	Condition/ Monitoring/ Measurement	Proposed Protection (if required)	Condition/ Monitoring/ Measurement	Trigger Level	Method of trigger level exceedance	Site Personnel Responsible
77	Two Story Brick House	17 Tarwin Ave, Glenwood	41060	Earthworks & pavement construction	Unlikely	Very Low	Visual appraisal	Not Required	Negligible	5mm/s	Refer to CNVIS		Visual inspection & documented report	Not Required				
78	Two Story Brick House	19 Tarwin Ave, Glenwood	41060	Earthworks & pavement construction	Unlikely	Very Low	Visual appraisal	Not Required	Negligible	5mm/s	Refer to CNVIS		Visual inspection & documented report	Not Required				
79	Two Story Brick House	5 Almona St, Glenwood	41060	Earthworks & pavement construction	Unlikely	Very Low	Visual appraisal	Adjust method to reduce vibration if vibration exceeds the Acceptable Effected limits	Controlled to be negligible	5mm/s	Refer to CNVIS		Visual inspection & documented report	Adjust methodology to reduce vibration if vibration exceeds the Acceptable Effected limits				
80	Two Story Brick House	3 Almona St, Glenwood	41060	Earthworks & pavement construction	Unlikely	Very Low	Visual appraisal	Adjust method to reduce vibration if vibration exceeds the Acceptable Effected limits	Controlled to be negligible	5mm/s	Refer to CNVIS		Visual inspection & documented report	Adjust methodology to reduce vibration if vibration exceeds the Acceptable Effected limits				
81	Single Story Brick House	10 Beth Way, Glenwood	41060	Earthworks & pavement construction	Unlikely	Very Low	Visual appraisal	Not Required	Negligible	20mm/s	Refer to CNVIS		Visual inspection & documented report	Not Required				
82	Two Story Brick House	35 Ipswich Ave, Glenwood	41060	Earthworks & pavement construction	Unlikely	Very Low	Visual appraisal	Not Required	Negligible	20mm/s	Refer to CNVIS		Visual inspection & documented report	Not Required				
83	Hungry Jack's Parklea	1190 Old Windsor Rd, Glenwood	41100	Earthworks & pavement construction	Unlikely	Very Low	Visual appraisal	Adjust method to reduce vibration if vibration exceeds the Acceptable Effected limits	Controlled to be negligible	20mm/s	Refer to CNVIS		Visual inspection & documented report	Adjust methodology to reduce vibration if vibration exceeds the Acceptable Effected limits				
84	Recently construction KFC Restaurant (behind Hungry Jacks Parklea)		41100	Earthworks & pavement construction	Unlikely	Very Low	Visual appraisal	Adjust method to reduce vibration if vibration exceeds the Acceptable Effected limits	Controlled to be negligible	20mm/s	Refer to CNVIS		Visual inspection & documented report	Adjust methodology to reduce vibration if vibration exceeds the Acceptable Effected limits				

(_) Previous ID given from Geotechnical Risk Assessment (extracted from J&K Refer 26401LP Vibration Risk Assessment)

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Public Utility Monitoring & Protection Plan

ID	Asset	Chainage	Activity	Likelihood of Predicted Damage Vibrations at Structure	Risk	Monitoring Method	Protection Method	Predicted Effects	Acceptable Effect	Monitoring Frequency	Date	Condition/ Monitoring/ Measurement	Proposed Protection (if required)
161	DN450 GRP Sewer Balmoral	41040	Excavation and roadworks	Possible to Unlikely	Low	Internal CCTV	Not Required	Negligible	5mm/s*	At the start of new activities that involve vibration	October-16	CCTV inspection & documented reports	Not Required
34	DN450 Recycled Water Main	41610	Pile boring and excavation	Possible	Low	Visual appraisal	Geotech report on pilecap excavation	Negligible	5mm/s*	At the commencement of piling and throughout excavation	September -15	Visual inspection & Sydney Water BOA approval	Not Required
51	DN525 GRP Sewer	43080	Pile boring and excavation	Possible	Moderate	Internal CCTV	Concrete Encasement	Negligible	5mm/s*	At the commencement of piling and throughout excavation	April -16	Visual inspection & Sydney Water approval	Concrete Encasement
52	DN900Sewer pier 52-58	43120 - 43410	Pile boring, excavation and haul rd construction	Possible to Unlikely	Low	Internal CCTV	Not Required	Negligible	5mm/s*	At the start of new activities that involve vibration	October-15	CCTV inspection & Sydney Water BOA approval	Not Required
58	Telstra pit pier 60	43480	Pile boring and excavation	Possible	Low	Visual appraisal	Geotech report on pilecap excavation, shoring	Negligible	6mm/s*	At the commencement of piling and throughout excavation	February-16	Visual Inspection	Shoring design
74	DN450 Sewer pier 75	44080	Pile boring and excavation	Possible to Unlikely	Very Low	Internal CCTV	Not Required	Negligible	5mm/s*	At the start of new activities that involve vibration	October-15	CCTV inspection & Sydney Water BOA approval	Not Required
97	DN324 SCL Water Mains – Concrete Encased pier 111	45320	Pile boring and excavation	Possible to Unlikely	Low	Visual appraisal	Geotech report on pilecap excavation	Negligible	5mm/s*	At the commencement of piling and throughout excavation	February-16	Visual Inspection	Not Required
97	DN600 Recycled Water main Pier 112	45400	Pile boring and excavation	Possible	Moderate	Visual appraisal, Vibration Monitoring	Concrete Encasement	Negligible	5mm/s*	At the commencement of piling and throughout excavation	July-15	Vibration Monitoring & Sydney Water BOA approval	Maintenance free mains and concrete encasement

Monitoring and Protection Plan

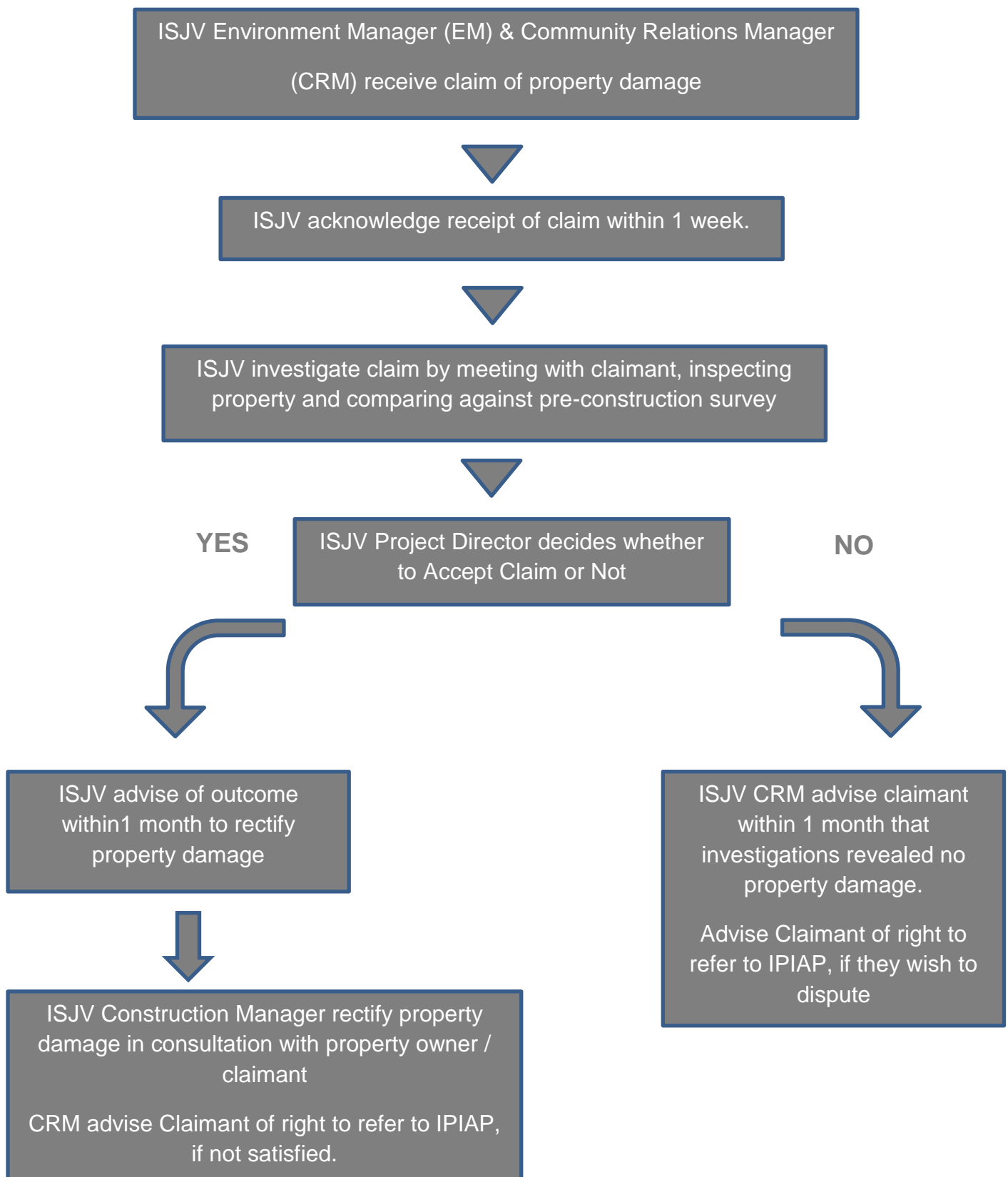
Surface and Viaduct Civil Works



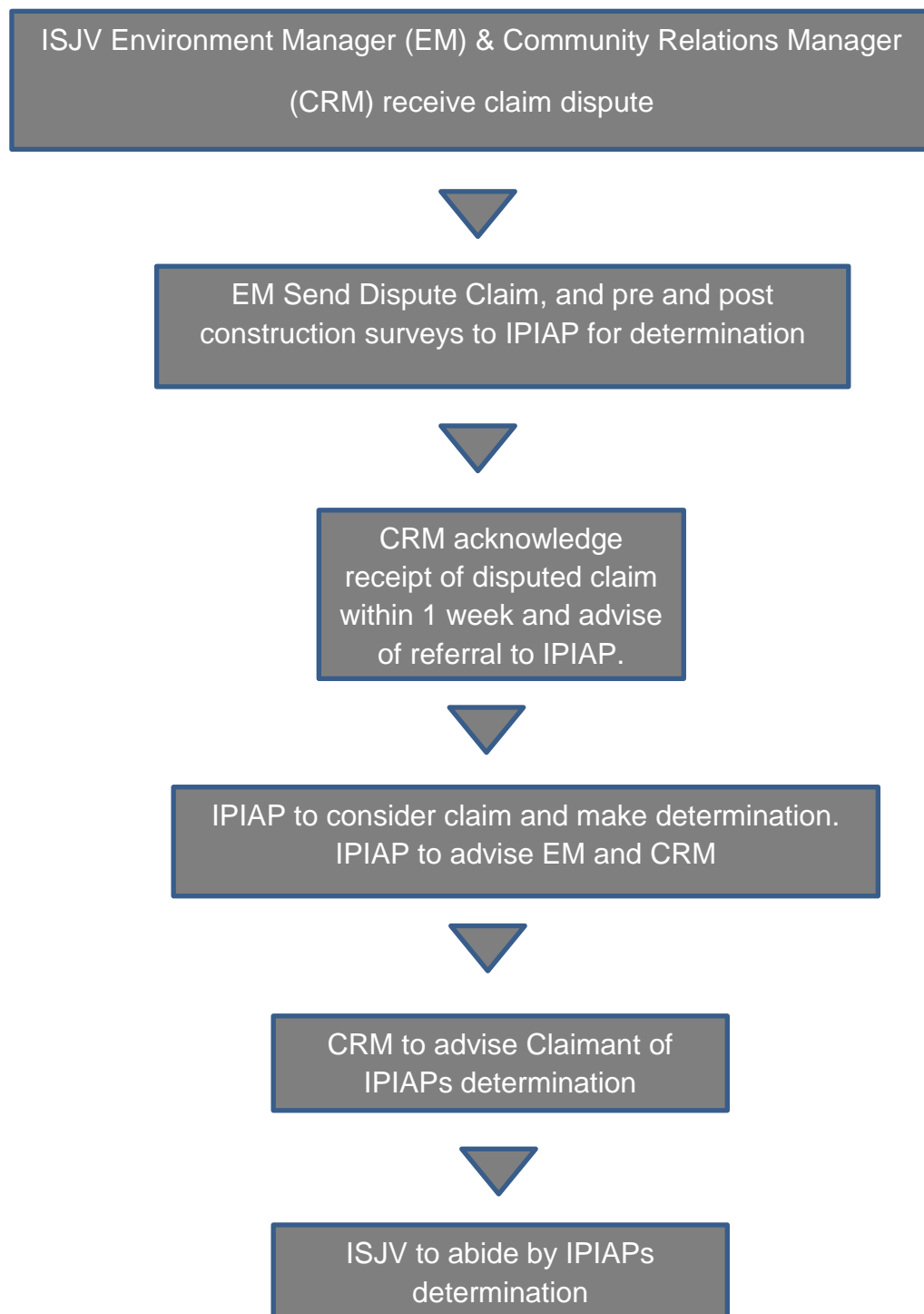
105, 106	DN750 and DN450 Water main pier 113	45510	Pile boring and excavation	Possible	Moderate	Visual appraisal, Vibration Monitoring	Concrete Encasement	Negligible	5mm/s*	At the commencement of piling and throughout excavation	July-15	Vibration Monitoring & Sydney Water BOA approval	Maintenance free mains and concrete encasement
108	DN600 Sewer SPC pier 7	46480	Pile boring, excavation and haul rd construction	Possible to Unlikely	Low	Internal CCTV	Not Required	Negligible	5mm/s*	At the start of new activities that involve vibration	October-15	CCTV inspection & Sydney Water BOA approval	Not Required

Appendix B. **Claims and Disputes Process for Property damage**

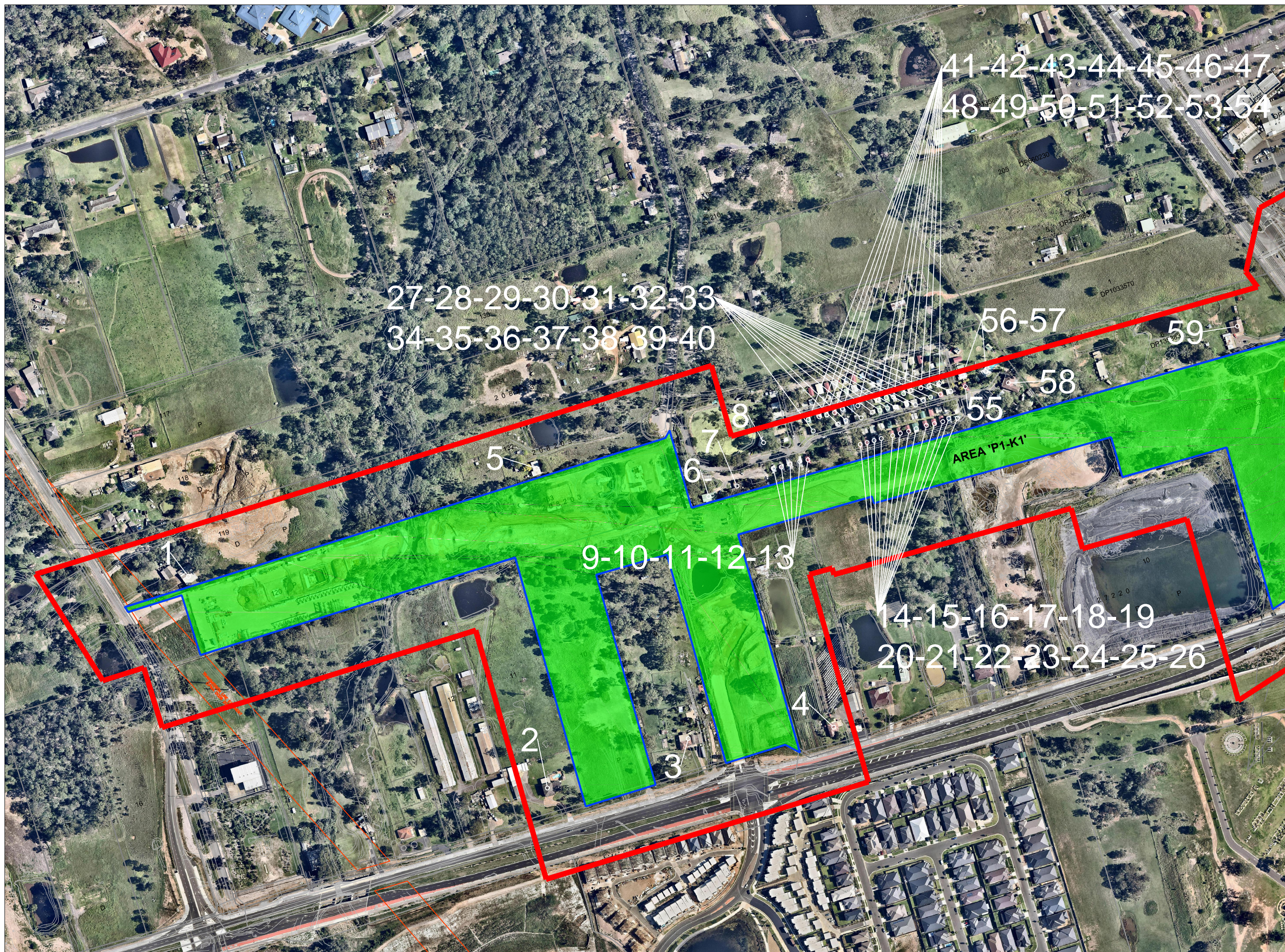
Process for Property Damage Claim

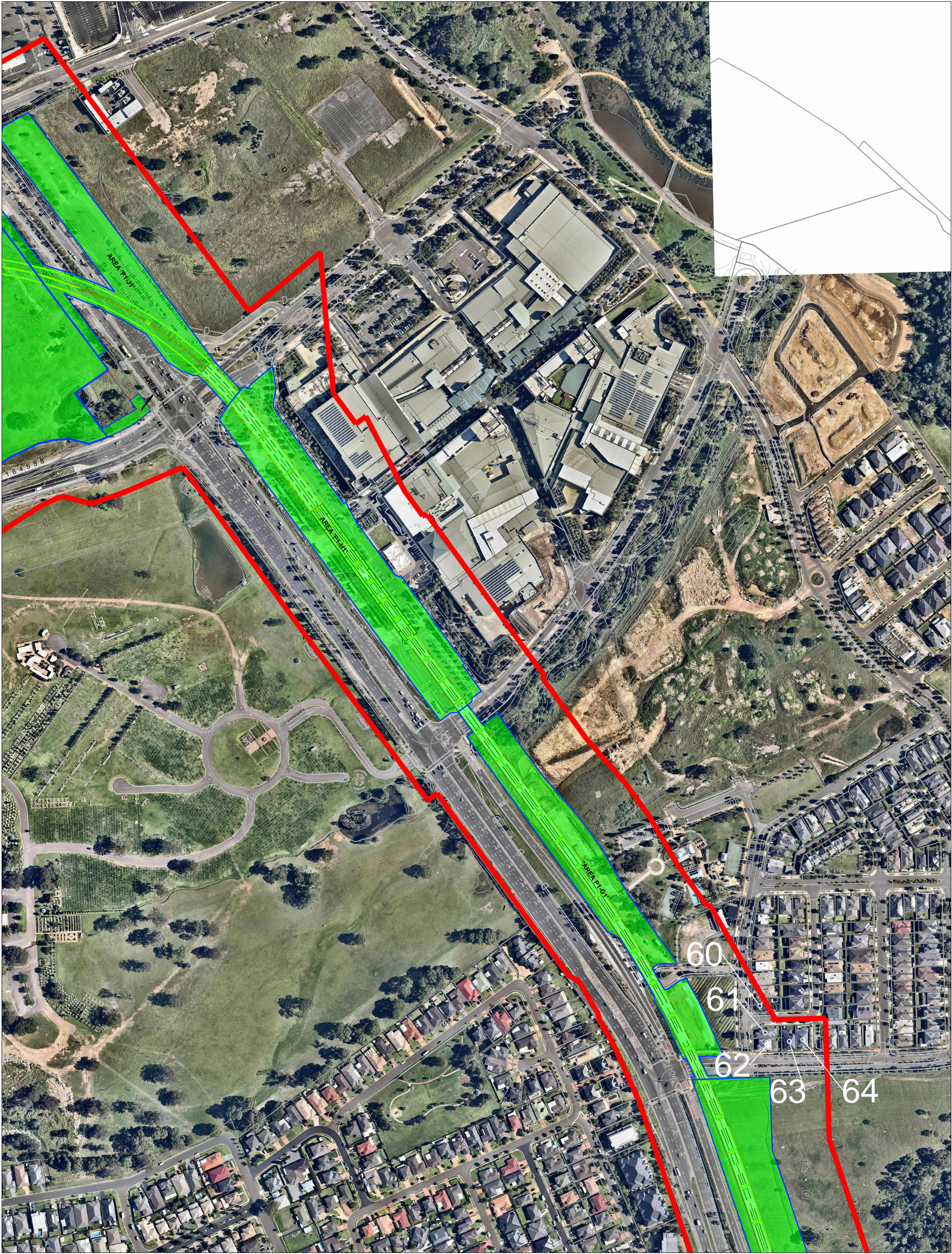


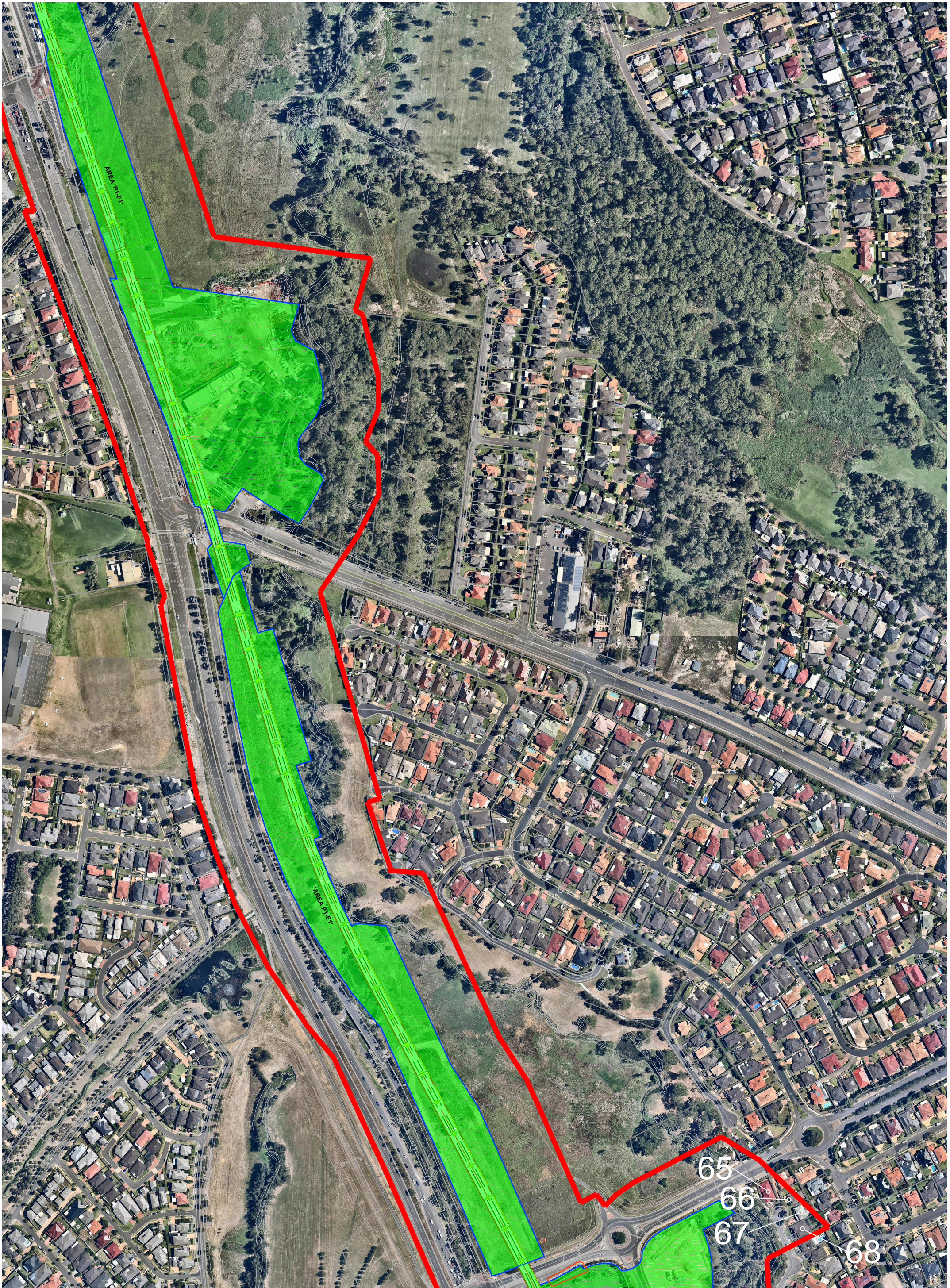
Process for Property Damage Claim Disputes

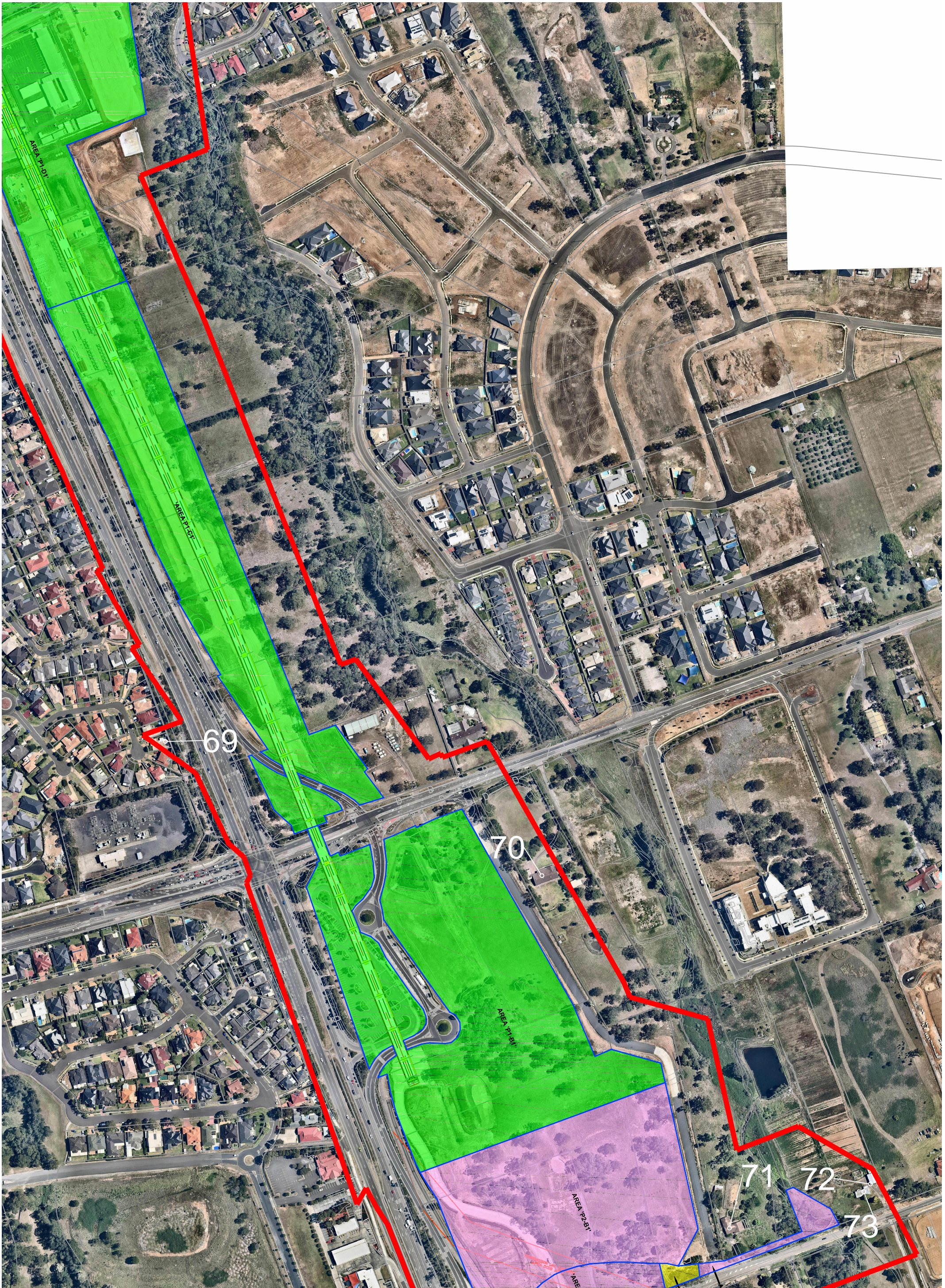


Appendix C. **Property SURVEY LOCATION MAP**











Appendix D. ROAD SURVEY LOCALITIES

Monitoring and Protection Plan

Surface and Viaduct Civil Works



Haulage route(s) for construction vehicles associated with SVC project works on local roads from the construction access/ egress point(s) to the arterial road network. A qualified person or team shall undertake a Road Dilapidation Report based on roads identified below.

Description	Qty (m)
Balmoral Road	100
Memorial Ave	220
Bus T Way	160
Bus T Way	160
Samantha Riley Drive (incl Roundabout)	180
Bus T way	150
Area 'D6 & D7'	250
Bus T way	900
Windsor Road	100
Bus T way	900
Sanctuary Drive	80
Bus T way	400
White Hart Drive	40
Bus T way	500
Rouse Hill Drive	50
Schofield Road	800