IN THE MATTER	of the Resource Management Act 1991 (**RMA**)
AND	
IN THE MATTER	of an application for regional resource consents and a land use consent under the Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011 (NES Soil) in fulfilment of section 88 of the RMA.

SUPPLEMENTARY EVIDENCE OF DR SARAH MEGAN FLYNN

ON BEHALF OF WATERCARE SERVICES LIMITED

Kauri Dieback – Terrestrial Ecology

7 April 2021

---

1. INTRODUCTION

1.1 My full name is Dr Sarah Megan Flynn.

1.2 I prepared a statement of evidence dated 4 February 2020 in relation to Watercare Services Limited (**Watercare**)'s application for regional resource consents and a land use consent for the replacement of the existing Huia Water Treatment Plant (**WTP**) (the **Project**). I refer to my qualifications and experience in my original statement of evidence and do not repeat those matters here.

1.3 I also prepared the following statements of evidence during the course of the hearing for the Project:

a) A statement of rebuttal and summary evidence dated 24 February 2020 which provided a brief summary of my original evidence and responded to matters in the evidence submitted on behalf of the Department of Conservation and by Dr Nick

Waipara and Ms Shona Myers[1]. I presented this statement of rebuttal and summary evidence at the Council hearing on 26 February 2020; and

b) A statement of further rebuttal evidence dated 4 March 2020 which responded to the evidence of Mr Jack Craw, Dr Amanda Black and Dr Peter Maddison.[2] I presented this statement of further rebuttal evidence at the Council hearing on 4 March 2020.

1.4 I advise that I have read the Code of Conduct for Expert Witnesses contained in the Environment Court Practice Note 2014 and have complied with it in preparing this evidence. I confirm that the issues addressed in this evidence are within my area of expertise and I have not omitted material facts known to me that might alter or detract from my evidence.

2. SCOPE OF SUPPLEMENTARY EVIDENCE

2.1 I prepared the updated draft Kauri Dieback Management Plan (**KDMP**) with staging plans incorporated as appendices dated 8 December 2020. A copy of the KDMP and staging plans are attached to my supplementary evidence **at Appendix 1**. Details of the preparation of the KDMP and staging plans are discussed further in my evidence below.

2.2 My evidence will cover the following matters:

a) Summary of the kauri dieback caucusing and preparation of related documents;

b) Description of the results of the *Phytophthora agathidicida* (**Pa**) and *Phytophthora cinnamomi* sampling/testing;

c) Description of the KDMP; and

d) Conclusions.

1 On behalf of The Royal Forest and Bird Protection Society of New Zealand Incorporated, Waitakere Ranges Protection Society, The Tree Council and Titirangi Residents and Ratepayers Association Incorporated.

2 On behalf of The Royal Forest and Bird Protection Society of New Zealand Incorporated, Waitakere Ranges Protection Society, The Tree Council and Titirangi Residents and Ratepayers Association Incorporated.

2.3 In this statement of supplementary evidence, I refer to:

a) Mr Campbell McGregor's supplementary evidence which describes the staging plans attached to the KDMP and protocols in the KDMP in relation to earthworks, and erosion and sediment control; and

b) Mr Daniel Williams' supplementary evidence which confirms the appropriateness of the protocols proposed in the KDMP from a contractor's perspective.

3. SUMMARY OF EVIDENCE

3.1 Expert caucusing on the issue of kauri dieback resulted in commissioning of a comprehensive programme of sampling and testing throughout the Project site and adjacent buffer area within Clarks Bush Reserve by an independent provider (BioSense Limited (**BioSense**)), in accordance with an agreed works specification developed during the caucusing process. Testing confirmed the presence of Pa throughout the Project site, adjacent buffer area, and watercourses within and downstream of the site. Results indicate that all topsoil within the Project site and surrounds must be regarded as potentially infected. Accordingly, the applicable management functions for the Project site are those that contain and control the movement of soil and surface water.

3.2 Accordingly, the focus of the KDMP is management of risk factors that could increase contact between exposed/disturbed soil and vectors for spread of the pathogen (principally water, machinery/equipment, and people). In particular, management of vegetation clearance and topsoil removal will limit the spatial extent of active working areas, divert any stormwater away from the footprint, contain all soil and water from the works footprint and control the discharge of stormwater while potentially infected material is excavated from the works site.

3.3 Site-wide hygiene protocols for vehicles, machinery/equipment and personnel entering, moving around and leaving the Project site specified in the KDMP will be installed and used throughout the Project.

3.4 In my opinion, the protocols proposed are robust and the proposal will not increase the distribution of Pa within or beyond the catchment, or the extent of kauri infection within the catchment beyond what is currently present.

4. KAURI DIEBACK CAUCUSING AND PREPARATION OF RELATED DOCUMENTS

4.1 This section summarises the initial and substantive caucusing which took place last year.

Initial expert caucusing

4.2 Initial expert caucusing[3] on the issue of kauri dieback took place via video conference on 16 April 2020 to discuss and (ideally) agree on the methodology, extent and scope of kauri dieback testing that is to be undertaken. It was chaired by an independent facilitator, Mr Alan Watson. To assist with the initial caucusing, I had prepared and circulated a "Sampling Protocol to assess presence and distribution of Phytophtora agathadicida in proposed WTP site and adjacent catchment - draft for discussion".

4.3 During the initial caucusing the Participants produced a joint witness statement dated 16 April 2020 (**JWS**) which was subsequently circulated by Mr Sam Otter, the Council's Senior Hearings Advisor.[4]

4.4 In summary, all agreed that I would draft a works specification outlining the purpose and context of sampling and relevant site information, to be reviewed and agreed to by all parties. The specification would then go to an agreed specialist technical service provider who undertakes sample collection for kauri dieback surveillance, who would develop the detailed sampling layout and collection methods following most recent best practice.

Engaging BioSense

4.5 Following that caucusing, and as agreed in the JWS, I prepared a specification and briefing letter for the external party who would be carrying out the kauri dieback sampling/testing (**Briefing Letter**). I circulated the Briefing Letter to the caucusing participants on 24 April 2020 for their comments. The caucusing participants agreed that BioSense had the necessary expertise and capability to carry out the sampling/testing and should be approached. The Briefing Letter was sent to BioSense.

3 Participants were myself on behalf of Watercare, Dr Murray Fea on behalf of the Council; Dr Nick Waipara on behalf of The Royal Forest and Bird Society of New Zealand Incorporated, Waitakere Ranges Protection Society, The Tree Council and Titirangi Residents and Ratepayers Association Incorporated; Mr Jack Craw on behalf of Save Our Kauri Trust, Titirangi Protection Group, the Royal Forest and Bird Society of New Zealand Incorporated, Waitakere Ranges Protection Society, the Tree Council and Titirangi Residents and Ratepayers Association Incorporated; and Mr David Havell on behalf of the Department of Conservation.

4 In accordance with paragraph 12(a) of the Minute issued to the parties by the Independent Hearings Panel (the **Panel**) on 13 March 2020 in relation to these proceedings setting out the Panel's Kauri Dieback directions.

4.6 I liaised with BioSense after the Briefing Letter was sent. BioSense provided me with a proposed sampling plan on 4 June 2020 that set out three different options for the design of the testing framework (**Proposal**). I then circulated this Proposal to the caucusing participants for their feedback. This feedback was provided by Thursday 11 June 2020 as agreed, and BioSense was instructed to carry out the kauri dieback testing in accordance with the instructions prepared by myself in consultation with the other experts.

BioSense sampling/testing and results

4.7 Sampling began on Friday 26 June 2020. However, due to some disruptions (including COVID-19 restrictions), BioSense completed the kauri dieback sampling/testing and provided results in mid-November 2020 in the "Kauri dieback disease surveillance of Watercare's proposed replacement water treatment plant site at Waima Catchment" report (**Biosense report**)

Substantive expert caucusing

4.8 Mr Williams, Mr McGregor and I prepared a package of information that summarised all the pertinent information that we considered was required for the experts to have a sound understanding of the proposal and the mitigation that is currently proposed in relation to kauri dieback (**Information Package**).[5] As directed the Information Package included details of the proposed kauri dieback protocols, the earthworks proposed, erosion and sediment control measures to be employed, vegetation removal and construction methodology. These details were set out in a draft KDMP and accompanying staging plans. The Information Package also included a copy of the results of the kauri dieback testing undertaken by BioSense.

4.9 The Information Package was completed and sent to Mr Otter on 8 December 2020, and circulated by Mr Otter to the experts that day. This was one week in advance of the substantive expert caucusing.

4.10 Substantive expert caucusing took place on 15 December 2020 as scheduled by Mr Otter.[6] It was facilitated by Mr David Hill, an Independent Hearing Commissioner.

5 In accordance with paragraph 12(f) and (g) of the Panel's minute dated 13 March 2020.
6 In accordance with the Panel's directions in paragraph 10 of its seventh minute dated 27 October 2020.

4.11 Attendees at the substantive expert caucusing comprised myself, Mr McGregor, Mr Williams, Mr Carl Tutt, Dr Nick Waipara, Dr Murray Fea, Mr David Havell and Mr Lee Hill.[7] Mr McGregor, Mr Williams, Mr Tutt and Mr Hill attended in an advisory capacity and did not record a position on any of the issues discussed.

4.12 Mr Jack Craw was invited to attend the caucusing but I understand he elected not do so. Dr Waipara was unwell and elected to attend online rather than in person. A second JWS was subsequently produced, signed at various dates in late January and early February 2021 by Dr Murray Fea, Mr David Havell and myself. Dr Waipara declined to participate in preparation of the JWS.

4.13 Since the completion of caucusing, Mr Craw and Dr Waipara requested that further caucusing be rescheduled and undertaken again. The Commissioners determined that further expert caucusing is not required and directed that the hearing be reconvened.

4.14 As recorded in the second JWS, attendees agreed that the BioSense investigation met the brief provided.

5. RESULTS OF PHYTOPHTHORA AGATHIDICIDA AND PHYTOPHTHORA CINNAMOMI SAMPLING/TESTING

5.1 As Mr Hill describes in his evidence, the BioSense team developed a field testing protocol to assess the presence and distribution of kauri dieback causing pathogens (specifically Pa, and also including *Phytophthora cinnamomi*).

5.2 The objective of sampling was to assess:

a) The disease status of kauri trees within and surrounding the proposed works footprint.

b) The presence and distribution of *Phytophthora* in soil within the Project site and adjacent buffer.

7 In accordance with paragraph 7(a) and (b) of the Panel's minute dated 8 May 2020 and paragraph 10(b) of the Panel's minute dated 27 October 2020.

c) The presence of *Phytophthora* within the adjacent reserve, focusing on likely infection pathways such as walking tracks, watercourses and areas of standing water, and sites of human and feral animal disturbance.

5.3 Sample collection and analysis methods sought to maximise detection probability, in order to give the best chance that kauri dieback-causing pathogens would be detected if present within the construction footprint and wider Project site. As Mr Hill explains, sample analyses used a combination of LAMP assay and qPCR detection methods for Pa and *P. cinnamomi,* rather than a traditional bioassay method as this novel method has been shown to produce more precise and repeatable results.

5.4 This testing has confirmed the presence of Pa within the Project site. While infections are more concentrated in stands of mature kauri located away from the works footprint, sporadic detections in soil and watercourses away from kauri specimens were found throughout the Project site, including within the works footprint.

5.5 A similar pattern of distribution was found in the adjacent portion of Clarks Bush reserve that was sampled, and several detections were found along the Exhibition Drive walking track which is still open to the public. Another disease-causing pathogen, *P. cinnamomi,* was also detected, mainly within stands of mature kauri.

5.6 The distribution of Pa across the Project site and in the adjacent reserve area that was sampled is generally consistent with the scenario I anticipated when drafting the earlier version of the KDMP that was provided with the consent application[8]. That is, the pathogen is present in infected kauri trees within both the Project site and in adjacent properties, and has been dispersed into soils in the wider area, probably via a variety of mechanisms, though most likely through movement of contaminated soil and/or surface water.

5.7 Pa was detected in 15.5% of samples overall, with a slightly lower rate of detection (9.5%) in stratified soil samples, and slightly higher rates in rootzone and track samples (18%) and watercourse samples (20%).

5.8 As expected, stands of mature kauri trees are the main locus of infection, but distribution of the pathogen across the sample area indicates that immediate proximity to kauri is not an

[8] Paragraph 7.27 of my evidence in chief (**EIC**).

especially reliable predictor of its presence or absence. Somewhat unexpected was the weak association with poorly maintained tracks (Clarks Bush and informal tracks through the infected kauri stand in the northwest corner of the site), though there were frequent detections from the Exhibition Drive track. The occurrence of Pa does appear to have some association with watercourses and areas of low relief.

5.9 Results indicate that all topsoil within the Project site and surrounds must be regarded as potentially infected, and the applicable management functions for the Project site are those that contain and control the movement of soil and surface water.

5.10 Chapter E11 of the Auckland Unitary Plan anticipates that earthworks will occur in the vicinity of potentially infected kauri, and there will at times be a need for movement and disposal of potentially infected soil in the region, as it repeatedly specifies that "*soil and organic material from land disturbance within 3 times the radius of the canopy drip line* [of kauri] *must not be transported beyond that area unless being transported to landfill for disposal".* It is my understanding that other experts also accept that there is at times a need to excavate and move potentially infected soil, and their concern with this Project is with respect to the scale of the Project and the sensitivity of the surrounding environment, rather than the fact that infected soil is to be moved.

5.11 I consider that the spatial extent of working area exposed at a given time, the stringency of protocols for excavation, transport and disposal of upper soil layers, and the proximity and disease status of receiving environments for soil and water, are more important risk factors than the scale of the Project or total volume of earthworks *per se*.

5.12 As other experts have emphasised at times throughout this hearing, the fundamental hazard is in the movement of even very small quantities of Pa propagules to uninfected hosts. In simple terms, the risk of spread does not depend on whether a large or a small volume of soil is transported inside a truck, but on the amount of material on the *outside* of the vehicle. In a similar vein, it is not the overall size of the works footprint that determines the amount of pathogen-infected sediment discharged, but the amount of exposed soil that comes in contact with water any time it rains. It is not a question of whether any Pa leaves the Project site as a result of construction works, but whether Pa is transported to uninfected sites as a result of construction activity.

5.13 I remain of the opinion that Pa infection is likely to be most prevalent in the rhizophere of infected plants, and within organic and upper subsoil layers[9], and that deep mineral soil layers have a low likelihood of infection. While all participating experts agreed in the February 2021 JWS that "*there is very limited evidence available to appraise the assumption that subsoil is not likely to be infected"*, all also agreed that the availability of the soil test developed by BioSense presents an opportunity to evaluate this assumption in the course of this Project.

5.14 In my evidence in chief[10] I noted that knowledge of kauri dieback disease distribution is incomplete, and expressed various reservations regarding the reliability of conventional testing methods for Pa. I consider that the availability of the sensitive and reliable LAMP assay/qPCR soil test developed by BioSense can be used to evaluate the performance of management measures such as location-specific adjustments in soil stripping depth and technique, and will enable effective monitoring of works to audit hygiene measures.

5.15 All participating experts in the JWS dated February 2021 agreed that the KDMP should include implementation of a Pa sampling regime (developed in accordance with advice from BioSense or appropriately qualified pathologists) early in the topsoil removal phase of work, to enable auditing of all specified hygiene and containment measures to ensure their effectiveness. Accordingly, the draft KDMP includes a highlighted section that is to set out the testing regime, though this has yet to be developed.

5.16 I remain of the opinion[11] that, while soil and water management should be to an exacting standard, "zero tolerance" of any off-site soil or water movement from the Project site to the land or waterway below is not warranted because the pathogen is already present there. This is particularly relevant to stormwater management, as while stormwater from the works footprint can be effectively collected and detained, it will need to be decanted to the watercourse (albeit in a controlled way).

5.17 I note that Pa was detected in both permanent watercourses (Armstrong and Yorke Streams). In the case of Yorke Stream, Pa was confirmed in samples collected 100m south of the Project site boundary. I also understand that these samples were collected using stream baits, whereby cassettes containing leaf litter are floated in the water column for a two week

[9] Paragraph 7.24 of EIC.
[10] Paragraph 7.21 of EIC.
[11] Paragraph 7.28 of EIC.

interval, and then collected and analysed. As leaf baits are infected by way of zoospores present in the water column, I consider this to be strong evidence that Pa is already being transported down the Yorke Stream catchment, despite the absence of significant soil disturbance.

6. MANAGEMENT APPROACH IN THE KDMP

6.1 The KDMP includes details of the proposed kauri dieback protocols, the earthworks proposed, erosion and sediment control measures to be employed, and site management methods for geotechnical investigations and vegetation removal. The focus of the KDMP is management of risk factors that could increase contact between exposed/disturbed soil and vectors for spread of the pathogen (principally water, machinery/equipment, and people).

6.2 A key aspect of the KDMP is careful and systematic management of vegetation clearance and topsoil removal to limit the spatial extent of active working areas, divert any stormwater away from the footprint, contain all soil and water from the works footprint and control the discharge of stormwater while potentially infected material is excavated from the works site.

6.3 The site is to be divided into subcatchments with localised sediment and erosion controls, and works are to move from one subcatchment to the next in successive stages[12]. This approach limits the scale of the active works footprint and minimises the risk of recontamination of completed stages. The attached appendices to the KDMP provide staging plans and key objectives and specifications for each stage.

6.4 Vegetation clearance will be undertaken in consecutive stages in 0.1 – 0.2 ha patches, to minimise the extent of ground exposed at any one time. Soil disturbance will be avoided as far as possible. Cleared areas are to be covered and bunded with mulched woody material/ kanuka brush/geotextile cloth in the interim between vegetation clearance and topsoil removal. All work surfaces will be stabilised daily if rainfall is anticipated to limit soil erosion.

6.5 The active working area of soil disturbance will be limited to a maximum of 3,000m², defined by the natural topography of drainage subcatchments within the works footprint. External catchment surface flows will be directed away from the works areas. Stormwater and sediment controls will ensure surface water run-off is effectively contained and treated for

[12] Catchment staging plans in Appendices to the draft KDMP (December 2020).

sediment within the working subcatchment before being decanted to a containment facility, and discharged to the watercourse at a controlled rate. These measures will confine all discharges to the site and receiving watercourse, and prevent uncontrolled, sediment-laden overland flows exiting the site.

6.6 Topsoil and subsoil will be excavated to approximately 1m depth, removed from site in lined and sealed trucks, and disposed of to an approved landfill (I note that participating experts all agreed in the JWS that a local disposal site would be preferable to minimise the travel distance). The Project Arborist is to supervise works and advise the necessary depth required for removal to ensure excavation extends well below the root zone and all organic material is removed. Trucks will be loaded on hard-stand areas and cleaned in a vehicle wash facility before leaving the site.

6.7 Site-wide hygiene protocols for vehicles, machinery/equipment and personnel entering, moving around and leaving the Project site specified in the KDMP will remain in place for subsequent stages of bulk earthworks and construction.

6.8 In my opinion, the management approach set out in the KDMP responds to the key concerns expressed by other experts in the JWS dated February 2021, in particular that the works would constitute massive disturbance, allow rainfall to interact with disturbed soil, divert runoff from natural flowpaths to other off-site areas, and discharge large pulses of pathogen-laden water and sediment to watercourses.

6.9 While I acknowledge that rainfall during site preparation earthworks has the potential to mobilise Pa in the soil so that it enters the stormwater runoff, the area generating runoff will not be greater than 3,000m^2 at any given time. Given that site preparation earthworks will be undertaken during summer[13], the likelihood of successive rainfall events occurring across stages is low. In addition, all external surface flows are to be redirected away from the works footprint, so existing surface flows through the site will be reduced. I consider that these measures will minimise the potential increase in pathogen concentration within the watercourse arising from soil disturbance, noting that the pathogen has already been detected within both Armstrong and Yorke Stream watercourses.

[13] In accordance with the kauri dieback principle *"avoid creating wet conditions around kauri and working in wet conditions"* as identified by Dr Fea, Dr Waipara and Dr Havell in the JWS (dated February 2021).

6.10 Kauri containment zones (**KCZ**) encompassing 3 times the crown radius of all kauri trees will be fenced and indicated with appropriate signage wherever these extend into the construction footprint, and additional specific controls pertaining to excavation, placement of fill and hygiene measures will apply within these zones. I note that while KCZs of nine mature trees extend into the works footprint, the footprint encroaches within the "tree protection zones" (encompassing the approximate root zones) of three mature kauri trees, and no mature kauri stems are present within the works footprint. BioSense detected six seedling or sapling kauri within the works footprint during the course of their systematic grid-based surveys.

6.11 BioSense evaluated the health of all individual kauri as part of their survey (Appendix 9 in the BioSense report), and identified that the majority of mature individuals were in a state of "ill thrift", or showed visible evidence of dieback, generally (though not exactly) in accordance with the pattern of disease distribution detected. Most kauri within the Project site are located well away from the construction works, and will be protected and proactively managed as part of this proposal. Therefore, I consider concerns expressed by other experts in the JWS (dated February 2021) that the host (kauri) population within the Project site will be *"altered from a healthy, relatively resistant one to a stressed, root-pruned and exposed one"*, enabling Pa to more aggressively infect the trees, to be unfounded, though I acknowledge that the risk of infection is increased for trees whose roots require pruning.

7. CONCLUSION

7.1 I consider that the case for avoiding the site posed by other experts does not adequately recognise the existing risk environment, which is that Pa is already present within the catchment beyond the Project site, and appears to be widespread; numerous controls can be implemented to ensure that the active works footprint and associated discharges can be kept to a modest size despite the overall scale of the Project; and that a new method of efficient and reliable testing for Pa will enable effective scrutiny of hygiene and containment protocols. In my opinion, these factors together offer confidence that the proposal will not increase the distribution of Pa within the catchment, or the extent of kauri infection within the catchment.

Dr Sarah Megan Flynn
7 April 2021

Appendix 1 – draft updated Kauri Dieback Management Plan and the staging plans

Boffa Miskell

Kauri Dieback Management Plan

Replacement Huia Water Treatment Plant, Waima
Prepared for Watercare Services Ltd.

Document Quality Assurance

Bibliographic reference for citation: Boffa Miskell Limited 2020. *Kauri Dieback Management Plan: Replacement Huia Water Treatment Plant, Waima*		
Prepared by:	Sarah Flynn Ecologist Boffa Miskell Limited	[Insert signature here]
	Campbell McGregor Engineer Harrison Grierson	
Reviewed by:	[**TO COMPLETE**] [Title / Position] Boffa Miskell Limited	
Status: [DRAFT]	Revision / version: 1	Issue date: 8 December 2020

Template revision: 20180621 0000

File ref: WTP_Kauri_Dieback_Management_Plan_updated_201207

CONTENTS

Appendices

1.0 Introduction

1.1 Project Description

Watercare operates water supply dams within the Waitākere Ranges, including the Upper and Lower Huia Dams and the Upper and Lower Nihotupu Dams. The Huia Water Treatment Plant (Huia WTP, named for the source of the water) is located in Waima and treats the water from these dams before it is distributed via the water transmission network.

The Huia WTP was constructed in 1929 and is now nearing the end of its operational life (90 years old). Watercare therefore proposes to construct a new WTP to replace the aging Huia WTP. As part of this project Watercare is also proposing to construct two treated water reservoirs (50ML total capacity) to increase treated water storage within the western supply zone.

The project is located on land owned by Watercare and is designated in the Auckland Unitary Plan (AUP) for 'Water supply purposes – water treatment plants and associated structures' (designation reference 9324 – Huia and Nihotupu Water Treatment Plants). The project spans three sites owned by Watercare which have a total site area of 15 ha. The land parcel on which the proposed replacement Huia WTP is located has an area of approximately 4.2 ha, the proposed Reservoir 1 land parcel is approximately 6.4 ha, and the existing WTP site (within which Reservoir 2 is proposed) is approximately 4.0 ha.

The works footprint is 4.3 ha in total, 3.5 ha of which comprises indigenous forest and scrub. The Project Site forms part of a 24,000 ha Significant Ecological Area (SEA_T_5539 in the Auckland Unitary Plan (AUP) - Operative in part) that encompasses much of the Waitakere Ranges. The Project Site is located in the headwaters of two Waituna Stream tributaries, including Armstrong Stream to the west and Yorke Stream to the east.

Based on current estimates of earthworks required for the project, approximately 75,000m³ of cut and 42,000m³ of fill is required across the site. Approximately 40,000m³ of the cut material is from the excavation associated with the construction of Reservoir 1. The main WTP site is close to an earthworks balance and the Reservoir 2 has a shortfall of 5,000m³.

1.2 Kauri Dieback Disease Characteristics

Phytophthora agathidicida is the pathogen regarded as a primary causal agent of dieback disease in otherwise healthy kauri, while other *Phytophthora* species may also have a role in the expression and severity of disease symptoms. Kauri dieback infects trees through their roots, and spreads primarily through the movement of contaminated soil and water, as well as by root-to-root contact between trees.

Mapping and surveillance has established that there are at least 344 distinct areas of kauri ecosystem within the Waitakere Ranges, and about 33% of these areas have kauri dieback or possible kauri dieback symptoms present.

Previous surveillance work (Hill et al., 2017) identified that kauri dieback infections showed a strong association with tracks and watercourses, and human activity and disturbance is assumed to be a key vector of the disease.

The kauri dieback pathogen has two types of propagule. The oocyte is formed within infected tissue and released into the soil where it can remain latent for an indefinite period. Soil movement is a key mode of dispersal of this type of propagule. The oocyte is resistant to sterigene and other disinfectants.

Ultimately, the oospore germinates and produces zoospores which can 'swim' through micropores in saturated soil, and in this way actively disperse themselves. In this form, the pathogen finds and infects tree roots. The zoospores can be destroyed with disinfectant.

Sources and locations of kauri dieback pathogen are:

- Infected tree roots of kauri;
- Parts of the forest floor and waterbodies where oospores have been dispersed;
- Moist, porous soil layers where motile zoospores have emerged and dispersed.

Mineral sub-soil layers below the root zones of vegetation are at lower risk of contamination relative to organic soil layers, as inorganic parts of the substrate are not porous and do not contain living plant material.

1.3 Kauri Dieback within the Project Site

The Assessment of Ecological Effects report for the proposed replacement WTP development (Boffa Miskell 2019) identified the risk of kauri dieback spread as a management issue, as potentially symptomatic kauri trees were observed within the Project Site. Stands of kauri occur within the Project Site, and nice mature kauri are present immediately adjacent to the works footprint. No mature kauri are located within the works footprint itself. Six kauri seedlings and saplings have been found within the WTP footprint, most in the vicinity of large trees near the southern boundary outside the WTP footprint.

A public walking track from Manuka Road through the Watercare land, that is the proposed site for the replacement Huia WTP, to Clarks Bush reserve was frequently used prior to its closure in 2017. Kauri forest interspersed with residential development dominates the broad ridgelines immediately southward of the Project Site.

2.0 Management Plan Approach

2.1 Overall purpose

The purpose of this Management Plan is to minimise the risk of spreading kauri dieback disease in the process of constructing the replacement WTP and reservoirs. This includes controlling movement of any potentially contaminated material on machinery, footwear, equipment or via surface runoff to minimise the risk of spreading the pathogen into uninfected areas.

Containment, removal and disposal of infected topsoil from the site to minimise the risk of kauri dieback spread during bulk earthworks is a key focus of this management plan.

P. agathadicida was not detected in a number of kauri trees sampled within in the Project Site and adjacent reserve. Management measures also include protection of the root zones of these trees to prevent damage which may increase the likelihood of infection.

2.2 Management Approach

Management of kauri dieback disease risk for the replacement WTP project has the following components:

1) Comprehensive soil testing across the Project Site to inform knowledge and assumptions regarding the current presence and distribution of kauri dieback disease pathogens in the area.
2) Staging and detailed specifications for geotechnical investigations, vegetation clearance and systematic removal and disposal of surface soil layers from the development footprint prior to undertaking enabling earthworks. Works specifications will minimise the risk that any potentially infected material is discharged or moved offsite in an uncontrolled manner. This includes measures to contain overland flows of stormwater, and offsite soil disposal to appropriate facilities to ensure these are equipped for the level of infection risk.
3) Containment and wash facilities and hygiene protocols to prevent site workers and machinery moving soil offsite and between work areas.

Fundamental to the success of this management plan is ensuring the proposed approach is practicable during construction. To ensure the staged and systematic approach set out in this management plan is achievable during construction, the methodology was developed in collaboration with construction contractors, erosion and sediment control experts and project ecologists.

The detailed indicative staging set out in the accompanying staging plans (Appendices 1 and 2) has been developed based on site topography, access requirements for construction machinery, space required for erosion and sediment control devices, site optimisation from a construction perspective to avoid the need for stockpiling during the topsoil removal phase of works, or the need for vehicle access through areas yet to be disturbed. Consequently, the accompanying staging plans reflect a realistic and practicable approach to construction in a constrained site while ensuring the requirement to minimise the risk of spreading kauri dieback disease is achievable.

2.3 Soil Testing

A field testing protocol to assess the presence and distribution of kauri dieback causing pathogens (specifically *Phytophthora agathidicida*, and also including *Phytophthora cinnamomi* was developed and implemented (Biosense 2020).

The objective of sampling was to assess:

1. The disease status of kauri trees within and surrounding the proposed works footprint.
2. The presence and distribution of phytophthora in soil within the Project Site and adjacent buffer.

3. The presence of *Phytophthora* within the adjacent reserve, focusing on likely infection pathways such as walking tracks, watercourses and areas of standing water, and sites of human and feral animal disturbance.

Sample collection and analysis methods sought to maximise detection probability, in order to give the best chance that kauri dieback-causing pathogens would be detected if present within the construction footprint and wider Project Site.

Sample analyses used a combination of LAMP assay and qPCR detection methods for *P. agathadicida* and *P. cinnamomi,* rather than a traditional bioassay method as this novel method has been shown to produce more precise and repeatable results (Winkworth et al 2020).

Testing (Biosense 2020) has confirmed the presence of *P. agathadicida* within the Project Site, and while infections are more concentrated in stands of mature kauri located away from the works footprint, sporadic detections in soil and watercourses away from kauri specimens were found throughout the Project Site, including within the works footprint. A similar pattern of distribution was found in the adjacent portion of Clarks Bush reserve that was sampled, and several detections were found along the Exhibition Drive walking track which is still open to the public. Another disease-causing pathogen, *P. cinnamomi,* was also detected within stands of mature kauri.

2.4 Site Protocols

As outlined above, the spread or movement of Kauri Dieback primarily occurs through contaminated soil or surface water. Therefore, the applicable management functions are those that control and/or mitigate the movement of soil and surface water during construction operations.

Soil testing has confirmed that *P. agathadicida* is prevalent throughout the Project Site, therefore comprehensive hygiene protocols are required for all work areas. The protocols have been split into five sub-sections which relate to the works phases outlined below.

The following sections should be considered in conjunction with the indicative staging plans contained within Appendices 1 and 2 of this report. While the staging is indicative, the objectives and specifications of the staging plans should be adhered to. These objectives and specifications are summarised below and described in sections 3 to 7.

Prior to Site Works\General

- Washdown Facilities (Vehicle and Personnel)
- Separate bootwash facilities at KCZ entry
- Washwater collected and contained onsite until it can be sterilised or disposed of offsite
- Delineation of earthworks/ native vegetation boundary
- Delineation of Kauri Containment Zones (KCZ)
- Imported hardfill direct from quarry of KD free catchment.

Geotechnical Assessments

- Form access tracks (geoweb or hardfill)

Vegetation Clearance

- Extension of access tracks (geoweb or hardfill)
- Renewal of stabilised entry and clean out and renewal of wash down facilities
- Any works within KCZ to be contained and machinery cleaned prior to entry
- Restricted Staging of Vegetation Clearance 0.1-0.2ha
- Cleared areas to be bunded with mulch/kanuka brush/fascines

Surface Soil Removal

- Renewal of stabilised entry and clean out and renewal of wash down facilities
- Localised sediment controls with downstream surface water containment
- Limit staging up to 3000m²
- Allow larger exposed areas in accordance with GD05 and best practice
- No stockpiling of material
- Disposal of material to approved facility licensed to receive such material
- Specific KCZ measures apply

Bulk Earthworks

- Clear delineation and control or runoff between surface soil removal and bulk earthworks catchments
- Specifications for cut and fill materials

3.0 Prior to Site Works

The following infrastructure and protocols are to be established before any vegetation clearance, soil disturbance, vehicle or machinery movement on the Project Site.

- A wash facility for vehicles, machinery, equipment and footwear is established at all entry and exit points on the Project Site. The facility is to include a truck washdown with shaker ramp or approved equivalent to enable collection of all sediment and surface water from the wash down process. Wash water is to be collected and contained on-site until it can be sterilised or disposed of utilising a sucker truck (or to trade waste).

- Kauri containment zones (KCZ) encompassing 3 times the crown radius of all kauri trees (figure 1) will be fenced and indicated with appropriate signage wherever these extend into the construction footprint. All KCZ fencing should include signage every 15m to 20m. An arborist will determine and mark out the actual extent of the kauri root zone prior to any earthworks within each KCZ, and the extent of the KCZ will be extended if required to encompass all kauri roots. Silt fencing on a 300mm high bund will be used, as this will assist in redirecting any surface water flow away from the KCZ, and prevent excavated soil entering or exiting the KCZ in an uncontrolled way.
- Boot and equipment wash facilities are to be installed at entry point to all KCZs within the construction footprint.
- Silt fencing will be installed along the boundary of the construction footprint where it adjoins native vegetation to be retained. Silt fencing will help prevent excavated soil spilling into areas outside the construction footprint.

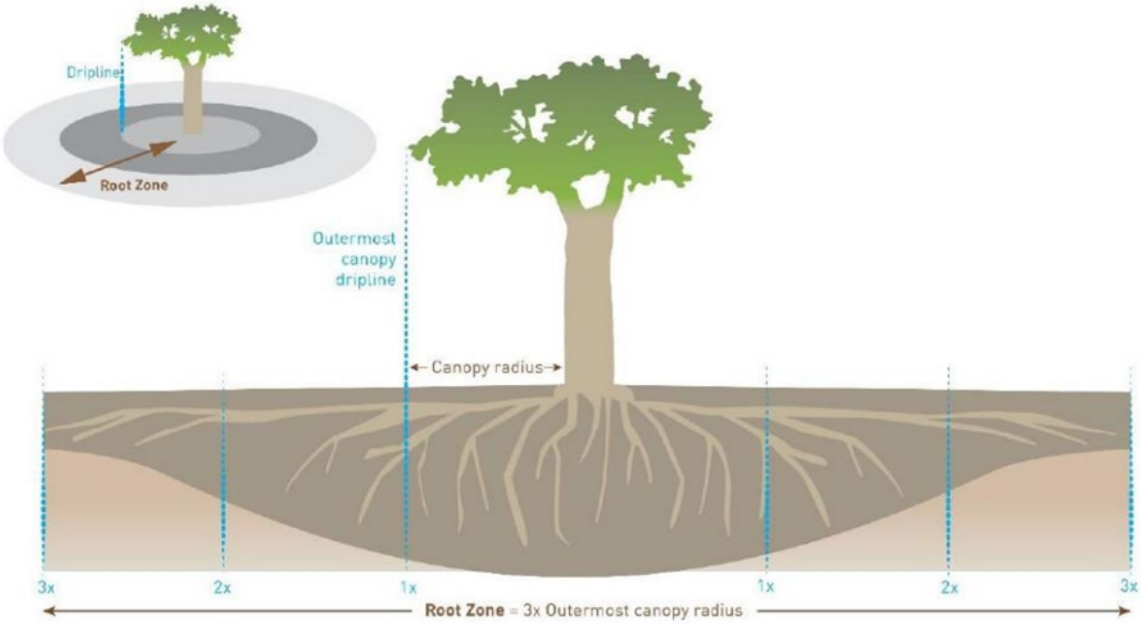


Figure 1. *Diagram showing root zone of kauri (3 times the radius of the outermost canopy dripline)[1]. Kauri trees don't have a defined taproot (Bergin & Steward, 2004) and most of the roots occur near the soil surface. Anchoring 'peg' roots can extend to a depth of 5m.*

- Silt fences will be installed as per Section F1.3 of the Auckland Council Guideline Document GD2016/005. Before site works commence, the Project Ecologist will inspect the silt fences and confirm with the Site Manager that the fences have been installed as per the specifications above.
- Any issues with the fence installation will be communicated to the Site Manager to ensure the issues are resolved. The Project Engineer will need to confirm in writing that the fences are installed correctly before any site works commence.

[1] Figure sourced from https://www.kauridieback.co.nz/media/2018/bpg-quarry-hygiene_v14_final-signed2.pdf.

- Access tracks (e.g., Geoweb and/or hard fill) are to be installed to enable machinery to move through the site for geotechnical investigations and vegetation clearance without contacting bare soil.

4.0 Geotechnical assessments

4.1 Description of Works

Geotechnical assessments are required prior to the detailed design of the replacement WTP. Localised vegetation clearance is required to enable geotechnical equipment access to test sites. The following objectives and principles will be implemented to minimise soil disturbance and control movement of soil for the purposes of Kauri Dieback containment. Vegetation cleared for geotechnical investigations will be retained on-site.

4.2 Objectives

The following objectives apply to this phase of works:

- Minimise site disturbance. Avoid significant trees and minimise vegetation removal only creating adequate corridors to form necessary access tracks and area to conduct tests.
- No grubbing or tree stump removal.

4.3 Specifications

- Appendix 1 scheme plans show indicative geotechnical sample locations and accessways. Access tracks will be stabilised with geoweb and hard fill prior to use. Final access track routes will be marked on the site following site walkovers to determine the least extent of clearance.
- A stabilised site entry and washdown facilities will be installed at site entry\egress points prior to commencement of works.
- All material imported to site must be either hardfill direct from a quarry (no recycled hardfill) or from a kauri-free catchment.
- The wash facility for vehicles, machinery, equipment and footwear is to be used at each entry and exit of personnel, vehicles and machinery to the Project Site. No entry or exit to or from the Project Site will occur anywhere except through the designated access points.
- All footwear, tools and equipment must be totally soil-free when entering and exiting the Project Site. Equipment (including footwear) should be cleaned and sprayed with Sterigene disinfectant (or equivalent).
- As far as possible, works are to be undertaken in dry weather to reduce soil adhering to vehicles and equipment.

- Trees felled during this phase are to be cut at the base to avoid grubbing or tree stump removal. Tree canopies are to be left onsite for clearance as part of the following site-wide phase.

5.0 Site-Wide Vegetation Clearance

5.1 Description of Works

Site wide vegetation clearance will be carried out systematically to enable fauna checks to be undertaken, as detailed in the Ecological Management Plan. The following controls will be implemented to minimise soil disturbance and control movement of soil for the purposes of Kauri Dieback containment.

5.2 Objectives

The following objectives apply to this phase of works:

- Minimise site soil disturbance.
- No grubbing or tree stump removal.
- Staged, systematic clearance across the site (refer Appendix 1)
- Limit work areas to 0.1 – 0.2ha at any one time.

5.3 Specifications

- Site access for machinery will be via formed tracks previously established for geotechnical investigations, and renewed/ extended as required.
- Stabilised entry will be renewed where necessary, and wash down facilities cleaned out, following geotechnical investigation phase.
- The wash facility for vehicles, machinery, equipment and footwear is to be used at each entry and exit of personnel, vehicles and machinery to the Project Site. No entry or exit to or from the Project Site will occur anywhere except through the designated access points.
- All footwear, tools and equipment must be totally soil-free when entering and exiting the Project Site. Equipment (including footwear) shall be cleaned and sprayed with Sterigene disinfectant (or equivalent).
- Wash down of footwear and equipment used within a KCZ should occur within the KCZ. Any equipment and machinery brought into a KCZ must be clean. Soil attached to machinery that has operated within a KCZ must be removed prior to exiting the KCZ, and cleaned in the wash-down facility prior to exiting the Project Site.

- All material imported to site must be either hardfill direct from a quarry (no recycled hardfill) or from a kauri-free catchment.

- Vegetation clearance will be staged (refer Appendix 1) and undertaken in 0.1 – 0.2 ha patches, to minimise the extent of disturbed ground exposed at any one time.

- Cleared areas are to be bunded with mulched woody material/ kanuka brush/ geotextile cloth in the interim between vegetation clearance and topsoil removal, as far as possible utilising material that has been felled onsite.

- Surface water that accumulates within the excavation and has been in contact with disturbed organic soils shall be allowed to drain to ground. Wood chip and fascines of kanuka scrub will be used to bund open workings. All work surfaces shall be stabilised at the end of a working day if rainfall is anticipated to limit erosion.

6.0 Surface Soil Removal

6.1 Description of Works

Systematic sampling of soil detected *P. agathadicida* in sporadic locations throughout the proposed works footprint. All topsoil is therefore to be treated as potentially infected. Topsoil and any other potentially infected matter to a nominal depth of 0.5 m, plus a further 0.5 m of subsoil[2] to extend well below the root zone, will be excavated in a staged manner and removed from site to minimise the risk of spreading Kauri Dieback disease into uninfected areas during bulk earthworks. It is this 1m of material that will be subject to the controls described as surface soil removal. Current estimates are that approximately 22,000m³ of topsoil is to be removed from site.

Mineral sub-soil layers below the root zones of vegetation are at low risk of contamination relative to organic soil layers[3], as inorganic parts of the substrate are not porous and do not contain living plant material.

During the process of topsoil removal, external catchment surface flows will be directed away from the works areas, while dirty water will be collected and treated for sediment at source within decanting earth bunds. Discharge from the decanting earth will then be conveyed to a separate stormwater containment facility. The containment facility will be sized to contain surface runoff from the exposed catchment area in any storm event up to a 1 in 10-year event. Following sterilisation of the surface water runoff, water will then be discharged over a 24 hour period from the containment facility to the downstream channel/stream.

[2] In all instances the actual depth will vary across the site. The Project Arborist is to supervise works and advise the necessary depth required for removal.

[3] Soil bioassays (Bellgard et al., 2013) from excavated root systems of diseased kauri confirmed the presence of *P. agathicida* in surface soil layers where roots were concentrated, but no *Phytophthora* species were recovered below a depth of 20 cm.

6.2 Objectives

The following objectives apply to this phase of works:

- Limit areas of soil disturbance to 3000m².
- Provide controls on the majority of catchments to mitigate sediment loss and contain surface water run-off.
- Collect and dispose of sediment from control devices post completion of the phase to an approved facility.
- Decanting earth bunds shall be designed to provided 3% live storage as opposed to 2% (GD05) to increase the storage volume and improve sediment retention.
- The surface water run off containment basin shall be utilised to capture surface run off from the exposed catchment area allowing for water to be "treated" prior to discharge. The basins shall be sized to contain the full 1 in 10-year storm event flow from the exposed (3000m²) earthworks catchment.

6.3 Site-Wide Hygiene Specifications

The following controls will be implemented during the staged removal of surface soil layers for the purposes of Kauri Dieback containment.

- Stabilised entry will be renewed where necessary, and wash down facilities cleaned out, following the vegetation clearance phase.
- The wash facility for vehicles, machinery, equipment and footwear is to be used at each entry and exit of personnel, vehicles and machinery to the Project Site. No entry or exit to or from the Project Site will occur anywhere except through the designated access points.
- All footwear, tools and equipment must be totally soil-free when entering and exiting the Project Site. Equipment (including footwear) should be cleaned and sprayed with Sterigene disinfectant (or equivalent).
- All works to be done with localised stormwater and sediment controls (as per staging plans, Appendix 2).
- Drainage and storm water run-off from the Project Site is to be diverted away from KCZs.
- Surface soil layers will be progressively removed, and the cleared area stabilised, as per catchment staging plans (Appendix 2).
- Where material is suitable for reuse onsite this shall be prioritised in lieu of disposal.
- Topsoil is to be loaded directly onto trucks (no stockpiling), covered and then transported for offsite disposal. All soil material removed from the Project Site must be disposed of to an offsite facility (as approved by Auckland Council).
- All material imported to site must be either hardfill direct from a quarry (no recycled hardfill) or from a kauri-free catchment.

6.4 KCZ Specific Measures

The following additional specific controls will apply to Kauri Containment Zones:

- Soil removal works within KCZs are to be progressively excavated inwards towards the tree root zone, and infilled with hardfill hardstand. All soil and organic material from within KCZs must be disposed of to an appropriately licenced landfill facility (as approved by Auckland Council's KDB Specialist).

- All material imported to site must be either hardfill direct from a quarry (no recycled hardfill) or from a kauri-free catchment.

- Wash down of footwear and equipment used within a KCZ should occur within the KCZ. Any equipment and machinery brought into a KCZ must be clean. Soil attached to machinery that has operated within a KCZ must be removed prior to exiting the KCZ, and cleaned in the wash-down facility prior to exiting the Project Site.

- Once KCZ organic matter and subsoil have been removed, and the areas covered with geotextile or hardstand material, vehicles and machinery can move between the KCZ and the wider project site without the above restrictions on movement, provided no further soil is disturbed within a KCZ.

6.5 Soil Removal and Disposal

Removal of potentially infected soil and organic matter from the site is to be undertaken with the following protocols:

- Transport vehicle trailers should have sealed sides (or liners installed) to ensure all loads being transported is appropriately contained and leakage from soil or debris is reduced during transit. There may be situations where this is not practical, however every care should be taken to reduce the risk of soil or debris from falling off the transport vehicle.
- Liners should be of a suitable thickness and durability to prevent rupture during transport and contain the material sufficiently to prevent any leakage. The liners can be folded over to encompass the entire load and then appropriately secured.
- The vehicle (including trailer unit) shall be sprayed after unloading with a solution containing 2% Sterigene solution either at the landfill (if available) or back at the depot prior to re-use. Liners must be appropriately disposed of.
- Soil disposal records (summaries) shall be kept for later validation reporting, if necessary.

7.0 Bulk Earthworks

7.1 Description of Works

Systematic removal of surface soil layers will reduce the possible extent and potential likelihood that Kauri Dieback disease is present within the construction footprint, hence for the bulk

earthworks phase hygiene protocols are proposed to occur at each construction site boundary only. Further, while topsoil and bulk earthworks are occurring concurrently in different catchments across the site, stormwater and sediment control measures will be put in place to avoid cross contamination of runoff from topsoil disposal catchments.

Once all topsoil earthworks are complete and only bulk earthworks are occurring across the site, standard erosion and sediment practises will apply.

7.2 Objectives

The following objectives apply to this phase of works:

- Ensure surface runoff from bulk earthworks catchments is discharged without cross contamination of runoff from the topsoil disposal catchment(s).

7.3 Specifications

- The wash facility for vehicles, machinery, equipment and footwear is to be used at each entry and exit of personnel, vehicles and machinery to the Project Site. No entry or exit to or from the Project Site will occur anywhere except through the designated access points.
- All footwear, tools and equipment must be totally soil-free when entering and exiting the Project Site. Equipment (including footwear) should be cleaned and sprayed with Sterigene disinfectant (or equivalent).
- Wash water is to be collected and contained on-site until it can be sterilised or disposed of.
- Wash water cannot be re-used or recycled within the wash station unless sterilised.
- Under no circumstances is any soil material resulting from the earthworks to be deposited outside of the silt fences.
- Any damage to silt fences will be remedied promptly.
- Drainage and storm water run-off from the construction site is to be diverted away from KCZ.
- Where material is suitable for reuse onsite this shall be prioritised in lieu of disposal.
- Cut material from the Bulk Earthworks phase that requires disposal will be carted to a clean fill disposal site. While this material is assumed to be free of kauri dieback pathogens, the disposal location shall not be within a catchment that contains Kauri trees.
- All material imported to site must be either hardfill direct from a quarry (no recycled hardfill) or from a kauri-free catchment.

8.0 Roles and Responsibilities

8.1 Site Manager

It is the Site Manager's responsibility to:

- Ensure all contractors are informed of the relevant protocols included in this document;
- Ensure that contractors and consultants understand that entry into and exit from the project site triggers kauri dieback control protocols;
- Undertake ongoing monitoring and repairs of the exclusion and silt fences which will be installed as part of the site preparation;
- Carry out and document daily and 'inclement weather' inspections of sediment and runoff controls around the works site and remediate issues identified;
- Undertake random audits of construction and environmental personnel to ensure compliance with the work protocols specified in this management plan.

8.2 Project Engineer

It is the Project Engineer's responsibility to:

- Review and assist the contractor in designing and maintaining compliant earthworks controls in accordance with the KDMP and consent conditions.
- Conduct periodic inspections of the installed control measures to ensure ongoing compliance.
- Provide instruction and oversight to ensure adequate hold points are stipulated and observed so that the KDMP principles are achieved.

8.3 Project Arborist

It is the Project Arborist's responsibility to:

- Identify driplines and root zones of all kauri trees in the vicinity of the works footprint.
- Confirm final location and supervise installation of KCZ fencing and signage;
- Supervise any earthworks within the KCZ to ensure damage to the root zone of any kauri tree is avoided, or in the case of the "knoll kauri tree", manually excavate and prune tree roots in advance of earthworks.
- Advise as to the appropriate depth of excavation to ensure all organic soil and root material from the site is excavated and disposed of appropriately and oversee the works.

8.4 Project Ecologist

It is the Project Ecologist's responsibility to:

- Inspect and sign off the site preparation as described in this management plan prior to earthworks commencing;
- To promptly communicate any issues with site preparation to the Site Manager so the issues can be remedied, prior to commencement of works; and
- To assist the Site Manager with audits and training as required.

9.0 Communication

9.1 Training and induction

Ensuring all contractors are aware of the potentially severe impacts of kauri dieback disease how it is spread, and effective prevention measures is key to promoting compliance with this Kauri Dieback Management Plan.

The Site Manager is to induct all personnel upon their first entry to the site. The following points should be included in all site inductions:

1. The background of Kauri Dieback disease; the organism that causes it and how it infects kauri;
2. The fact that Kauri dieback is present on the site, and locations where it has been detected;
3. The impacts of Kauri Dieback Disease on kauri and the wider forest ecosystem;
4. How the disease is spread, noting that small fragments of contaminated soil can spread the disease;
5. That there is no known cure for Kauri Dieback Disease, and if *Phytophthora agathidicida* is introduced to an ecosystem it is not currently possible to eradicate it;
6. The hygiene procedures each contractor is required to undertake and how these procedures will help keep the work site and its surrounds free of kauri dieback.

Training in hygiene procedures will be undertaken as part of the induction process for new personnel when they enter the site. Training will emphasise individual and collective responsibility for making sure equipment is completely clean of soil, and step through site entry and exit procedures to ensure these are clear and unambiguous.

9.2 Signage

Signage will be placed around wash stations and the site office to reinforce the hygiene procedures outlined in the training.

All KCZ will be appropriately marked with signage every 15m to 20m alerting personal of the KCZ.

10.0 Monitoring

10.1 Entry and exit from site

The Site Manager will be responsible for ensuring that all vehicles, equipment and machinery are being appropriately washed with Sterigene (or equivalent) upon entry into the Project Sites, and that wash stations are kept clean, maintained and in working order.

10.2 Sediment Controls

The Site manager is responsible for daily inspections to ensure the effectiveness of containment and erosion control measures (bunds, geotextile covers, wood chip, brush fascines, etc) implemented around both the active works area and treated areas during the process of topsoil stripping. A checklist of observations and accompanying site photographs will be compiled, including (but not limited to):

- conditions - wet/ dry/ dusty
- any bare soil exposed
- any flowing water observed
- integrity of fencing and other containment structures

Any issues identified are to be immediately remedied and documented with photographs.

10.3 Weather Events

Weather forecasts are to be closely monitored during site works to ensure the work site is adequately closed, covered and bunded during rainfall events. Bunds downslope of active works are to be inspected during any rain event in the course of vegetation clearance and topsoil removal, and immediately remedied if breaches are identified.

10.4 Soil testing for *P. agathadicida* [TBC]

To complete in consultation with Biosense – objectives and targets for auditing of hygiene protocols

11.0 Management Plan Review

The understanding of kauri dieback and protocols for managing and preventing the spread of it are continually evolving to reflect the latest research and scientific information available. The above therefore represents a detailed approach based on the most recently available data and information. However, it is expected that this will be amended and updated in accordance with current best practice to manage the spread of kauri dieback disease.

12.0 References

Aley, J., & MacDonald, E. (2018). *Mark II Prototype Cleaning Station – compliance research report*. Department of Conservation.

Bellgard, S. E., Weir, B. S., Pennycook, S. R., Paderes, E. P., Winks, C., Beever, R. E., Than, D. J., Hill, L., & Williams, S. E. (2013). Specialist Phytophthora Research: Biology, Pathology, Ecology and Detection of PTA- Final Report. Prepared for Chris Green on behalf of the Planning & Intelligence team, Kauri Dieback Joint Agency Response.

Bergin, D., & Steward, G. (2004). *Kauri: Ecology, establishment, growth, and management*. New Zealand Forest Research Institute Limited.

Appendices

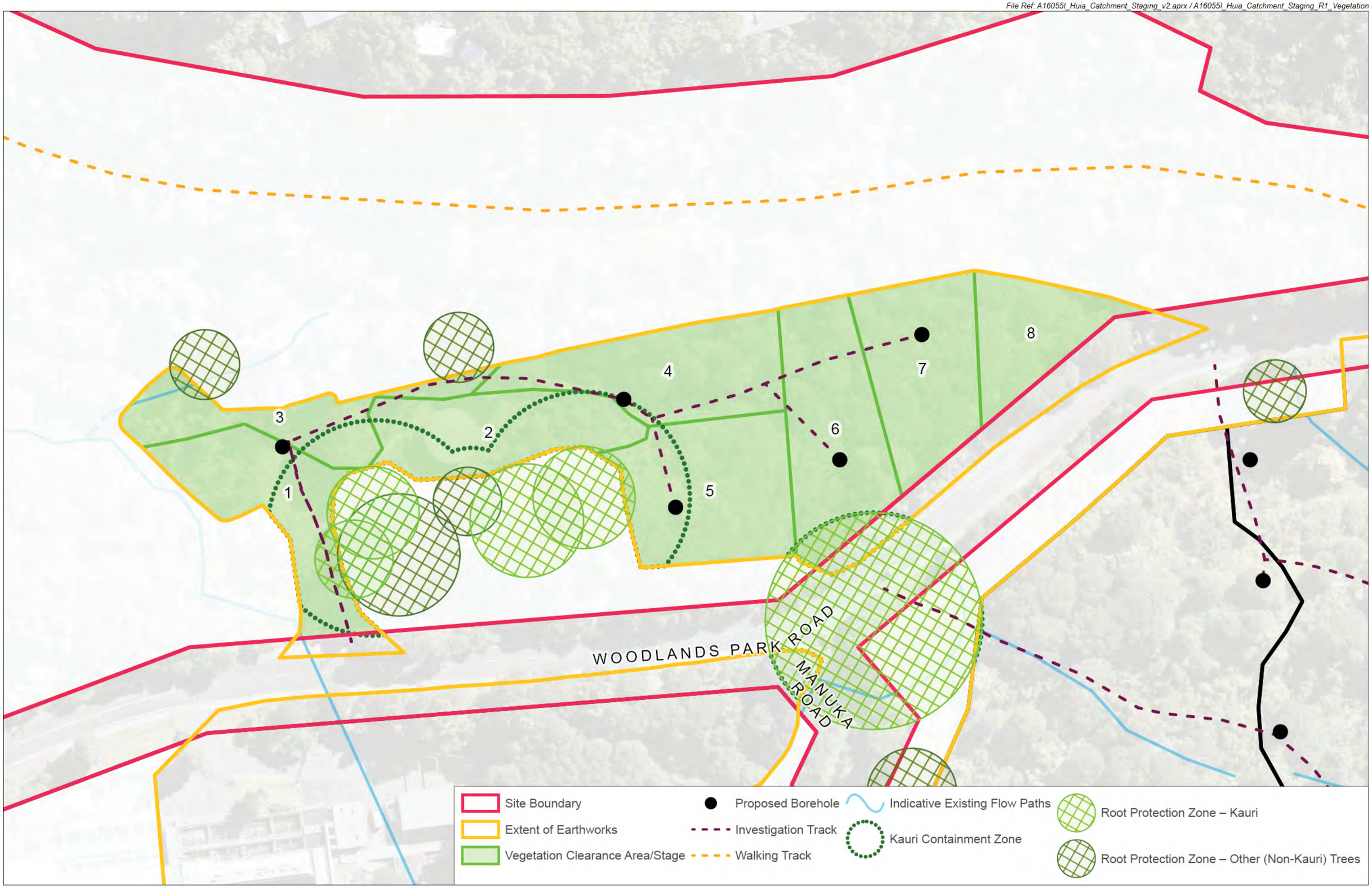
Appendix 1: GEOTECHNICAL INVESTIGATIONS AND VEGETATION CLEARANCE

As specified in Section 5.2.1 of the Kauri Dieback Management Plan, geotechnical assessments are required prior to design of the WTP. Localised vegetation clearance is required to enable geotechnical equipment access to test sites.

As specified in Section 5.2.2 of the Kauri Dieback Management Plan, site wide vegetation clearance will be carried out systematically to enable fauna checks to be undertaken, prior to commencement of earthworks.

The followingscheme plans detail the access routes for geotechnical investigations, and sequencing of subsequent site-wide vegetation clearance (using previously established access routes).

Explanatory notes for geotechnical investigations and vegetation clearance staging follow the staging plans.



Boffa Miskell

www.boffamiskell.co.nz

0 25 m

1:800 @ A3

Data Sources: Boffa Miskell, LINZ, Auckland Council

Projection: NZGD 2000 New Zealand Transverse Mercator

A16055G HUIA WTP ECOLOGY EVIDENCE AND HEARING

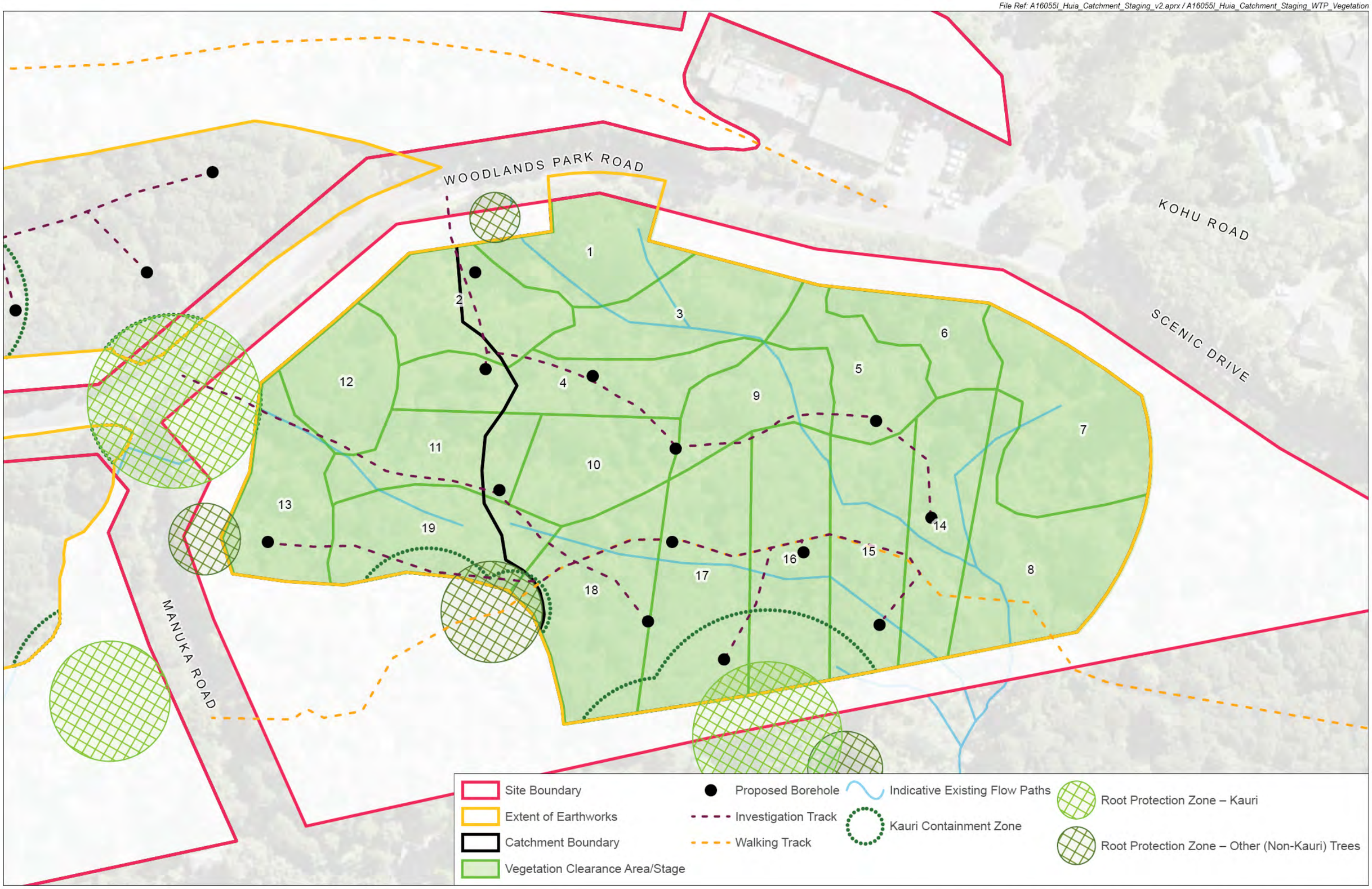
Geotech Investigations and Vegetation Clearance Staging – Reservoir 1

Date: 09 June 2020 | Revision: 0

Plan prepared by Boffa Miskell Limited

Project Manager: Ian.Boothroyd@boffamiskell.co.nz | Drawn: ATy | Checked: SFI

Vegetation Clearance



Boffa Miskell

www.boffamiskell.co.nz

0 — 50 m

1:1,000 @ A3

Data Sources: Boffa Miskell, LINZ, Auckland Council

Projection: NZGD 2000 New Zealand Transverse Mercator

A16055G HUIA WTP ECOLOGY EVIDENCE AND HEARING

Geotech Investigations and Vegetation Clearance Staging – Water Treatment Plant

Date: 09 June 2020 | Revision: 0

Plan prepared by Boffa Miskell Limited

Project Manager: Ian.Boothroyd@boffamiskell.co.nz | Drawn: ATy | Checked: SFI

Vegetation Clearance

Accompanying notes: GEOTECHNICAL INVESTIGATIONS

KEY STAGE OBJECTIVES\ CRITERIA

- Minimise disturbance areas to establish entrance controls for both sediment and Kauri Dieback containment.
- Provide sufficient clearance to allow access for geotechnical equipment and investigations.

KEY STAGE OPERATIONS

- Vegetation clearance required (prior to general vegetation clearance) to enable access for geotechnical equipment on site. Will generally involve clearance for a 4m wide access track and 8m diameter clearance at each drill spot for working space. Vegetation will be pushed to the side of clearance area (as opposed to being removed from site).
- Forming a stabilised entry and installing wash down facilities. Facility to include truck washdown facility with shaker ramp or approved equivalent to enable collection of all sediment and surface water from wash down process.

Accompanying notes: VEGETATION CLEARANCE

KEY STAGE OBJECTIVES\ CRITERIA

- Minimise accidental mortality of native fauna species
- Limit the extent of bare ground exposed at one time, reducing the potential for sediment runoff during rainfall events.

KEY STAGE OPERATIONS

- Vegetation clearance, including tree/scrub removal and grass/weedfield clearance will be carried out in stages across the construction footprint. This approach enables the appropriate management of effects
- The identified tree protection zones will require exploratory testing to confirm the exact extent of root zone to sufficiently protect the integrity of the tree. This information will be used to inform the design process.
- Vegetation clearance (including trees, scrub, grass and weedfield) is to be carried out in the appropriate season (as specified in the EMP).
- The works site will be progressively cleared in patches of approximately 0.1 – 0.2 ha (Figure1).

- Cleared areas are to be covered with mulched woody material/kanuka brush/geotextile cloth in the interim between vegetation clearance and topsoil removal.
- All native vegetation to be retained outside of the earthworks footprint must be protected through the construction process.
- Vegetation clearance must adhere to Kauri Dieback Management procedures with respect to hygiene and soil disturbance.
- Renew stabilised entry where necessary and clean out wash down facilities from geotechnical investigation phase. Facility to include truck washdown facility with shaker ramp or approved equivalent to enable collection of all sediment and surface water from wash down process.

STAGE ESTIMATED TIMEFRAME – Replacement WTP

- Stage estimated timeframe – 12 weeks
- Works estimated to commence Year 0 of programme.

STAGE ESTIMATED TIMEFRAME – Reservoir 1

- Stage estimated timeframe – 4 weeks
- Works estimated to commence Year 0 of programme.

Appendix 2: STAGED REMOVAL OF SURFACE SOIL LAYERS

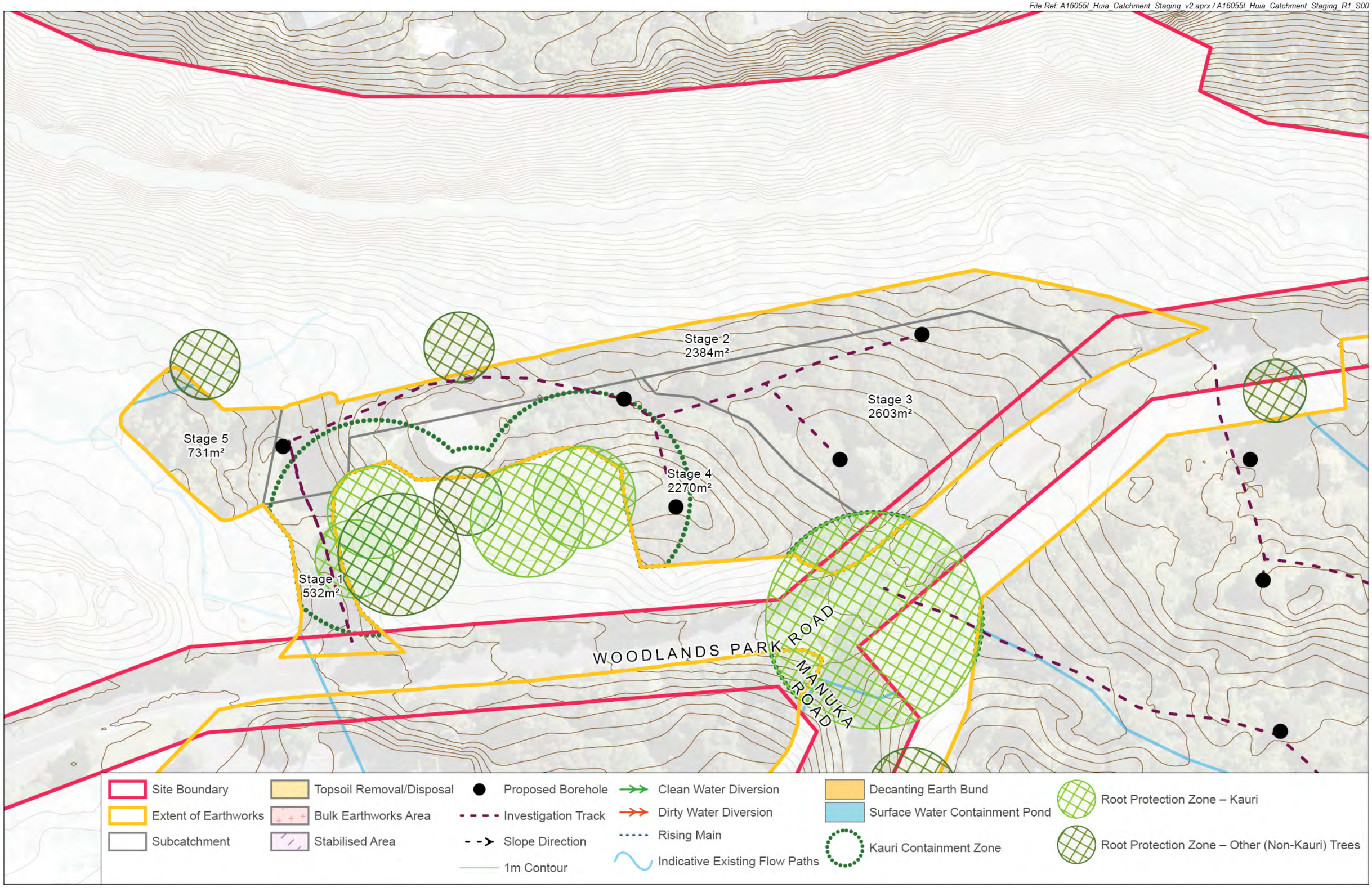
As specified in Section 5.2.3 of the Kauri Dieback Management Plan, topsoil and any other potentially infected matter to a nominal depth of 0.5 m plus 0.5 m subsoil will be excavated in a staged manner and removed from site to minimise the risk of spreading Kauri Dieback disease during bulk earthworks. The staging process is planned by subcatchment within the Works footprint. This series of plans defines the subcatchment areas and details the staging sequence, kauri dieback containmentmeasures, and associated stormwater and sediment controls, as successive subcatchments within the Works Footprint are stripped and stabilised.

The staging plans for the proposed reservoir site are in the series “Topsoil removal disposal phase staging – Reservoir 1”. The staging plans for the proposed replacement water treatment site are in the series “Topsoil removal disposal phase staging – Water Treatment Plant”. No staging plans are provided for Reservoir 2 as the area of surface soil removal is sufficiently small that staging is not required.

Explanatory notes for each stage accompany the relevant plan.

RESERVOIR 1 SITE - STAGE 0

Overview showing subcatchment areas and boundaries, flow paths and access tracks.



Boffa Miskell

www.boffamiskell.co.nz

0 25 m

1:800 @ A3

Data Sources: Boffa Miskell, LINZ, Auckland Council

Projection: NZGD 2000 New Zealand Transverse Mercator

A16055G HUIA WTP ECOLOGY EVIDENCE AND HEARING

Topsoil Removal Disposal Phase Staging – Reservoir 1

Date: 13 January 2020 | Revision: 0

Plan prepared by Boffa Miskell Limited

Project Manager: Ian.Boothroyd@boffamiskell.co.nz | Drawn: ATy | Checked: SFI

Stage 0

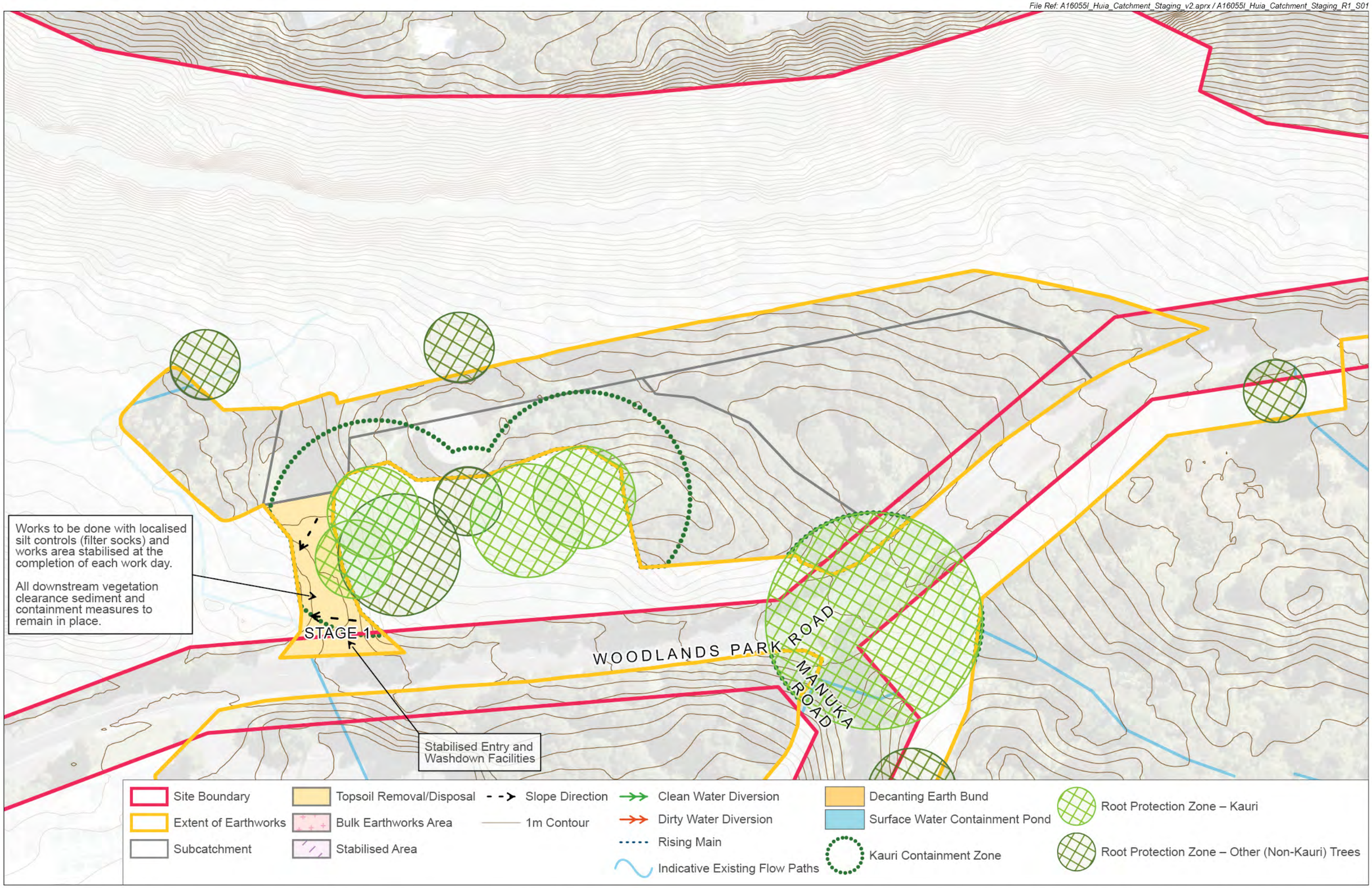
RESERVOIR 1 SITE - STAGE 1

KEY STAGE OBJECTIVES\CRITERIA

- Minimise disturbance areas to establish entrance controls for both sediment and Kauri Dieback containment.
- Assumed all site offices and laydown areas will be situated on the HRWTP site during this stage of operations.
- All controls to be sized based on criteria setout for the HRWTP site.
    - Maximum topsoil disposal area 3000m²
    - DEB to treat surface water runoff to remove sediment load.
    - Surface water containment pond (established Stage 3) to be sized to contain the full 10-year rainfall event from the 3000m² catchment.

KEY STAGE OPERATIONS

- Renew stabilised entry where necessary and clean out wash down facilities from vegetation clearance phase. Facility to include truck washdown facility with shaker ramp or approved equivalent to enable collection of all sediment and surface water from wash down process.
- The water collected from the washdown process during the topsoil disposal and prior phases will be collected and transported offsite.
- Progressively remove topsoil and any other potentially infected material to a nominal depth of 0.5 m plus 0.5 m subsoil[1] and expand stabilised area within the stage 1 area.
- All works to be done with localised sediment controls and works area stabilised at completion of each work day.
- All downstream vegetation clearance measures to remain in place.



Boffa Miskell

www.boffamiskell.co.nz

0 25 m

1:800 @ A3

Data Sources: Boffa Miskell, LINZ, Auckland Council

Projection: NZGD 2000 New Zealand Transverse Mercator

A16055G HUIA WTP ECOLOGY EVIDENCE AND HEARING

Topsoil Removal Disposal Phase Staging – Reservoir 1

Date: 13 January 2020 | Revision: 0

Plan prepared by Boffa Miskell Limited

Project Manager: Ian.Boothroyd@boffamiskell.co.nz | Drawn: ATy | Checked: SFI

Stage 1

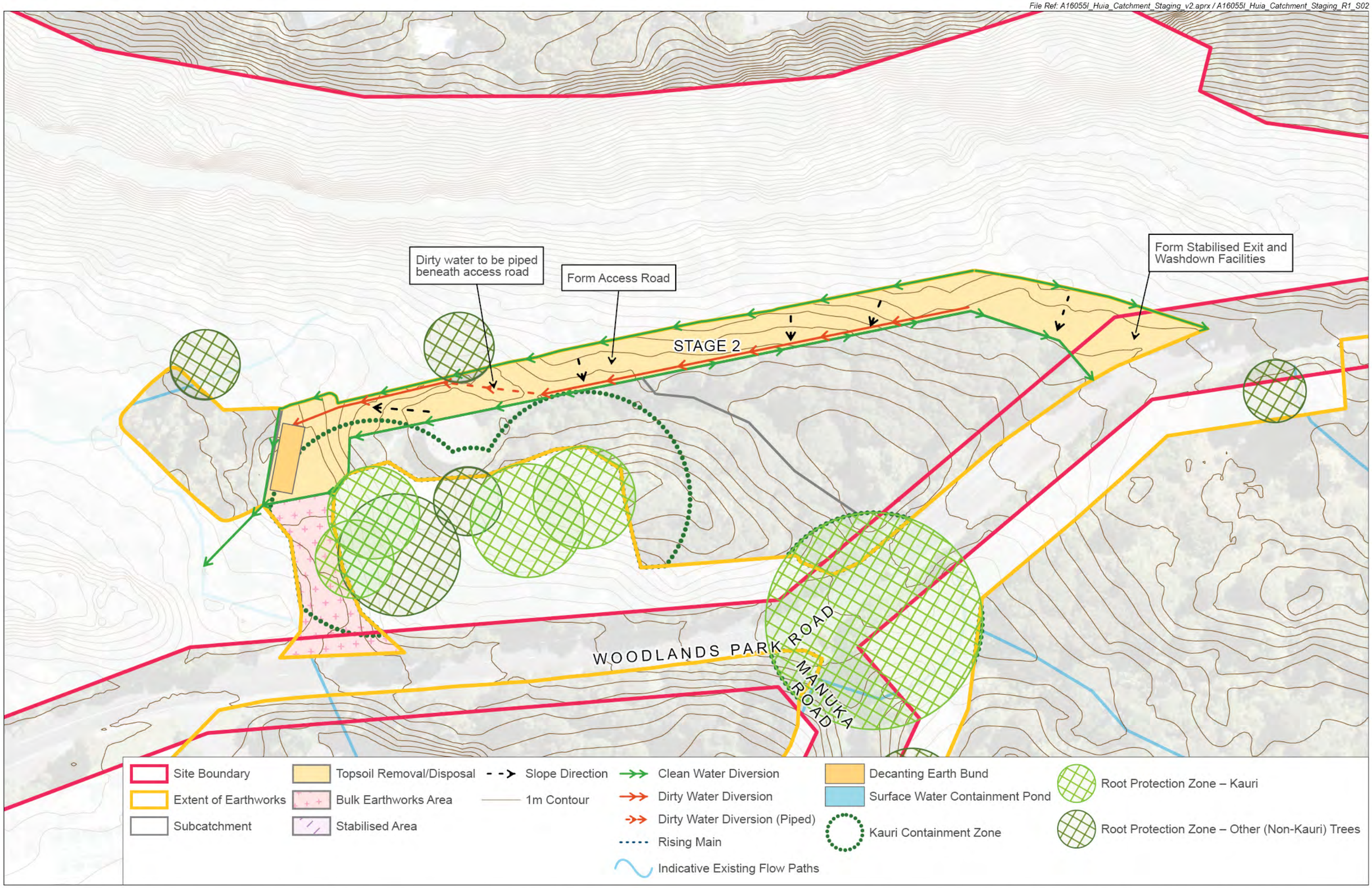
RESERVOIR 1 SITE - STAGE 2

KEY STAGE OBJECTIVES\CRITERIA

- Establish access road along northern boundary of disturbance area and secondary access point (exit only).

KEY STAGE OPERATIONS

- Establish decanting earth bund
- Establish cleanwater diversion upslope of disturbance area.
- Construct dirty water channel downslope of disturbance area and convey flows to decanting earth bund.
- Progressively remove topsoil and any other potentially infected material to a nominal depth of 0.5 m plus 0.5 m subsoil[1] and dispose of off-site. Expand stabilised area within the stage 2 area.
- Works within kauri containment zone (KCZ) to be progressively excavated and hardfill hardstand extending into KCZ as works progress.
- All downstream vegetation clearance measures to remain in place.



Boffa Miskell

www.boffamiskell.co.nz

0 25 m

1:800 @ A3

Data Sources: Boffa Miskell, LINZ, Auckland Council

Projection: NZGD 2000 New Zealand Transverse Mercator

A16055G HUIA WTP ECOLOGY EVIDENCE AND HEARING

Topsoil Removal Disposal Phase Staging – Reservoir 1

Date: 13 January 2020 | Revision: 0

Plan prepared by Boffa Miskell Limited

Project Manager: Ian.Boothroyd@boffamiskell.co.nz | Drawn: ATy | Checked: SFI

Stage 2

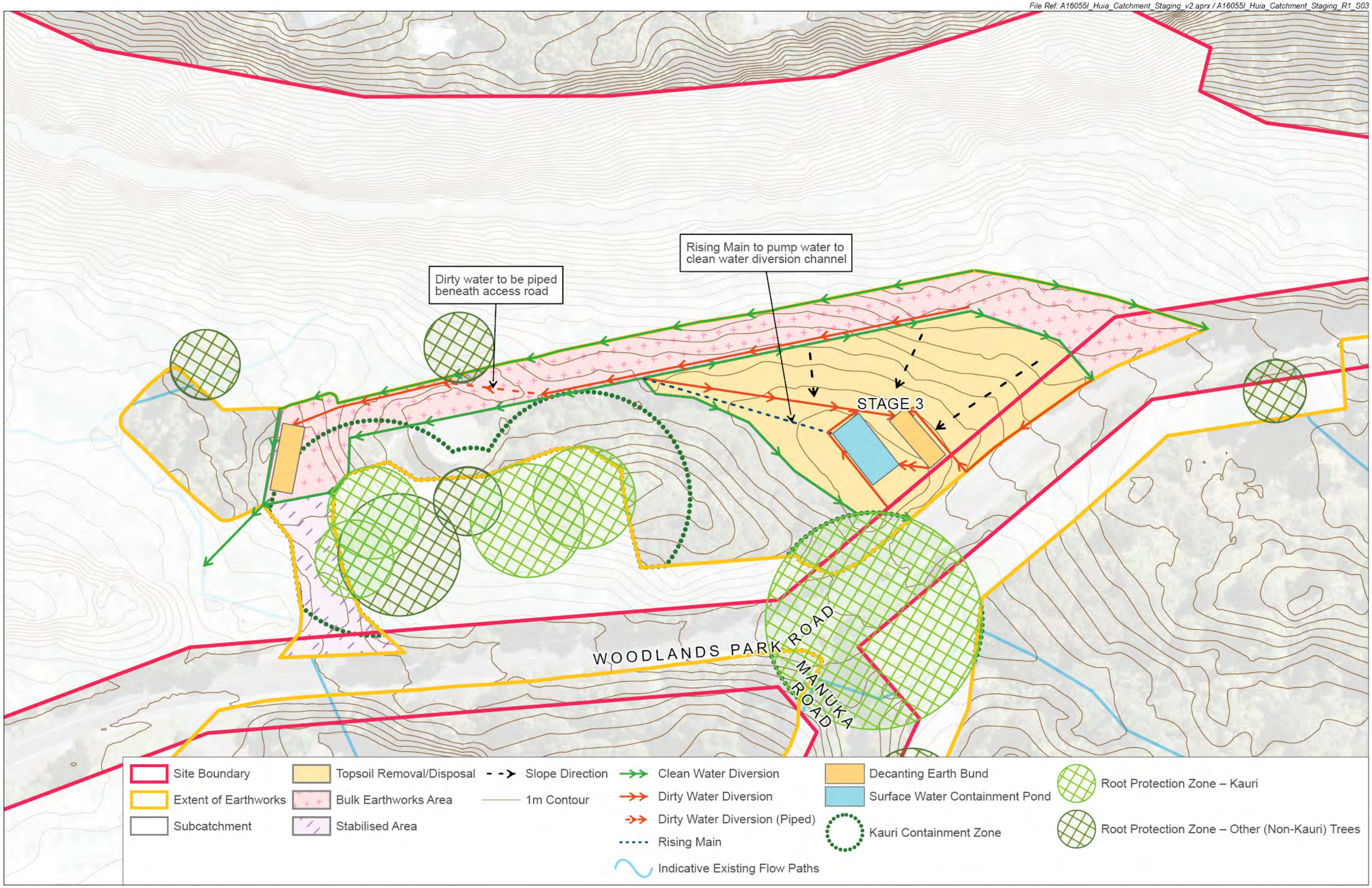
RESERVOIR 1 SITE - STAGE 3

KEY STAGE OBJECTIVES\CRITERIA

- Establish surface water containment pond and rising main for discharge.
- Complete any bulk earthworks within Stage 2 corridor.

KEY STAGE OPERATIONS

- Establish decanting earth bund for stage catchment
- Establish cleanwater diversion upslope of disturbance area.
- Construct dirty water channel downslope of disturbance area and convey flows to decanting earth bund.
- Progressively remove topsoil to and any other potentially infected material to a nominal depth of 0.5 m plus 0.5 m subsoil[1] and dispose of off-site. Expand stabilised area within the stage 3 area.
- Works within kauri containment zone (KCZ) to be progressively excavated and hardfill hardstand extending into KCZ as works progress.



Boffa Miskell

www.boffamiskell.co.nz

0 25 m

1:800 @ A3

Data Sources: Boffa Miskell, LINZ, Auckland Council

Projection: NZGD 2000 New Zealand Transverse Mercator

A16055G HUIA WTP ECOLOGY EVIDENCE AND HEARING

Topsoil Removal Disposal Phase Staging – Reservoir 1

Date: 13 January 2020 | Revision: 0

Plan prepared by Boffa Miskell Limited

Project Manager: Ian.Boothroyd@boffamiskell.co.nz | Drawn: ATy | Checked: SFI

Stage 3

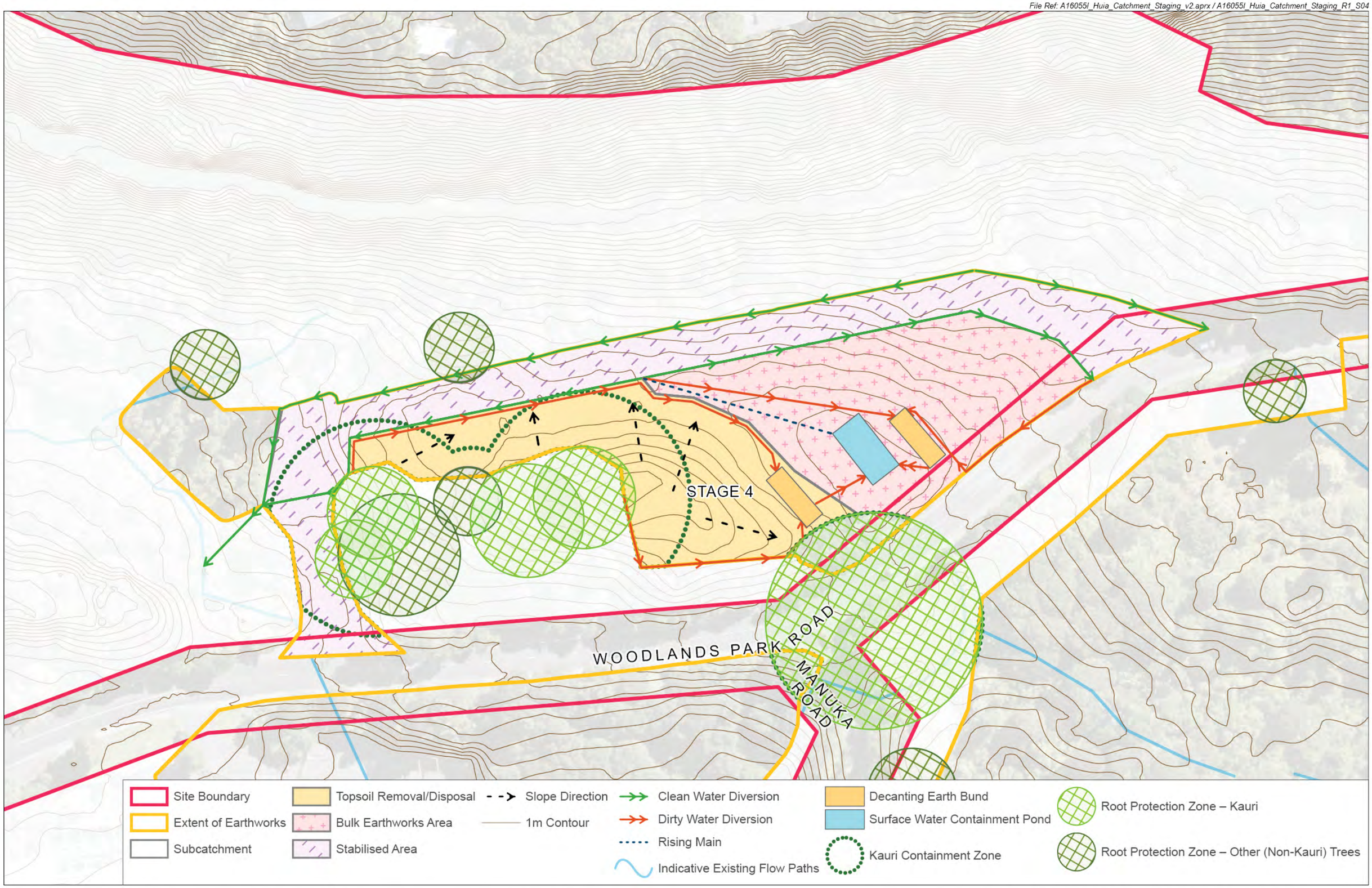
RESERVOIR 1 SITE - STAGE 4

KEY STAGE OBJECTIVES\CRITERIA

- Complete topsoil removal phase from reservoir footprint.
- Continue with bulk earthworks within Stage 3

KEY STAGE OPERATIONS

- Establish decanting earth bund for stage catchment
- Establish cleanwater diversion upslope of disturbance area.
- Construct dirty water channel downslope of disturbance area and convey flows to decanting earth bund.
- Progressively remove topsoil and any other potentially infected material to a nominal depth of 0.5 m plus 0.5 m subsoil[1] and dispose of off-site. Expand stabilised area within the stage 4 area.
- Works within kauri containment zone (KCZ) to be progressively excavated and hardfill hardstand extending into KCZ as works progress.



Boffa Miskell

www.boffamiskell.co.nz

0 25 m

1:800 @ A3

Data Sources: Boffa Miskell, LINZ, Auckland Council

Projection: NZGD 2000 New Zealand Transverse Mercator

A16055G HUIA WTP ECOLOGY EVIDENCE AND HEARING

Topsoil Removal Disposal Phase Staging – Reservoir 1

Date: 13 January 2020 | Revision: 0

Plan prepared by Boffa Miskell Limited

Project Manager: Ian.Boothroyd@boffamiskell.co.nz | Drawn: ATy | Checked: SFI

Stage 4

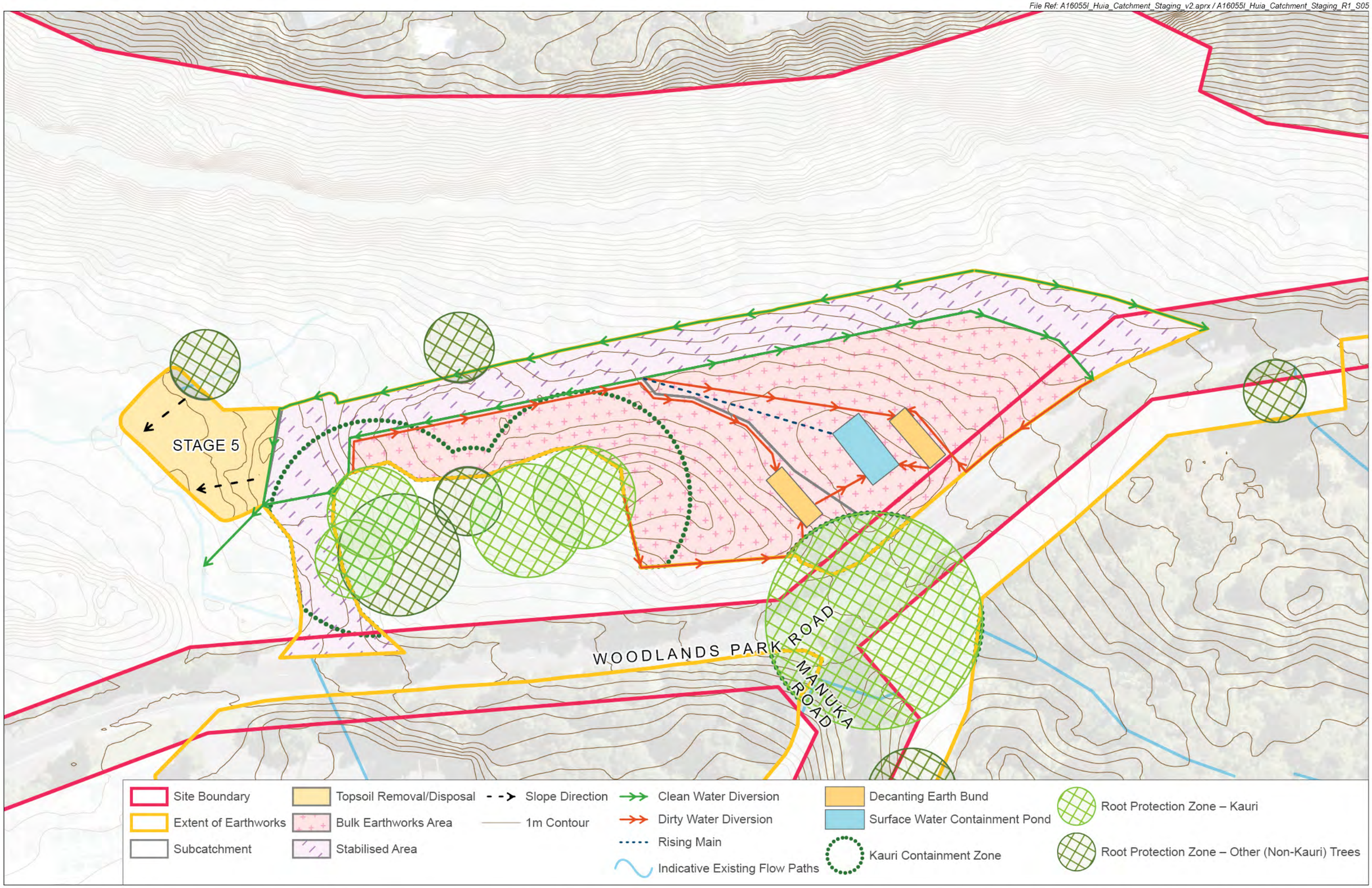
RESERVOIR 1 SITE - STAGE 5

KEY STAGE OBJECTIVES\CRITERIA

- Complete topsoil removal phase from Reservoir 1 site (NH2 tunnel).
- Continue with bulk earthworks within Stages 3&4

KEY STAGE OPERATIONS

- Progressively remove topsoil and expand stabilised area within the stage 5 area.
- All works to be done with localised sediment controls and works area stabilised at completion of each work day.
- The water collected from the washdown process (during the topsoil disposal and prior phases) will be collected and transported offsite.
- Once the site is "clean" i.e. topsoil disposal phase is completed, water would be treated to remove sediment load and then discharged downstream.



Boffa Miskell

www.boffamiskell.co.nz

0 25 m

1:800 @ A3

Data Sources: Boffa Miskell, LINZ, Auckland Council

Projection: NZGD 2000 New Zealand Transverse Mercator

A16055G HUIA WTP ECOLOGY EVIDENCE AND HEARING

Topsoil Removal Disposal Phase Staging – Reservoir 1

Date: 13 January 2020 | Revision: 0

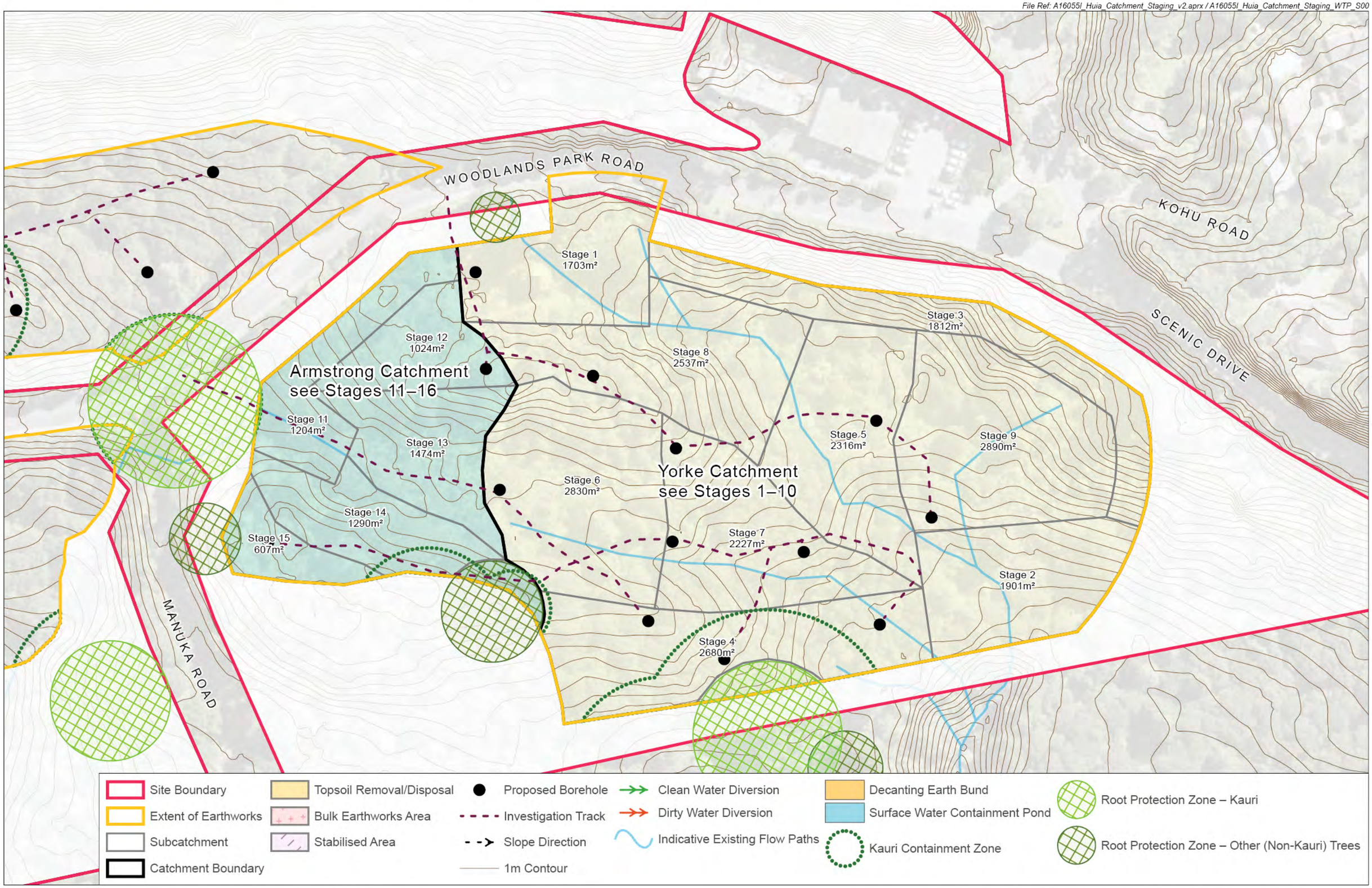
Plan prepared by Boffa Miskell Limited

Project Manager: Ian.Boothroyd@boffamiskell.co.nz | Drawn: ATy | Checked: SFI

Stage 5

WATER TREATMENT PLANT SITE - STAGE 0

Overview of subcatchment areas and boundaries, flow paths and access tracks



Boffa Miskell

www.boffamiskell.co.nz

0 50 m

1:1,000 @ A3

Data Sources: Boffa Miskell, LINZ, Auckland Council

Projection: NZGD 2000 New Zealand Transverse Mercator

A16055G HUIA WTP ECOLOGY EVIDENCE AND HEARING

Topsoil Removal Disposal Phase Staging – Water Treatment Plant

Date: 13 January 2020 | Revision: 0

Plan prepared by Boffa Miskell Limited

Project Manager: Ian.Boothroyd@boffamiskell.co.nz | Drawn: ATy | Checked: SFI

Stage 0

WATER TREATMENT PLANT SITE - STAGE 1

KEY STAGE OBJECTIVES\CRITERIA

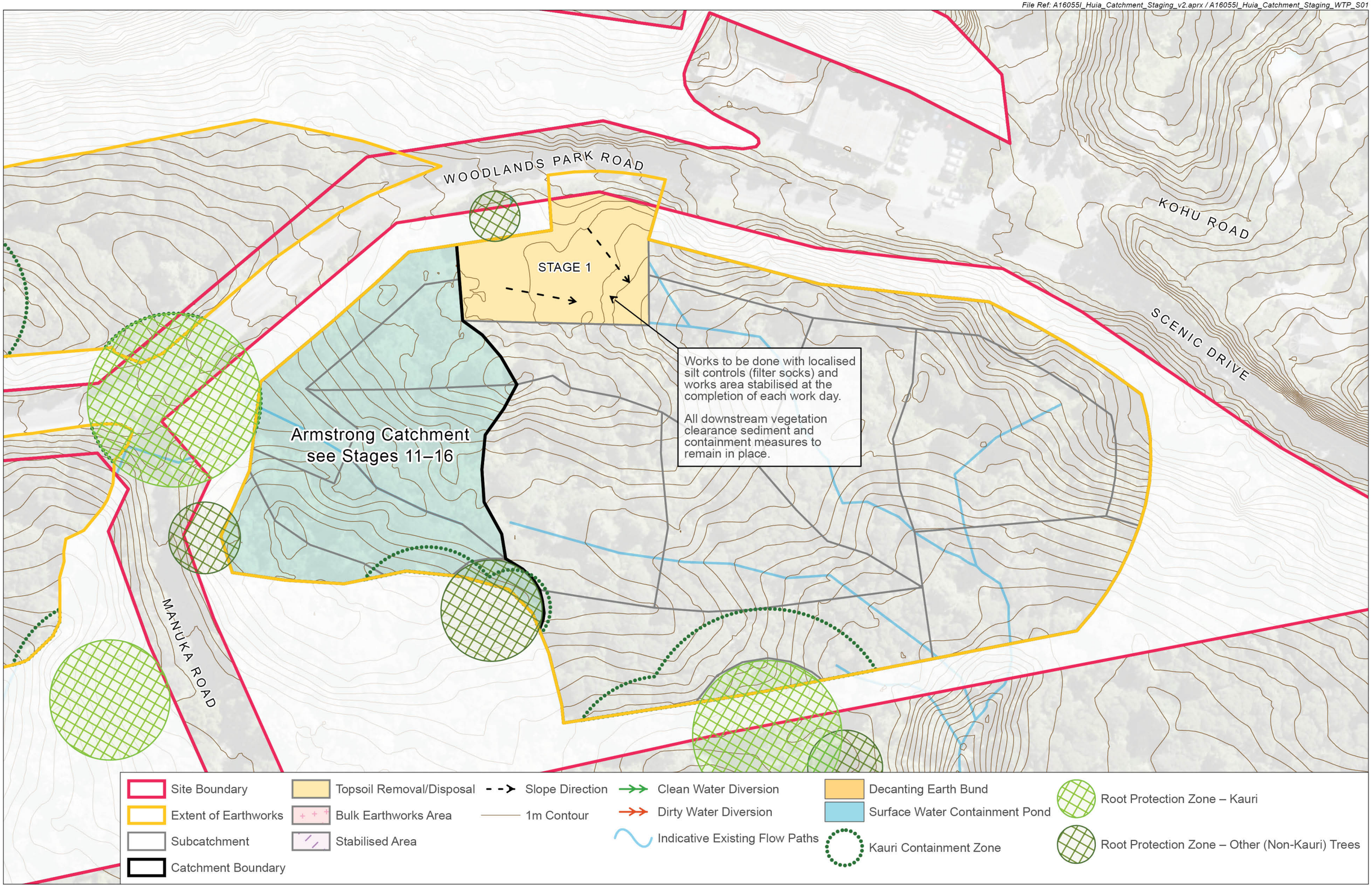
- Minimise disturbance areas to establish entrance controls for both sediment and Kauri Dieback containment.

KEY STAGE OPERATIONS

- Renew stabilised entry where necessary and clean out wash down facilities from vegetation clearance phase. Facility to include truck washdown facility with shaker ramp or approved equivalent to enable collection of all sediment and surface water from wash down process.
- The water collected from the washdown process (during the topsoil disposal and prior phases) will be collected and transported offsite.
- Progressively remove topsoil and expand stabilised area to create a laydown area for plant and site offices within the stage 1 area. Top soil to be loaded directly onto trucks, covered and then transported for offsite disposal.
- All works to be done with localised sediment controls and works area stabilised at completion of each work day.
- All works to be completed in accordance with Site Management Plan (SMP) procedures to manage potentially contaminated material.
- All downstream vegetation clearance measures to remain in place.

EARTHWORKS VOLUMES

- Topsoil removal 850m³
    - Cut 1100m³
    - Fill 200m³
- Stage estimated timeframe - 4-6 weeks (includes 2 weeks for topsoil removal/disposal). Works estimated to commence week 1 of programme.



Boffa Miskell

www.boffamiskell.co.nz

0 — 50 m

1:1,000 @ A3

Data Sources: Boffa Miskell, LINZ, Auckland Council

Projection: NZGD 2000 New Zealand Transverse Mercator

A16055G HUIA WTP ECOLOGY EVIDENCE AND HEARING

Topsoil Removal Disposal Phase Staging – Water Treatment Plant

Date: 03 December 2020 | Revision: 0

Plan prepared by Boffa Miskell Limited

Project Manager: Ian.Boothroyd@boffamiskell.co.nz | Drawn: ATy | Checked: SFI

Stage 1

WATER TREATMENT PLANT SITE - STAGE 2

KEY STAGE OBJECTIVES\CRITERIA

- Establish sediment pond (surface water containment pond) which shall be used only for stormwater containment during topsoil removal phase (stage 4 onwards). All ponds shall be sized to contain at least the full 10 year storm event from the maximum proposed work area. The works area shall not exceed 3000m².
- All future work stages will utilise a two stage treatment process. At source treatment for sediment shall be provided for each catchment with a decanting earth bund (deb). Decanting earth bunds shall be sized based on 3% of the catchment area (as opposed to 2% (GD05)). Water shall then be discharge to SRP S1 for containment/treatment prior to discharge to receiving environment.
- No topsoil removal/disposal catchment will exceed an area of 3000m².

KEY STAGE OPERATIONS

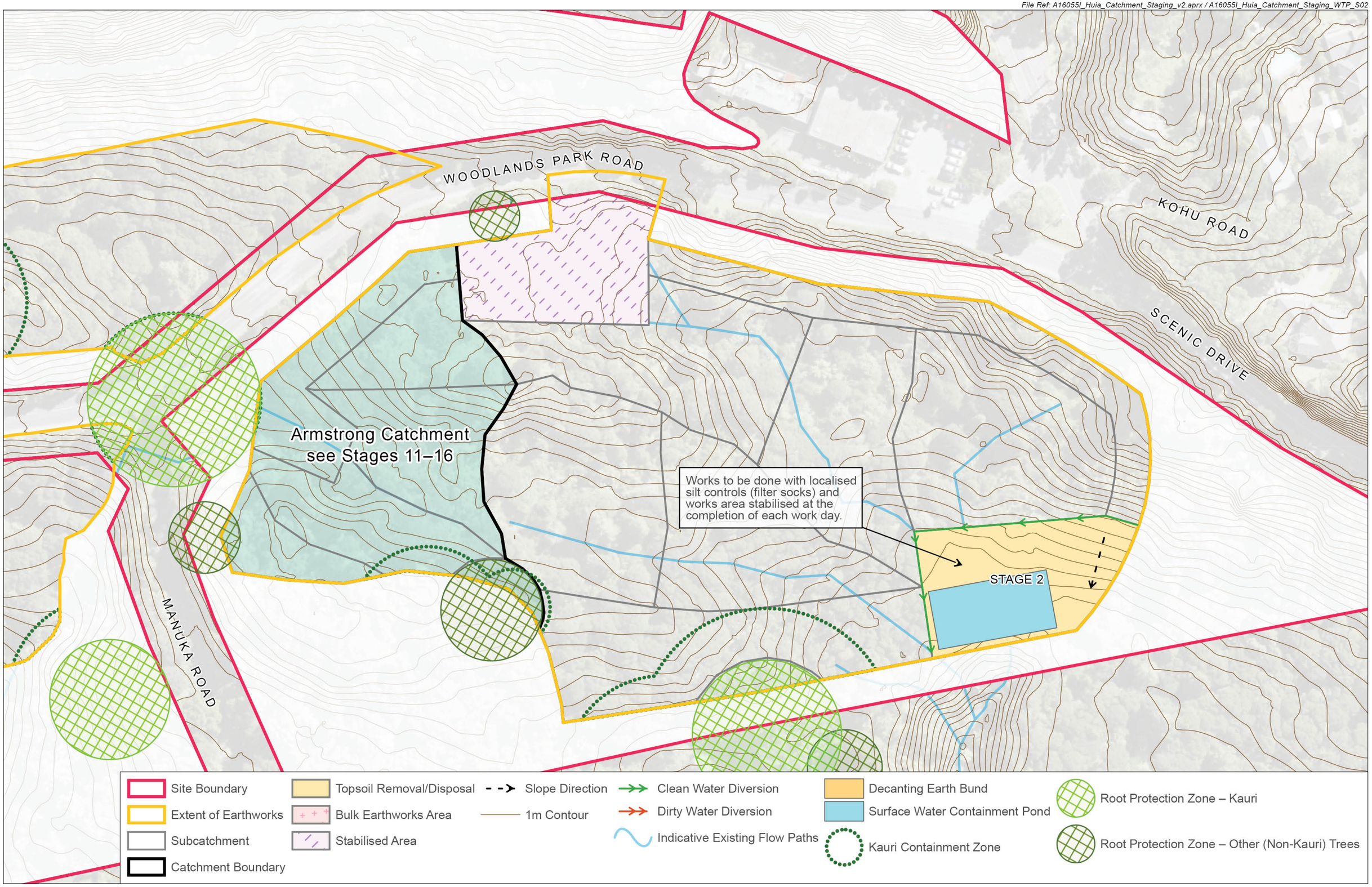
- Utilising existing access tracks and extend as necessary to allow for formation of SRP S1 (surface water containment pond).
- Construct cleanwater diversion upstream of pond site.
- Construct SRP S1
- Excavate topsoil and any other potentially infected matter to a nominal depth of 0.5 m plus 0.5 m subsoil[2], and remove from site.

EARTHWORKS VOLUMES

- Topsoil removal 950m³
    - CUT 0m³
    - FILL 3800m³*

      *Earthworks volume likely to completed later in programme following completion of retaining structure.
- Stage estimated timeframe - 3-4 weeks (includes 2 weeks for topsoil removal/disposal). Works estimated to commence week 3 of programme.

[2] In all instances the actual depth will vary across the site. The Project Arborist is to supervise works and advise the necessary depth required for removal.



Boffa Miskell

www.boffamiskell.co.nz

0 — 50 m

1:1,000 @ A3

Data Sources: Boffa Miskell, LINZ, Auckland Council

Projection: NZGD 2000 New Zealand Transverse Mercator

A16055G HUIA WTP ECOLOGY EVIDENCE AND HEARING

Topsoil Removal Disposal Phase Staging – Water Treatment Plant

Date: 03 December 2020 | Revision: 0

Plan prepared by Boffa Miskell Limited

Project Manager: Ian.Boothroyd@boffamiskell.co.nz | Drawn: ATy | Checked: SFI

Stage 2

WATER TREATMENT PLANT SITE - STAGE 3

KEY STAGE OBJECTIVES\CRITERIA

- Divert external catchment surface flows away from the works area.
- Allow for establishment of permanent intermittent stream realignment.

KEY STAGE OPERATIONS

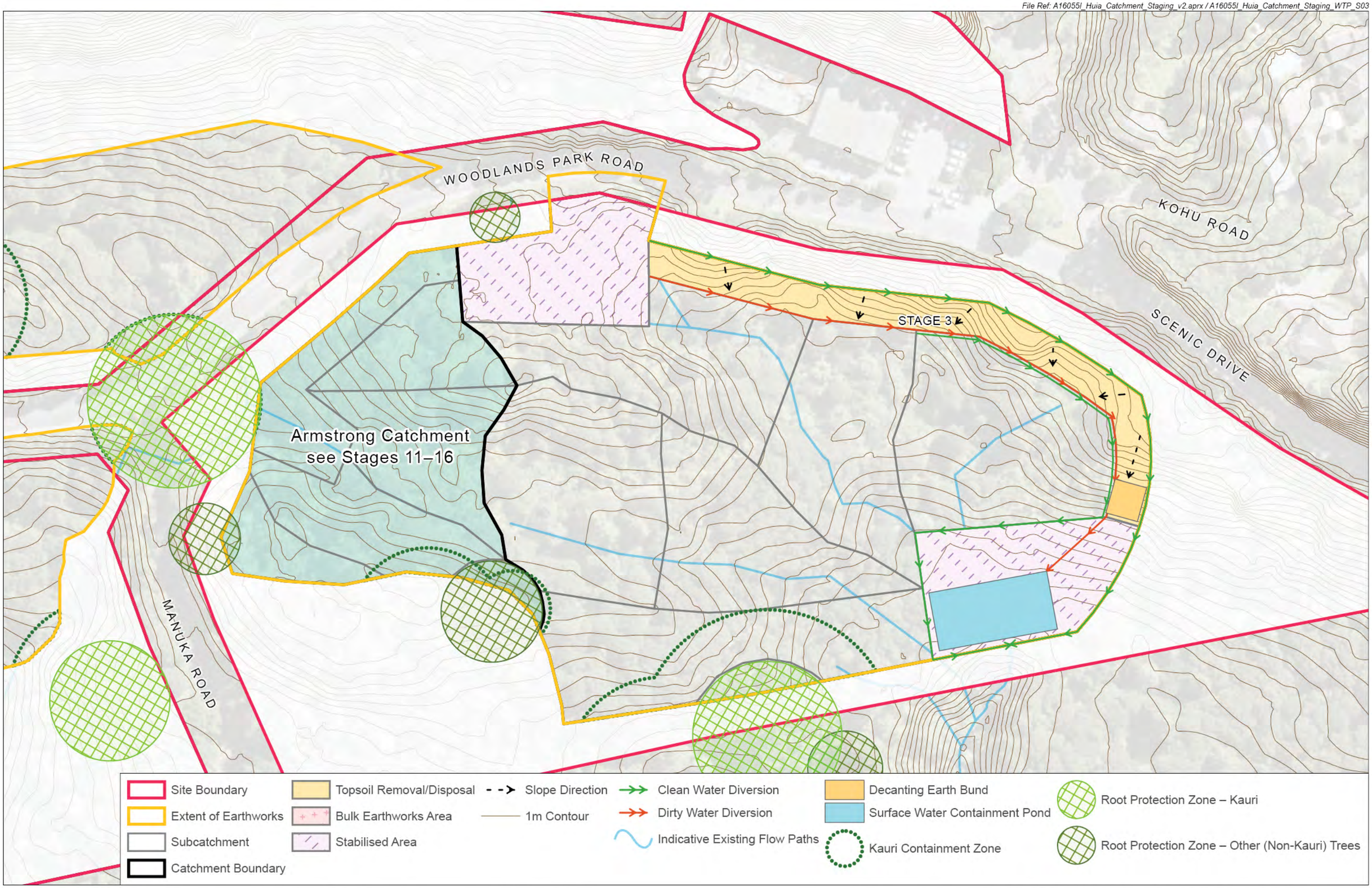
- Establish cleanwater diversion upslope of disturbance area.
- Construct dirty water channel downslope of disturbance area and convey flows to SRP S1.
- Works to progress south to north with cutoff drains in place at northern border of exposed works area to ensure clean water is diverted away.
- All works to be completed in accordance with Site Management Plan (SMP) procedures to manage potentially contaminated material.
- Excavate topsoil and any other potentially contaminated material and infected matter to a nominal depth of 0.5 m plus 0.5 m subsoil[1].
- Top soil and any contaminated material to be loaded directly onto trucks, covered and then transported for offsite disposal.

EARTHWORKS VOLUMES

- Topsoil removal 900m³
    - CUT 1200m³*
    - FILL 1500m³*

  *Earthworks include estimated allowance for construction of pond.

- Stage estimated timeframe - 4-6 weeks (includes 2 weeks for topsoil removal/disposal). Works estimated to commence week 6 of programme.



Boffa Miskell

www.boffamiskell.co.nz

0 50 m

1:1,000 @ A3

Data Sources: Boffa Miskell, LINZ, Auckland Council

Projection: NZGD 2000 New Zealand Transverse Mercator

A16055G HUIA WTP ECOLOGY EVIDENCE AND HEARING

Topsoil Removal Disposal Phase Staging – Water Treatment Plant

Date: 13 January 2020 | Revision: 0

Plan prepared by Boffa Miskell Limited

Project Manager: Ian.Boothroyd@boffamiskell.co.nz | Drawn: ATy | Checked: SFI

Stage 3

WATER TREATMENT PLANT SITE - STAGE 4

KEY STAGE OBJECTIVES\CRITERIA

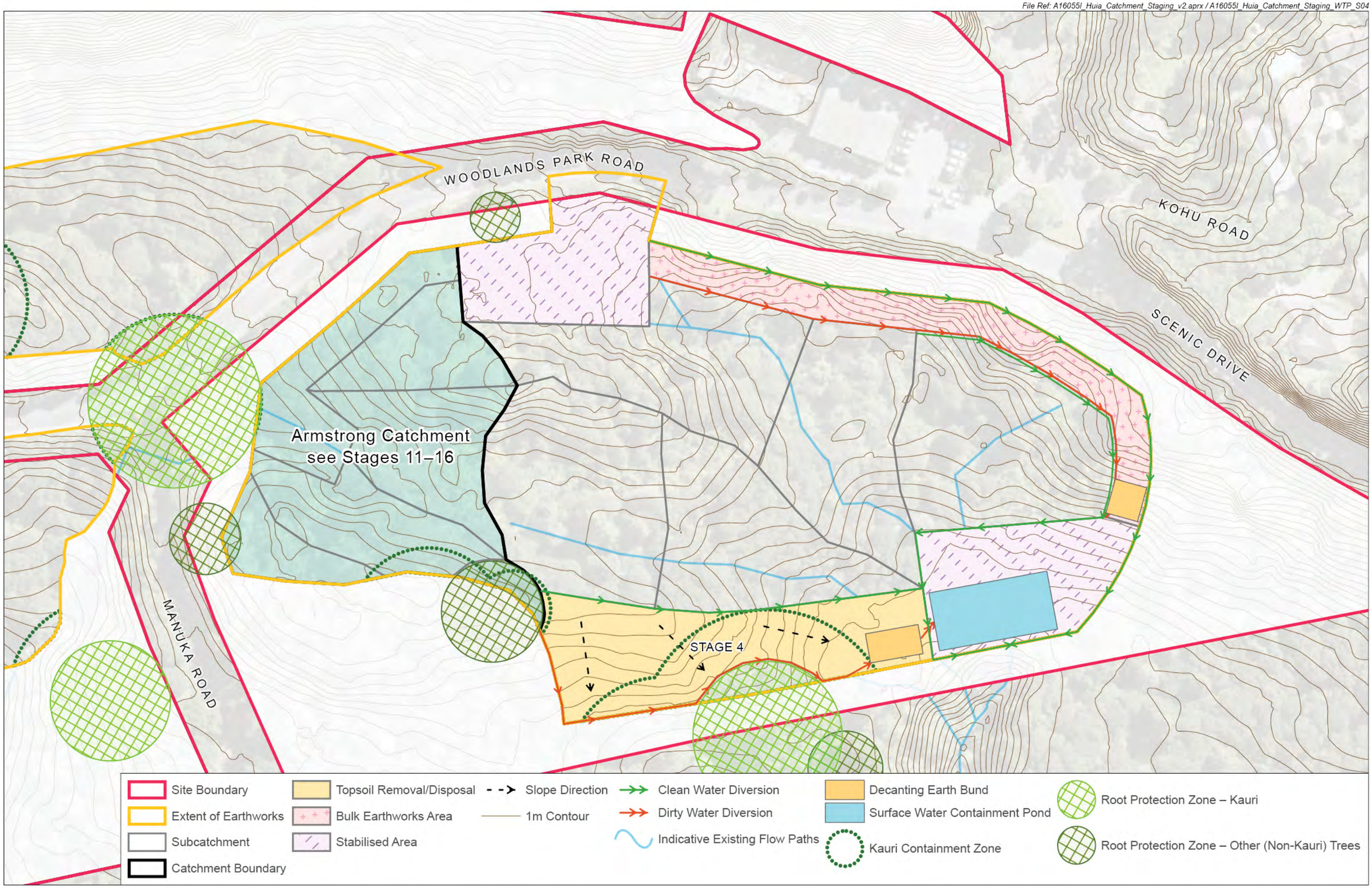
- Previous stage of topsoil removal within works catchment is completed prior to commencement of this stage.
- DEB provides sediment control while SRP S1 provides surface run off containment to mitigate potential spread of Kauri Dieback.
- Previous stages remain open for earthworking to final subgrade levels with sediment controls remaining in place.

KEY STAGE OPERATIONS

- Establish cleanwater diversion upslope of disturbance area.
- Construct decanting earth bund.
- Establish localised washdown area. All washdown water to discharge to decanting earth bund or to separate containment facility.
- Works within kauri containment zone (KCZ) to be progressively excavated north to south with hardfill hardstand extending into KCZ.
- Following completion of KCZ works construct dirty water conveyance channel along the southern boundary discharging to DEB.
- Excavate topsoil and any other potentially infected material to a nominal depth of 0.5 m plus 0.5 m subsoil[1].
- Top soil and any infected material to be loaded directly onto trucks, covered and then transported for offsite disposal and remove from site.

EARTHWORKS VOLUMES

- Topsoil removal 1350m³
    - Cut 4300m³
    - Fill 8000m³
- Stage estimated timeframe - 20- 24 weeks (includes 4 weeks for topsoil removal/disposal and works within KCZ). Works estimated to commence week 10 of programme.



Boffa Miskell

www.boffamiskell.co.nz

0 50 m

1:1,000 @ A3

Data Sources: Boffa Miskell, LINZ, Auckland Council

Projection: NZGD 2000 New Zealand Transverse Mercator

A16055G HUIA WTP ECOLOGY EVIDENCE AND HEARING

Topsoil Removal Disposal Phase Staging – Water Treatment Plant

Date: 13 January 2020 | Revision: 0

Plan prepared by Boffa Miskell Limited

Project Manager: Ian.Boothroyd@boffamiskell.co.nz | Drawn: ATy | Checked: SFI

Stage 4

WATER TREATMENT PLANT SITE - STAGE 5

KEY STAGE OBJECTIVES\CRITERIA

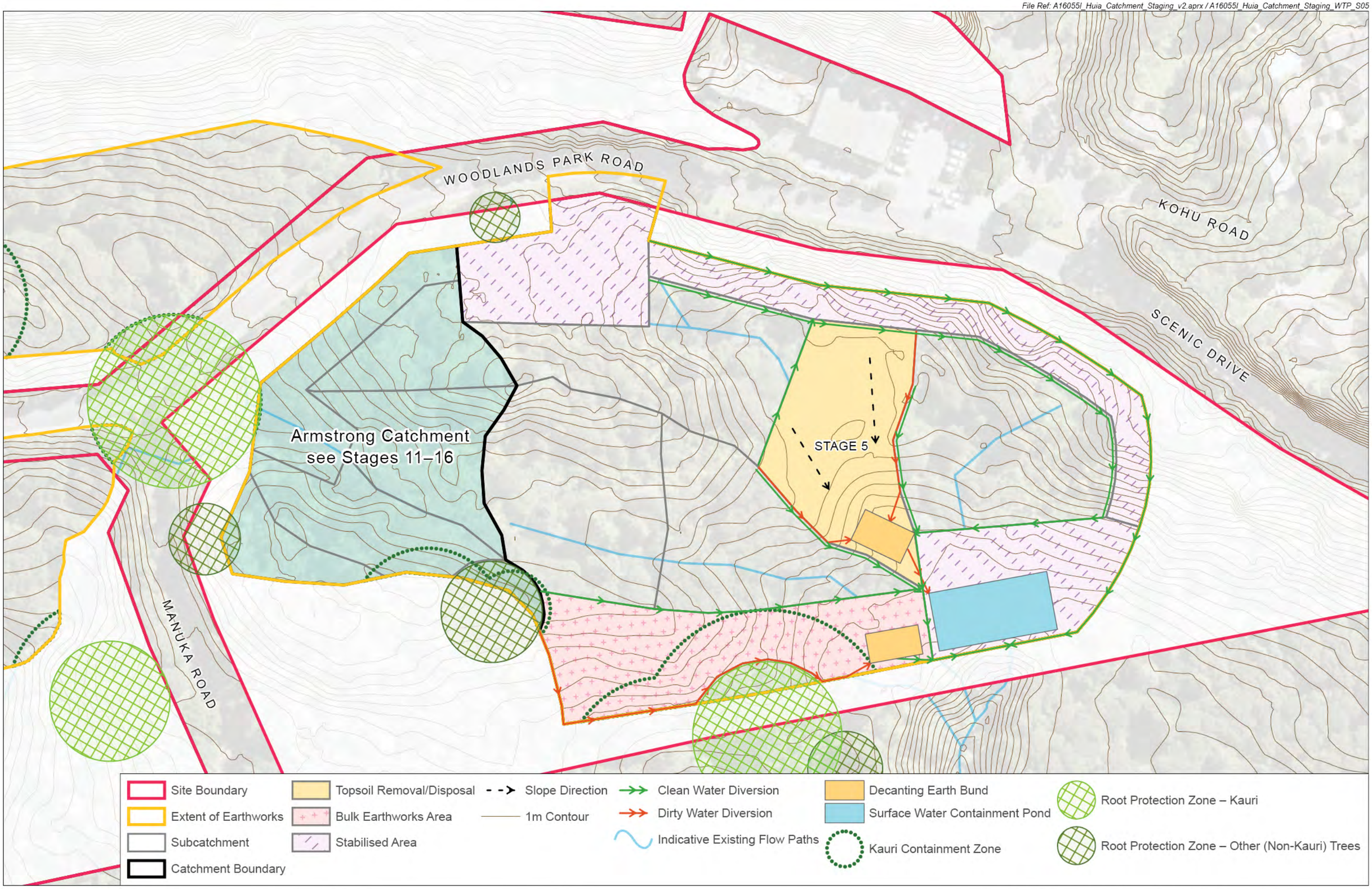
- Previous stage of topsoil removal within works catchment is completed prior to commencement of this stage.
- DEB provides sediment control while SRP S1 provides surface run off containment to mitigate spread of Kauri Dieback.
- previous stages remain open for earthworking to final subgrade levels with sediment controls remaining in place.

KEY STAGE OPERATIONS

- Establish cleanwater diversion upslope of disturbance area. Connect/pipe to existing clean water diversion (CWD) to the north.
- Construct decanting earth bund and dirty water channels.
- Excavate topsoil and any other potentially infected material to a nominal depth of 0.5 m plus 0.5 m subsoil[1], load directly onto trucks, cover and remove from site.
- Excavated material that is suitable for reuse to be placed in bulk earthworks area.

EARTHWORKS VOLUMES

- Topsoil removal 1160m³
    - Cut 3600m³
    - Fill 4500m³
- Stage estimated timeframe - 18 - 22 weeks (includes 2 weeks for topsoil removal/disposal). Works estimated to commence week 14 of programme.



Boffa Miskell

www.boffamiskell.co.nz

0 50 m

1:1,000 @ A3

Data Sources: Boffa Miskell, LINZ, Auckland Council

Projection: NZGD 2000 New Zealand Transverse Mercator

A16055G HUIA WTP ECOLOGY EVIDENCE AND HEARING

Topsoil Removal Disposal Phase Staging – Water Treatment Plant

Date: 13 January 2020 | Revision: 0

Plan prepared by Boffa Miskell Limited

Project Manager: Ian.Boothroyd@boffamiskell.co.nz | Drawn: ATy | Checked: SFI

Stage 5

WATER TREATMENT PLANT SITE - STAGE 6

KEY STAGE OBJECTIVES\CRITERIA

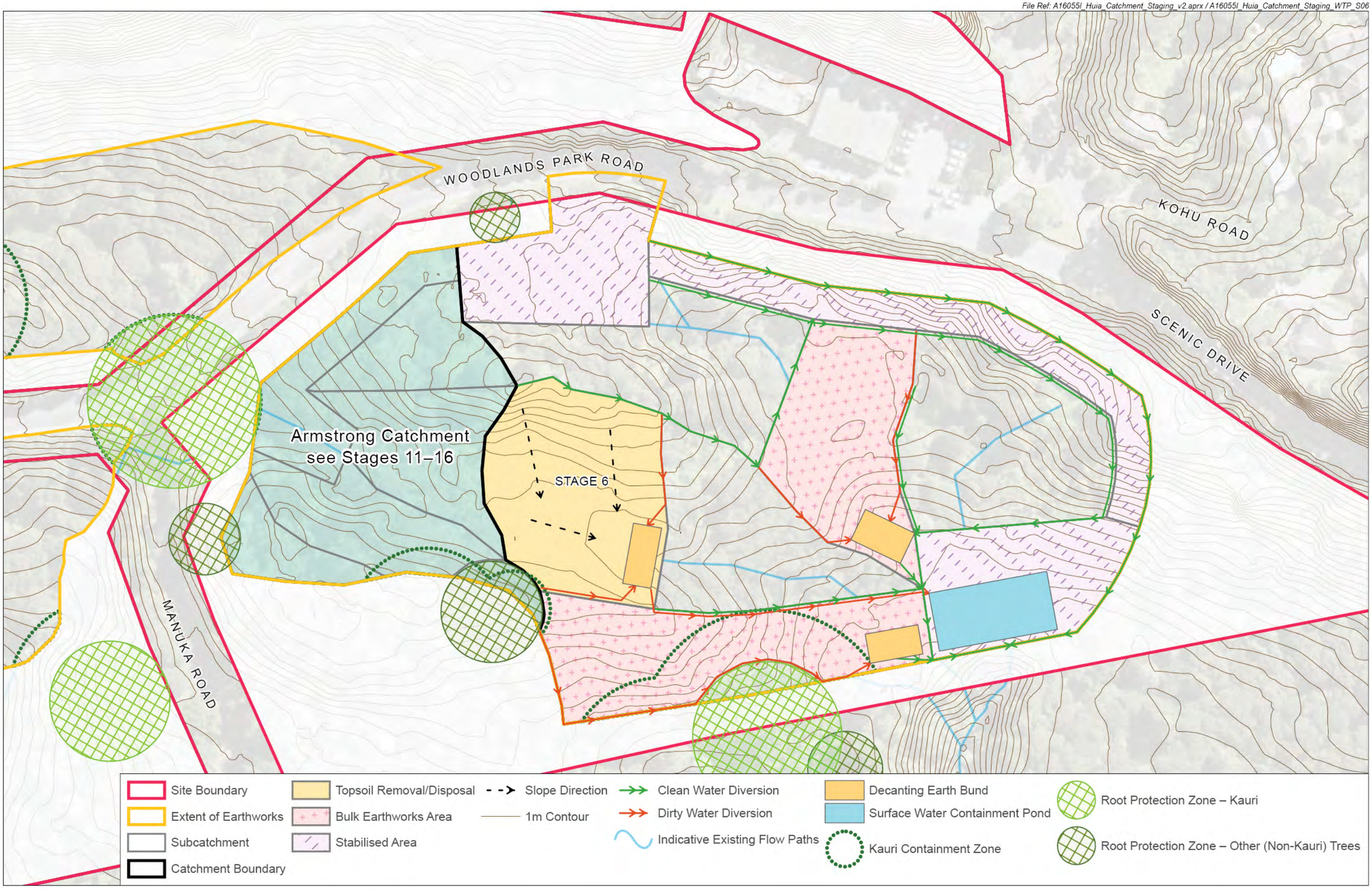
- Previous stage of topsoil removal within works catchment is completed prior to commencement of this stage.
- DEB provides sediment control while SRP S1 provides surface run off containment to mitigate spread of Kauri Dieback.
- Previous stages remain open for earthworking to final subgrade levels with sediment controls remaining in place.

KEY STAGE OPERATIONS

- Establish cleanwater diversion upslope of disturbance area. Connect/pipe to existing CWD to the north.
- Construct decanting earth bund and dirty water channels.
- Excavate topsoil and any other potentially infected material to a nominal depth of 0.5 m plus 0.5 m subsoil[1], load directly onto trucks, cover and remove from site.
- Excavated material that is suitable for reuse to be placed in bulk earthworks area.

EARTHWORKS VOLUMES

- Topsoil removal 1420m³
    - Cut 10,400m³
    - Fill 900m³
- Stage estimated timeframe - 30-36 weeks (includes 3 weeks for topsoil removal/disposal and works within KCZ). Works estimated to commence week 16 of programme.



Boffa Miskell

www.boffamiskell.co.nz

0 50 m

1:1,000 @ A3

Data Sources: Boffa Miskell, LINZ, Auckland Council

Projection: NZGD 2000 New Zealand Transverse Mercator

A16055G HUIA WTP ECOLOGY EVIDENCE AND HEARING

Topsoil Removal Disposal Phase Staging – Water Treatment Plant

Date: 13 January 2020 | Revision: 0

Plan prepared by Boffa Miskell Limited

Project Manager: Ian.Boothroyd@boffamiskell.co.nz | Drawn: ATy | Checked: SFI

Stage 6

WATER TREATMENT PLANT SITE - STAGE 7

KEY STAGE OBJECTIVES\CRITERIA

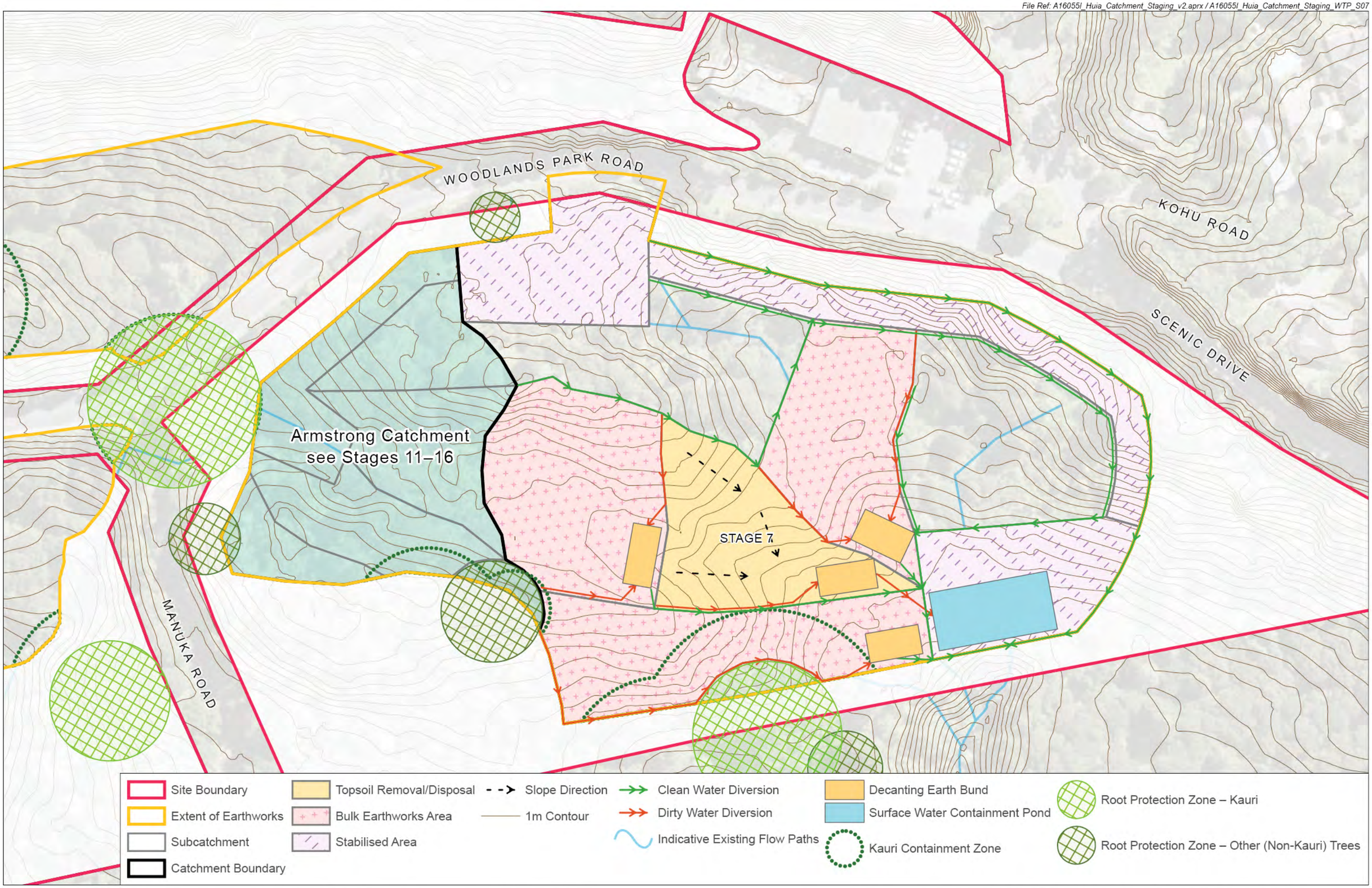
- Previous stage of topsoil removal within works catchment is completed prior to commencement of this stage.
- DEB provides sediment control while SRP S1 provides surface run off containment to mitigate spread of Kauri Dieback.
- Previous stages remain open for earthworking to final subgrade levels with sediment controls remaining in place.

KEY STAGE OPERATIONS

- Establish cleanwater diversion upslope of disturbance area. Connect/pipe to existing CWD to the north.
- Construct decanting earth bund and dirty water channels.
- Excavate topsoil and any other potentially infected material to a nominal depth of 0.5 m plus 0.5 m subsoil[1], load directly onto trucks, cover and remove from site.
- Excavated material that is suitable for reuse to be placed in bulk earthworks area.

EARTHWORKS VOLUMES

- Topsoil removal 1120m³
    - Cut 7000m³
    - Fill 5000m³
- Stage estimated timeframe - 28- 34 weeks (includes 2 weeks for topsoil removal/disposal and works within KCZ). Works estimated to commence week 19 of programme.



Boffa Miskell

www.boffamiskell.co.nz

0 — 50 m

1:1,000 @ A3

Data Sources: Boffa Miskell, LINZ, Auckland Council

Projection: NZGD 2000 New Zealand Transverse Mercator

A16055G HUIA WTP ECOLOGY EVIDENCE AND HEARING

Topsoil Removal Disposal Phase Staging – Water Treatment Plant

Date: 13 January 2020 | Revision: 0

Plan prepared by Boffa Miskell Limited

Project Manager: Ian.Boothroyd@boffamiskell.co.nz | Drawn: ATy | Checked: SFI

Stage 7

WATER TREATMENT PLANT SITE - STAGE 8

KEY STAGE OBJECTIVES\CRITERIA

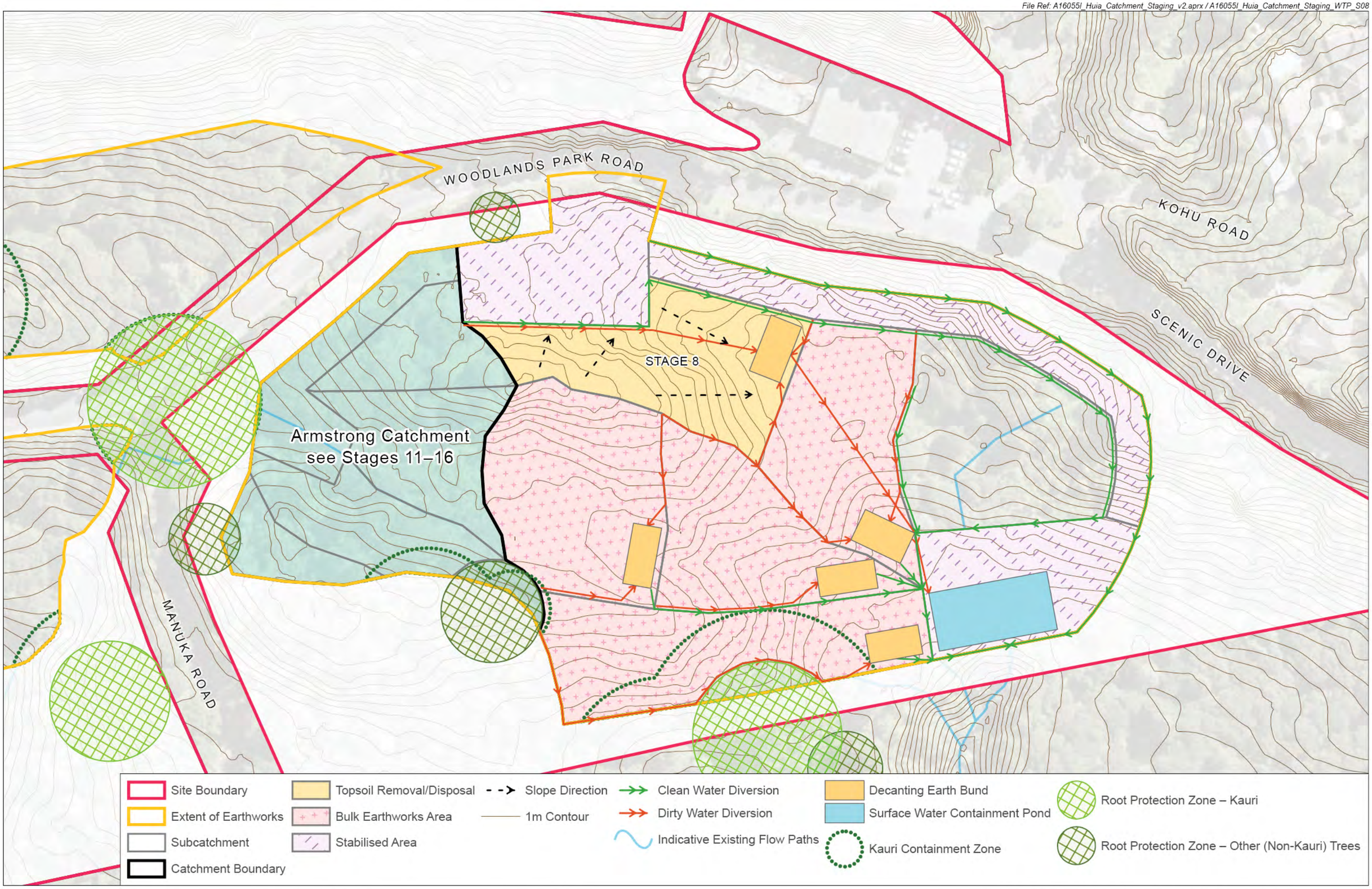
- Previous stage of topsoil removal within works catchment is completed prior to commencement of this stage.
- DEB provides sediment control while SRP S1 provides surface run off containment to mitigate spread of Kauri Dieback.
- All works to be completed in accordance with Site Management Plan (SMP) procedures to manage potentially contaminated material.
- Previous stages remain open for earthworking to final subgrade levels with sediment controls remaining in place.

KEY STAGE OPERATIONS

- Establish cleanwater diversion upslope of disturbance area.
- Construct decanting earth bund and dirty water channels.
- Excavate topsoil and any other potentially contaminated material and infected matter and remove from site.
- Excavated material that is suitable for reuse to be placed in bulk earthworks area.

EARTHWORKS VOLUMES

- Topsoil removal 1270m³
    - Cut 6500m³
    - Fill 3800m³
- Stage estimated timeframe - 19-22 weeks (includes 2 weeks for topsoil removal/disposal and works within KCZ). Works estimated to commence week 21 of programme.



Boffa Miskell

www.boffamiskell.co.nz

0 50 m

1:1,000 @ A3

Data Sources: Boffa Miskell, LINZ, Auckland Council

Projection: NZGD 2000 New Zealand Transverse Mercator

A16055G HUIA WTP ECOLOGY EVIDENCE AND HEARING

Topsoil Removal Disposal Phase Staging – Water Treatment Plant

Date: 13 January 2020 | Revision: 0

Plan prepared by Boffa Miskell Limited

Project Manager: Ian.Boothroyd@boffamiskell.co.nz | Drawn: ATy | Checked: SFI

Stage 8

WATER TREATMENT PLANT SITE - STAGE 9

KEY STAGE OBJECTIVES\CRITERIA

- Previous stage of topsoil removal within works catchment is completed prior to commencement of this stage.
- DEB provides sediment control while SRP S1 provides surface run off containment to mitigate spread of Kauri Dieback.
- Previous stages remain open for earthworking to final subgrade levels with sediment controls remaining in place.

KEY STAGE OPERATIONS

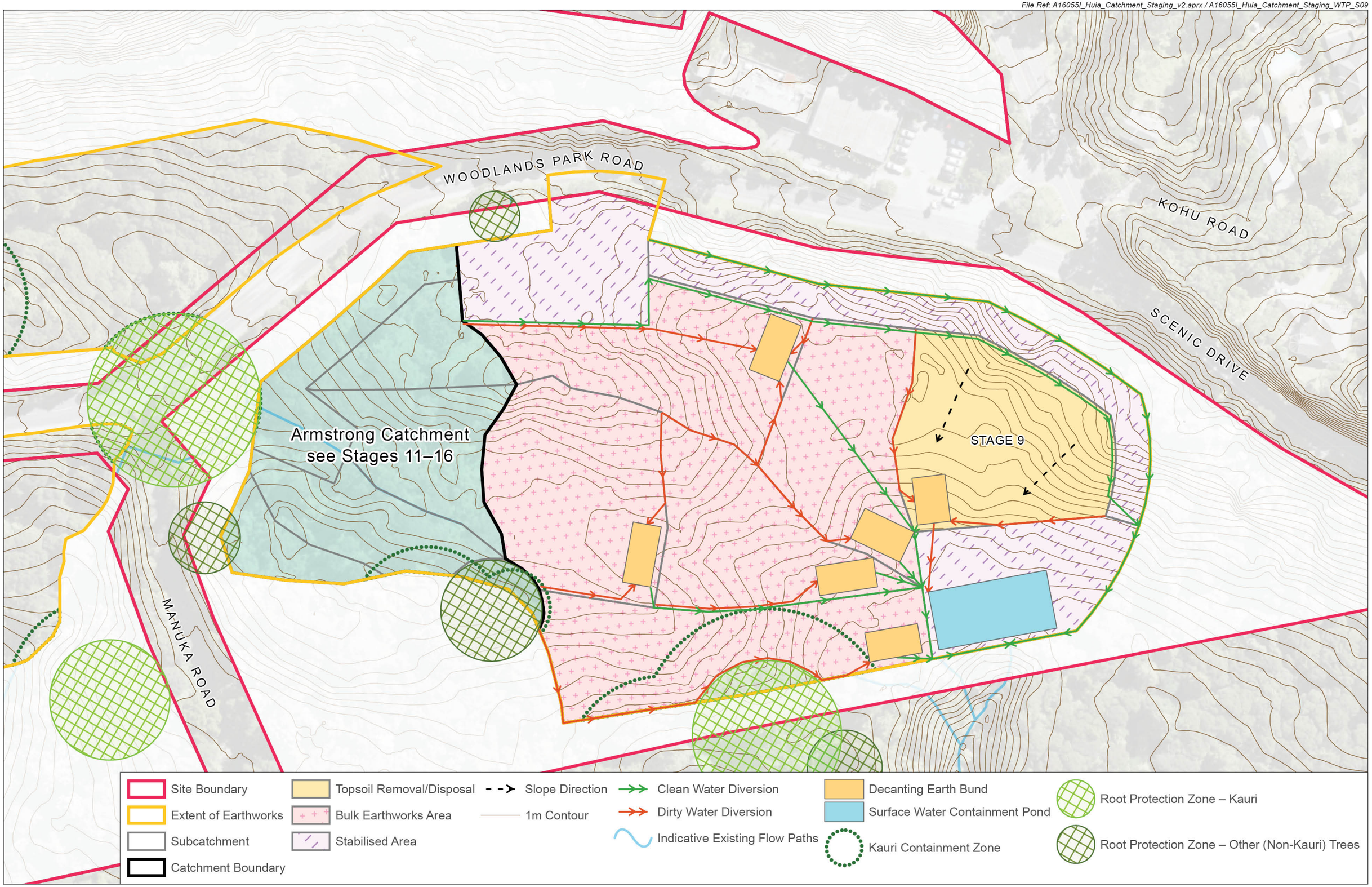
- Establish cleanwater diversion upslope of disturbance area.
- Construct decanting earth bund and dirty water channels.
- Excavate topsoil and any other potentially infected material to a nominal depth of 0.5 m plus 0.5 m subsoil[1], load directly onto trucks, cover and remove from site.
- Excavated material that is suitable for reuse to be placed in bulk earthworks area.

EARTHWORKS VOLUMES

- Topsoil removal 1450m³
    - Cut 2700m³*
    - Fill 500m³*

*Bulk earthworks volumes exclude volume required to create laydown area.

- Stage estimated timeframe - 6-9 weeks (includes 2 weeks for topsoil removal/disposal). Works estimated to commence week 23 of programme.



Boffa Miskell

www.boffamiskell.co.nz

0 50 m

1:1,000 @ A3

Data Sources: Boffa Miskell, LINZ, Auckland Council

Projection: NZGD 2000 New Zealand Transverse Mercator

A16055G HUIA WTP ECOLOGY EVIDENCE AND HEARING

Topsoil Removal Disposal Phase Staging – Water Treatment Plant

Date: 03 December 2020 | Revision: 0

Plan prepared by Boffa Miskell Limited

Project Manager: Ian.Boothroyd@boffamiskell.co.nz | Drawn: ATy | Checked: SFI

Stage 9

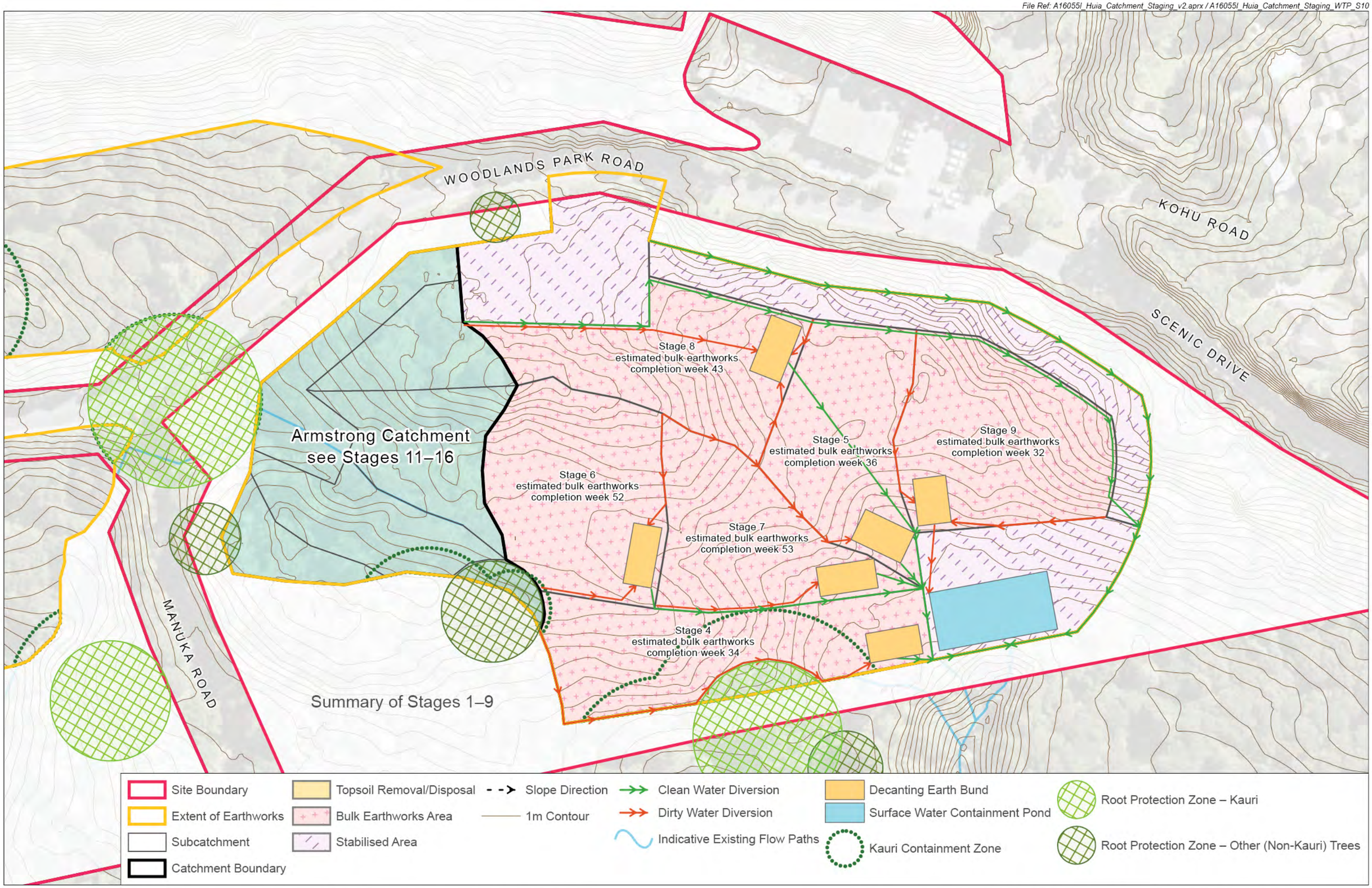
WATER TREATMENT PLANT SITE - STAGE 10

KEY STAGE OBJECTIVES\CRITERIA

- Completion of bulk earthworks operations within previous stages.
- Provide indicative timeframes/completion dates for stabilisation of catchments (earthworks completion).

KEY STAGE OPERATIONS

- Continue with bulk earthworks operations to subgrade level and stabilise.
- Upon stabilisation of each catchment stage remove sediment controls.
- The water collected from the washdown process (during the topsoil disposal and prior phases) will be collected and transported offsite.
- Once the site is "clean" i.e. topsoil disposal phase is completed, water would be treated to remove sediment load and then discharged downstream.



Boffa Miskell

www.boffamiskell.co.nz

0 50 m

1:1,000 @ A3

Data Sources: Boffa Miskell, LINZ, Auckland Council

Projection: NZGD 2000 New Zealand Transverse Mercator

A16055G HUIA WTP ECOLOGY EVIDENCE AND HEARING

Topsoil Removal Disposal Phase Staging – Water Treatment Plant

Date: 13 January 2020 | Revision: 0

Plan prepared by Boffa Miskell Limited

Project Manager: Ian.Boothroyd@boffamiskell.co.nz | Drawn: ATy | Checked: SFI

Stage 10

WATER TREATMENT PLANT SITE - STAGE 11

KEY STAGE OBJECTIVES\CRITERIA

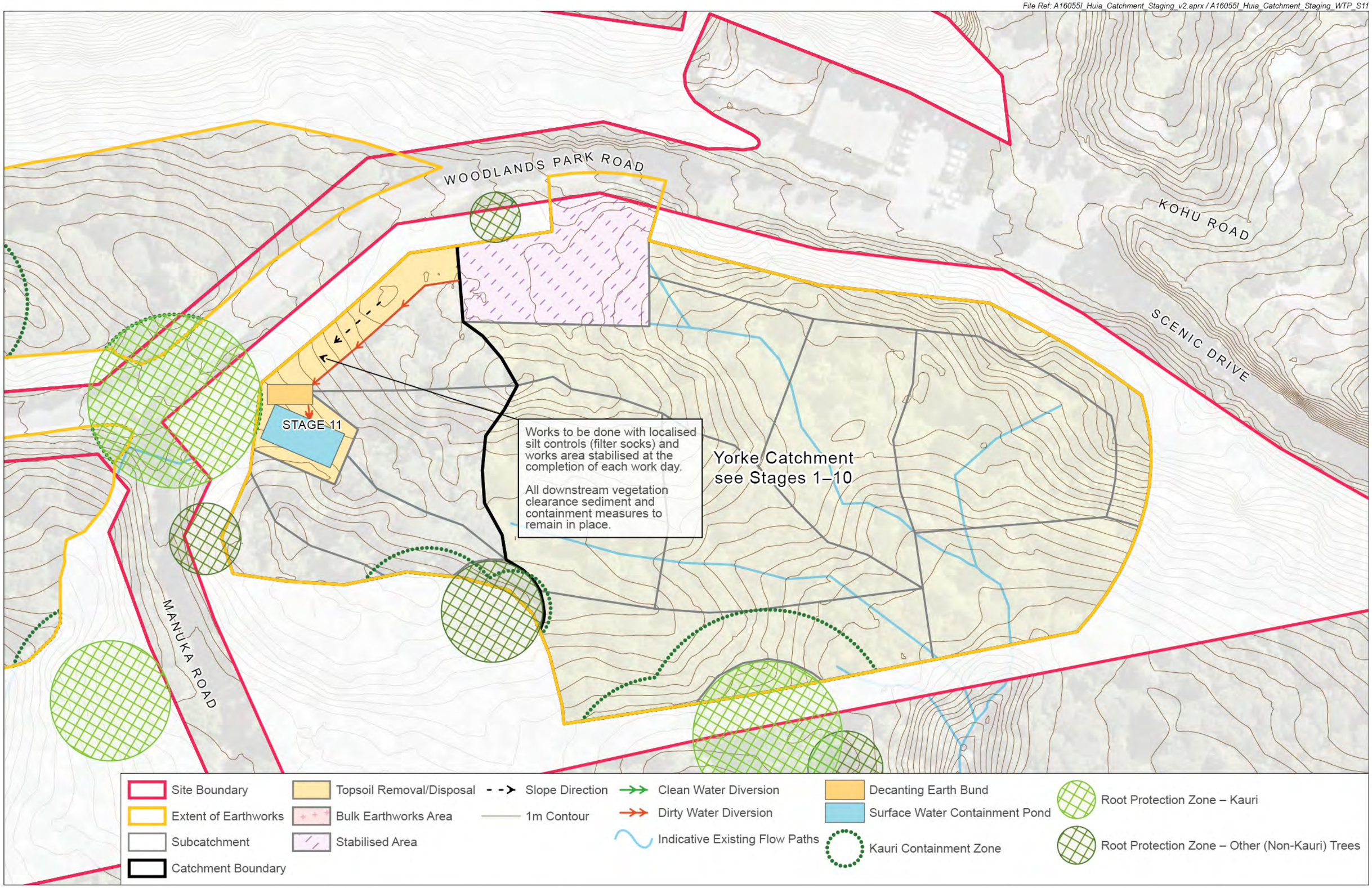
- Establish sediment pond which shall be used only for stormwater containment during topsoil removal phase (stage 12 to stage 15). All ponds shall be sized to contain at least the full 10- year storm event from the maximum proposed work area. The works area shall not exceed 3000m².
- All future work stages will utilise a two-stage treatment process. At source treatment for sediment shall be provided for each catchment with a decanting earth bund (DEB). Decanting earth bunds shall be sized based on 3% of the catchment area (as opposed to 2% (GD05)). Water shall then be discharge to SRP1 for containment/treatment prior to discharge to receiving environment.
- No topsoil removal/disposal catchment will exceed an area of 3000m²

KEY STAGE OPERATIONS

- Utilising existing access tracks and extend as necessary to allow for formation of SRP S2.
- Construct cleanwater diversion upstream of catchment.
- Construct SRP S2

EARTHWORKS VOLUMES

- Topsoil Removal 600m³
    - Cut 200m³
    - Fill 500m³
- Stage estimated timeframe - 3-4 weeks (includes 2 weeks for topsoil removal/disposal). Works can commence after week 6 of programme (completion of stage 1).



Boffa Miskell

www.boffamiskell.co.nz

0 — 50 m

1:1,000 @ A3

Data Sources: Boffa Miskell, LINZ, Auckland Council

Projection: NZGD 2000 New Zealand Transverse Mercator

A16055G HUIA WTP ECOLOGY EVIDENCE AND HEARING

Topsoil Removal Disposal Phase Staging – Water Treatment Plant

Date: 13 January 2020 | Revision: 0

Plan prepared by Boffa Miskell Limited

Project Manager: Ian.Boothroyd@boffamiskell.co.nz | Drawn: ATy | Checked: SFI

Stage 11

WATER TREATMENT PLANT SITE - STAGE 12

KEY STAGE OBJECTIVES\CRITERIA

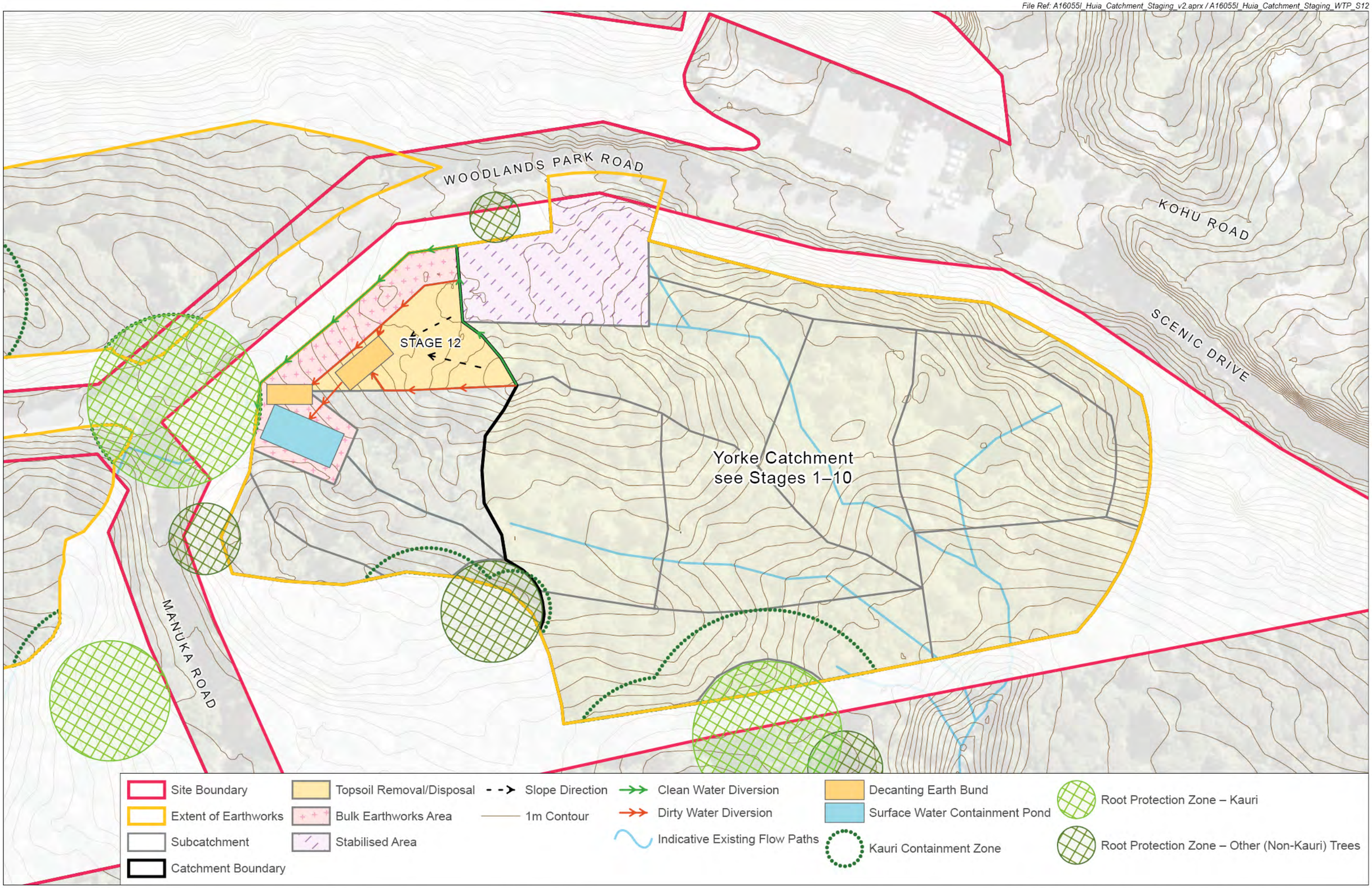
- Previous stage of topsoil removal within works catchment is completed prior to commencement of this stage.
- DEB provides sediment control while SRP S2 provides surface run off containment to mitigate potential spread of kauri dieback.
- Previous stages remain open for earthworking to final subgrade levels with sediment controls remaining in place.

KEY STAGE OPERATIONS

- Establish cleanwater diversion upslope of disturbance area.
- Construct decanting earth bund and dirty water channels.
- Excavate topsoil and any other potentially infected material to a nominal depth of 0.5 m plus 0.5 m subsoil[1] and remove from site.
- Excavated material that is suitable for reuse to be placed in bulk earthworks area.

EARTHWORKS VOLUMES

- Topsoil Removal 510m³
    - Cut 3200m³
    - Fill 200m³
- Stage estimated timeframe - 16- 18 weeks (includes 2 weeks for topsoil removal/disposal). Works estimated to commence week 10 of programme.



Boffa Miskell

www.boffamiskell.co.nz

0 50 m

1:1,000 @ A3

Data Sources: Boffa Miskell, LINZ, Auckland Council

Projection: NZGD 2000 New Zealand Transverse Mercator

A16055G HUIA WTP ECOLOGY EVIDENCE AND HEARING

Topsoil Removal Disposal Phase Staging – Water Treatment Plant

Date: 13 January 2020 | Revision: 0

Plan prepared by Boffa Miskell Limited

Project Manager: Ian.Boothroyd@boffamiskell.co.nz | Drawn: ATy | Checked: SFI

Stage 12

WATER TREATMENT PLANT SITE - STAGE 13

KEY STAGE OBJECTIVES\CRITERIA

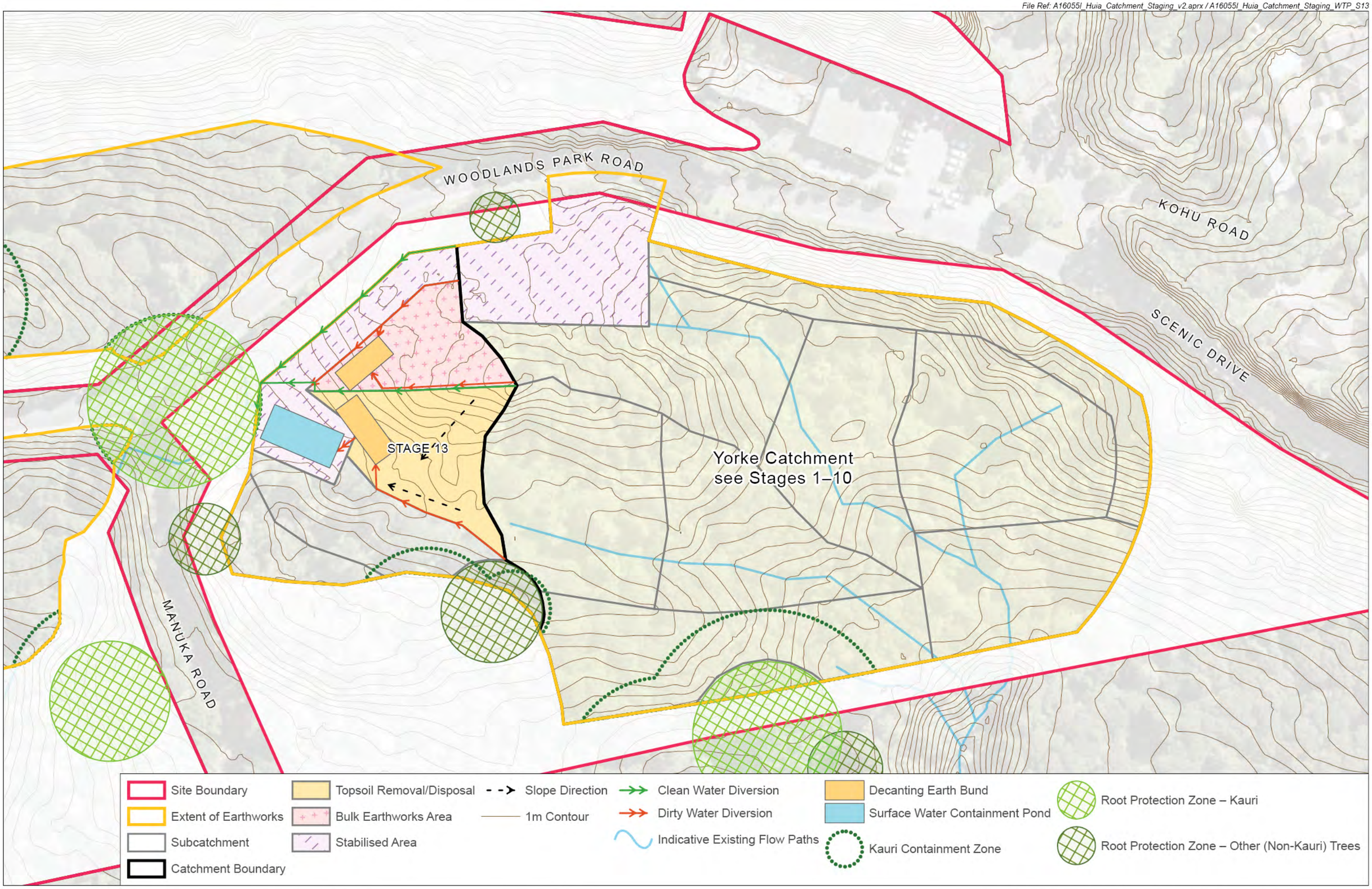
- Previous stage of topsoil removal within works catchment is completed prior to commencement of this stage.
- DEB provides sediment control while SRP S2 provides surface run off containment to mitigate spread of kauri dieback.
- Previous stages remain open for earthworking to final subgrade levels with sediment controls remaining in place.

KEY STAGE OPERATIONS

- Establish cleanwater diversion upslope of disturbance area.
- Construct decanting earth bund and dirty water channels.
- Works within the KCZ to be progressively excavated and hardfill hardstand extended into KCZ as works progress.
- Excavate topsoil and any other potentially infected material to a nominal depth of 0.5 m plus 0.5 m subsoil[1] and remove from site.
- Excavated material that is suitable for reuse to be placed in bulk earthworks area.

EARTHWORKS VOLUMES

- Topsoil Removal 750m³
    - Cut 1300m³
    - Fill 3500m³
- Stage estimated timeframe - 16-18 weeks (includes 2 weeks for topsoil removal/disposal and works within KCZ). Works estimated to commence week 12 of programme.



Boffa Miskell

www.boffamiskell.co.nz

0 50 m

1:1,000 @ A3

Data Sources: Boffa Miskell, LINZ, Auckland Council

Projection: NZGD 2000 New Zealand Transverse Mercator

A16055G HUIA WTP ECOLOGY EVIDENCE AND HEARING

Topsoil Removal Disposal Phase Staging – Water Treatment Plant

Date: 13 January 2020 | Revision: 0

Plan prepared by Boffa Miskell Limited

Project Manager: Ian.Boothroyd@boffamiskell.co.nz | Drawn: ATy | Checked: SFI

Stage 13

WATER TREATMENT PLANT SITE - STAGE 14

KEY STAGE OBJECTIVES\CRITERIA

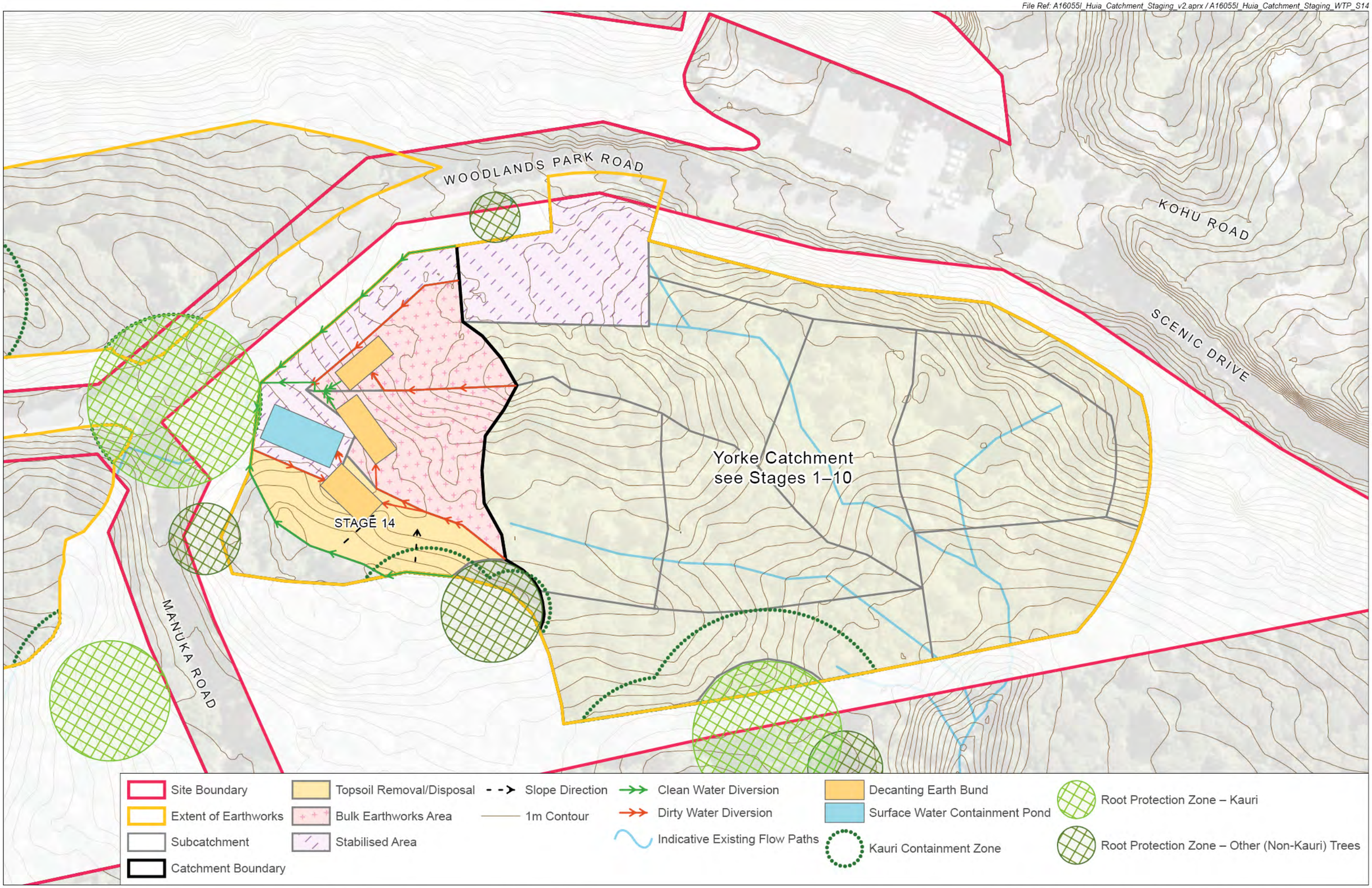
- Previous stage of topsoil removal within works catchment is completed prior to commencement of this stage.
- DEB provides sediment control while SRP S2 provides surface run off containment to mitigate potential spread of kauri dieback.
- Previous stages remain open for earthworking to final subgrade levels with sediment controls remaining in place.

KEY STAGE OPERATIONS

- Establish cleanwater diversion upslope of disturbance area.
- Construct decanting earth bund and dirty water channels.
- Works within the KCZ to be progressively excavated and hardfill hardstand extended into KCZ as works progress.
- Excavate topsoil and any other potentially infected material to a nominal depth of 0.5 m plus 0.5 m subsoil[1], load directly onto trucks, cover and remove from site.
- Excavated material that is suitable for reuse to be placed in bulk earthworks area.

EARTHWORKS VOLUMES

- Topsoil Removal 650m³
    - Cut 500m³
    - Fill 2800m³
- Stage estimated timeframe 8-10 weeks (includes 4 weeks for topsoil removal/disposal and works within KCZ). Works estimated to commence week 14 of programme.



Boffa Miskell

www.boffamiskell.co.nz

0 — 50 m

1:1,000 @ A3

Data Sources: Boffa Miskell, LINZ, Auckland Council

Projection: NZGD 2000 New Zealand Transverse Mercator

A16055G HUIA WTP ECOLOGY EVIDENCE AND HEARING

Topsoil Removal Disposal Phase Staging – Water Treatment Plant

Date: 13 January 2020 | Revision: 0

Plan prepared by Boffa Miskell Limited

Project Manager: Ian.Boothroyd@boffamiskell.co.nz | Drawn: ATy | Checked: SFI

Stage 14

WATER TREATMENT PLANT SITE - STAGE 15

KEY STAGE OBJECTIVES\CRITERIA

- Previous stage of topsoil removal within works catchment is completed prior to commencement of this stage.
- DEB provides sediment control while SRP S2 provides surface run off containment to mitigate potential spread of kauri dieback.
- Previous stages remain open for earthworking to final subgrade levels with sediment controls remaining in place.

KEY STAGE OPERATIONS

- Establish cleanwater diversion upslope of disturbance area.
- Construct decanting earth bund and dirty water channels.
- Works within the KCZ to be progressively excavated and hardfill hardstand extended into KCZ as works progress.
- Excavate topsoil and any other potentially infected material to a nominal depth of 0.5 m plus 0.5 m subsoil[1], load directly onto trucks, cover and remove from site.
- Excavated material that is suitable for reuse to be placed in bulk earthworks area.

EARTHWORKS VOLUMES

- Topsoil Removal 300m³
    - Cut 750m³
    - Fill 50m³
- Stage estimated timeframe 4-6 weeks (includes 2 weeks for topsoil removal/disposal and works within KCZ). Works estimated to commence week 18 of programme.

WOODLANDS PARK ROAD

KOHU ROAD

SCENIC DRIVE

Yorke Catchment
see Stages 1–10

STAGE 15

MANUKA ROAD

Works to be done with localised silt controls (filter socks) and works area stabilised at the completion of each work day.

All downstream vegetation clearance sediment and containment measures to remain in place.

Site Boundary
Extent of Earthworks
Subcatchment
Catchment Boundary
Topsoil Removal/Disposal
Bulk Earthworks Area
Stabilised Area
Slope Direction
1m Contour
Clean Water Diversion
Dirty Water Diversion
Indicative Existing Flow Paths
Decanting Earth Bund
Surface Water Containment Pond
Kauri Containment Zone
Root Protection Zone – Kauri
Root Protection Zone – Other (Non-Kauri) Trees

Boffa Miskell

0 50 m
1:1,000 @ A3

Data Sources: Boffa Miskell, LINZ, Auckland Council

A16055G HUIA WTP ECOLOGY EVIDENCE AND HEARING

Topsoil Removal Disposal Phase Staging – Water Treatment Plant

Date: 13 January 2020 | Revision: 0

Stage 15

WATER TREATMENT PLANT SITE - STAGE 16

KEY STAGE OBJECTIVES\CRITERIA

- Completion of bulk earthworks operations within previous stages

KEY STAGE OPERATIONS

- Continue with bulk earthworks operations to subgrade level and stabilise.
- Upon stabilisation of each catchment stage remove sediment controls.