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NorthLinkWA
Perth-Darwin National Highway

Baseline Survey Plan

Flora and Vegetation – Inland Waters Environmental Quality – Hydrological Processes

Perth–Darwin National Highway (Swan Valley Section)

MARCH 2017

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Revision	Date	Description	Prepared	Reviewed	Approved
A	07/07/2016	Draft (Coffey v1)	T. Vu	E. Waterhouse	B. Napier
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1 INTRODUCTION

Main Roads Western Australia (MRWA) proposes to construct a new 38 km section of the Perth-Darwin National Highway (Swan Valley Section) (Figure 1) between Malaga and Muchea in Western Australia (the proposal). The proposal is a dual carriageway highway and will connect the intersection of Tonkin Highway and Reid Highway in the south with Great Northern Highway and Brand Highway in the north.

This Baseline Survey Plan (this plan) for the Flora and Vegetation - Inland Waters Environmental Quality – Hydrological Processes – Condition Environmental Management Plan (Condition EMP) (Coffey, 2017) is submitted in accordance with Ministerial Statement No. 1036 conditions 14-4 to 14-6 for the proposal.

1.1 Objective

This plan will detail the survey method, identification and rationale for the survey site locations and the frequency and timing of the baseline survey for survey sites relevant to the groundwater and surface water levels and quality and surface water flow to *Darwinia foetida*, Claypans of the Swan Coastal Plain Threatened Ecological Community (TEC), Communities of Tumulus Springs (Organic Mounds Springs, Swan Coastal Plain) TEC and conservation category wetlands (CCWs). In accordance with condition 14-4, this plan will:

(1) When implemented, determine the baseline state of areas identified in condition 14-4(3) so that ongoing monitoring can determine that conditions 14-1(1) and 14-1(2) will be met;

(2) Detail the proposed methodology for the baseline surveys;

(3) Identify and spatially define the proposed survey locations and reference/control sites and provide rationale for the location of the sites; and

(4) Detail the proposed frequency and timing for the baseline surveys.

1.2 Baseline Groundwater and Surface Water Survey Background

In December 2015, MRWA commenced a pre-construction baseline groundwater and surface water survey program for the proposal. The pre-construction baseline groundwater and surface water survey program was comprised of the following tasks:

- Desktop assessment of groundwater survey well locations and confirmation of serviceability of the existing well network.
- Pre-construction baseline groundwater and surface water survey program (the baseline survey).

The baseline survey includes monthly survey events for:

- Forty-one groundwater survey well locations.
- Twenty-one surface water sampling locations.
- Full analytical suite analysis for every survey round.
- On-going monthly survey rounds until construction of the proposal.

The pre-construction baseline groundwater and surface water survey program has been conducted in accordance with the methodology described below and will be included in the final baseline survey report.

1.3 Baseline Surface Water Flow Background

In May 2015, BG&E developed the drainage strategy, which informed project design of retention and infiltration basins, spill management, local government area drainage systems, culverts and separation/buffer distances to water production wellheads (BG&E, 2015). The drainage strategy included a topography assessment using contours generated from LiDAR (light detection and ranging) data. The objective of the topography assessment was to:

- Determine the major flow event paths based on LiDAR contouring.
- Size catchment area and flow direction from the road alignment to the Twin Swamps Nature Reserve.

The topography assessment did not include specific models calibrated to determine local catchment sizes or flow direction to *Darwinia foetida*, Claypans of the Swan Coastal Plain, Communities of Tumulus Springs and CCWs from the road alignment. Therefore the results of the topography assessment and drainage strategy do not contain suitable data to establish the trigger and threshold criteria required by conditions 8-2(1) and 8-2(2).

A review of LiDAR data to define surface water flow features associated with *Darwinia foetida*, Claypans of the Swan Coastal Plain and Communities of Tumulus Springs and CCWs for the purposes of establishing trigger and threshold criteria has been conducted in accordance with the methodology described in this plan and results will be included in the Condition EMP.

1.4 Requirements of the Condition

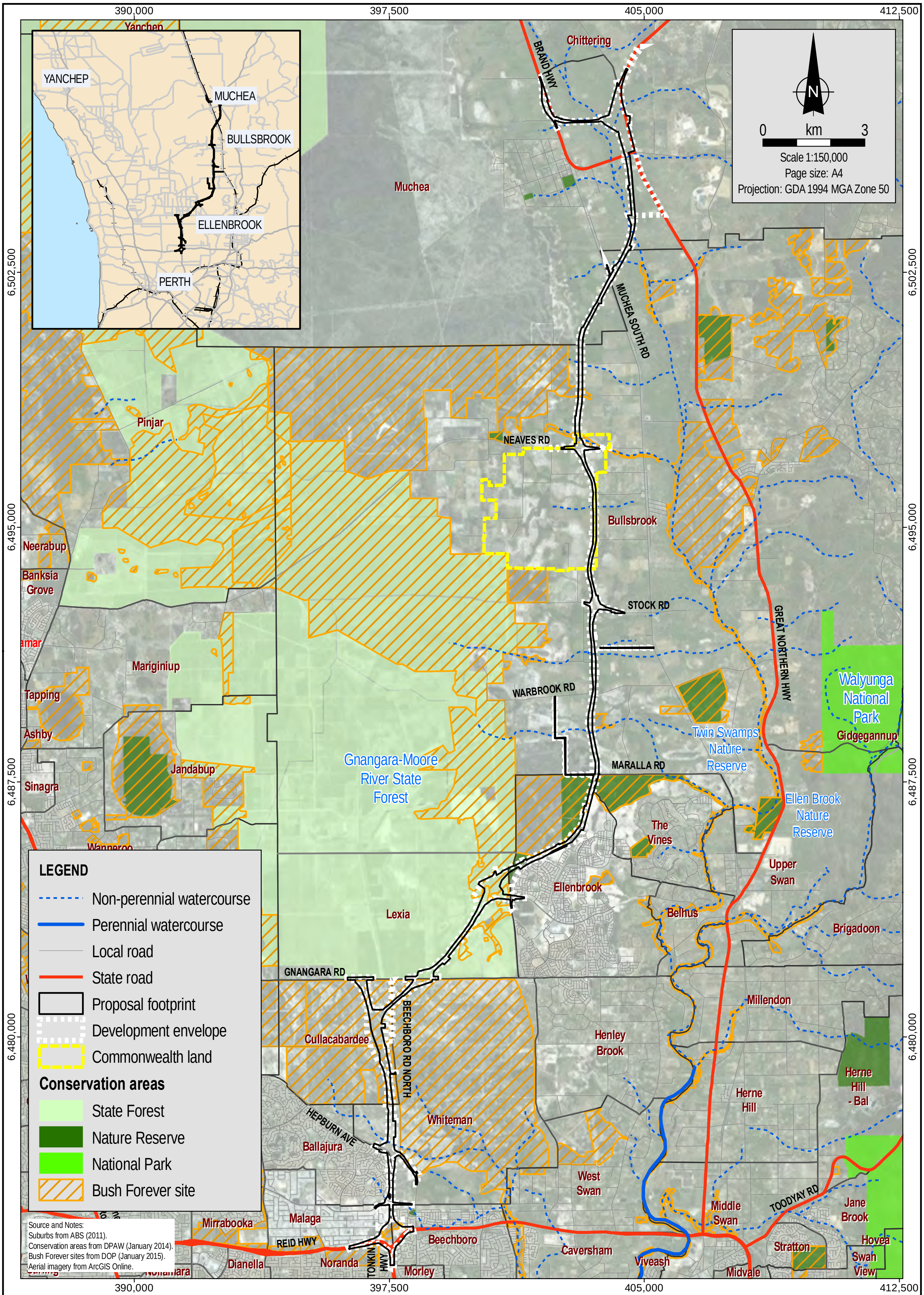
Condition requirement and in-plan section references are provided in Table 1.

As required under condition 5-1, this plan will be made publicly available for the life of the proposal.

Table 1 Condition requirements and in-plan section references

Condition No.	Condition	Section in this plan
14-4	Prior to the commencement of ground disturbing activities, the proponent shall prepare in consultation with the Department of Water and the Department of Parks and Wildlife, and submit a Baseline Survey Plan(s) to the CEO. The Baseline Survey Plan(s) shall: 1. When implemented, determine the baseline state of areas identified in condition 14-4(3) so that ongoing monitoring can determine that conditions 14-1(1) and 14-1(2) will be met.	Section 4
	2. Detail the proposed methodology for the baseline surveys.	Section 3
	3. Identify and spatially define the proposed survey locations and reference/control sites and provide rationale for the location of the sites.	Section 2.4
	4. Detail the proposed frequency and timing for the baseline surveys.	Section 3
14-5	After receiving notice in writing from the CEO that the Baseline Survey Plan satisfies the requirements of condition 14-4, the proponent shall undertake the baseline surveys in accordance with the requirements of the Baseline Survey Plan.	This plan

Condition No.	Condition	Section in this plan
14-6	On completion of the baseline surveys the proponent shall report to the CEO on the following: 1. Completion of the baseline surveys in accordance with the Baseline Survey Plan.	Section 4
	2. The results of the baseline surveys.	Section 4



NorthLinkWA	coffey A TETRA TECH COMPANY	Date: 29.06.2016 MXD: 4483AA_69_GIS001_1 File Name: 4483AA_69_F001_GIS	Perth–Darwin National Highway Baseline Survey Plan - Flora and Vegetation - Inland Waters Environmental Quality - Hydrological Processes	Proposal overview	Figure No: 1

2 BASELINE SURVEY APPROACH

Site-specific groundwater and surface water quality, groundwater level and surface water flow data is required to establish environmental criteria to support the environmental outcomes detailed in condition 14-1(1) and 14-1(2) of Ministerial Statement No. 1036.

Those outcomes are to ensure that:

- Construction and operation of the proposal, including from dewatering and groundwater abstraction, does not result in indirect impacts to the Claypans of the Swan Coastal Plain and Communities of Tumulus Springs and CCWs as shown in Figures 5 and 6 [of the Ministerial Statement].
- Construction of the proposal maintains predevelopment surface water flows to the *Darwinia foetida*, Claypans of the Swan Coastal Plain and Communities of Tumulus Springs and CCWs.

This section describes the baseline survey approach to determine the baseline groundwater and surface water quality, groundwater level and surface water flow features of *Darwinia foetida*, Claypans of the Swan Coastal Plain, Communities of Tumulus Springs and CCWs.

The approach used information gathered from the following:

- Relevant environmental values.
- Environment aspects of the proposal and related impacts.
- Relevant environmental policies, strategies and criteria.

The information presented in this section will also identify and provide rationale against the identified and spatially defined survey well and surface water site locations.

2.1 Identification and Rationale for the Locations of the Groundwater and Surface Water Survey and Temporal Reference Sites

The location of groundwater and surface water survey sites (survey sites) is based on the Australian Water Quality Guidelines for slightly to moderately disturbed ecosystems (ANZECC and ARMCANZ, 2000), the location of infiltration and retention basins, culverts and risks to the identified environmental values. The survey sites, which also act as temporal reference sites, are shown in Figure 2 and listed in Table 2. Coordinates for the survey sites are provided in Appendix A.

Table 2 Rationale for the location of the survey sites

Applicable guidelines adopted in target areas	Rationale	Groundwater and surface water survey locations
ANZECC and ARMCANZ (2000) Australian Water Quality Guidelines (AWQG) Fresh water aquatic ecosystem (moderately disturbed ecosystems)	Wells located down hydraulic gradient of the development envelope adjacent to the slightly to moderately disturbed systems of the population of *Darwinia foetida*, Claypans of the Swan Coastal Plain, Communities of Tumulus Springs (Organic Mound Springs, Swan Coastal Plain) and CCWs. Surface water at the Claypans of the Swan Coastal Plain, Communities of Tumulus Springs (Organic Mound Springs, Swan Coastal Plain) and CCWs. Surface water features located adjacent to the population of *Darwinia foetida* within the proposal footprint located on the existing road reserve.	**Sampling group Claypans of the Swan Coastal Plain and *Darwinia foetida*** MW50, MW51, MW52 SWL20 **Sampling group Communities of Tumulus Springs** MW40, MW41, MW42 SWL17 **Sampling group CCWs** MW1, MW2, MW3, MW4, MW5, MW6, MW10, MW11, MW12, MW26,MW27, MW28, MW29, MW30, MW31, MW32, MW36, MW37, MW38, MW39, MW40, MW41, MW42, MW55 SWL1, SWL2, SWL3, SWL4, SWL5, SWL6, SWL7, SWL8, SWL9, SWL10, SWL11, SWL12, SWL13, SWL14, SWL15, SWL16, SWL17

Survey will occur at 27 groundwater and 18 surface water survey sites. At most surface water locations, three samples will be taken to ensure a representative and comparable baseline dataset is collected for the surface water survey site. Only two samples will be taken at SWL15 due to difficulties accessing more than two sample locations at the site. Survey sites used for data collection as part of the baseline survey will continue to be used throughout the life of the project for ongoing monitoring, where possible.

Survey sites are shown in Figure 2.

Baseline survey sites shown in Figure 2 are also the temporal reference sites for the proposal. Baseline data from the survey sites will define the reference condition of water. This represents measurements made before a disturbance or before management actions are implemented. Given suitable reference data can be derived from the survey sites prior to construction, the use of additional spatial reference sites is not considered necessary. ANZECC and ARMCANZ (2000) states the best reference condition is pre-disturbance data, which forms a valuable basis from which to define the reference condition. If the disturbance has already occurred then data from spatial reference sites can be used. Given proposal activities have not commenced and baseline reference data of sufficient quality and timespan can be obtained to provide valid comparisons with post-disturbance data, the use of pre-disturbance data will act as the reference data for this proposal, i.e. survey sites will act as temporal reference sites.

2.2 Identification and Rationale for the Locations of the Surface Water Flow Features

To meet the environmental outcome set out in condition 14-1(2), surface water flows to the known population of *Darwinia foetida*, Claypans of the Swan Coastal Plain, Communities of Tumulus Springs and CCWs are required to be maintained. Achieving this environmental outcome requires an understanding of existing surface water flows to these environmental values. Trigger and threshold criteria can then be set around proposal activities that have the potential to influence existing surface water flows.

A determination of existing surface water flows will require and understanding of topography of the area surrounding the environmental values identified in condition 14-1(2). Topographical information will be obtained from an airborne LiDAR survey.

The survey locations for surface water flow features are therefore centred on the environmental values identified in condition 14-1(2).

Further detail is provided in Section 3.2, which outlines the proposed survey method and provides further detail on the survey locations and approach.

2.3 Environmental Values

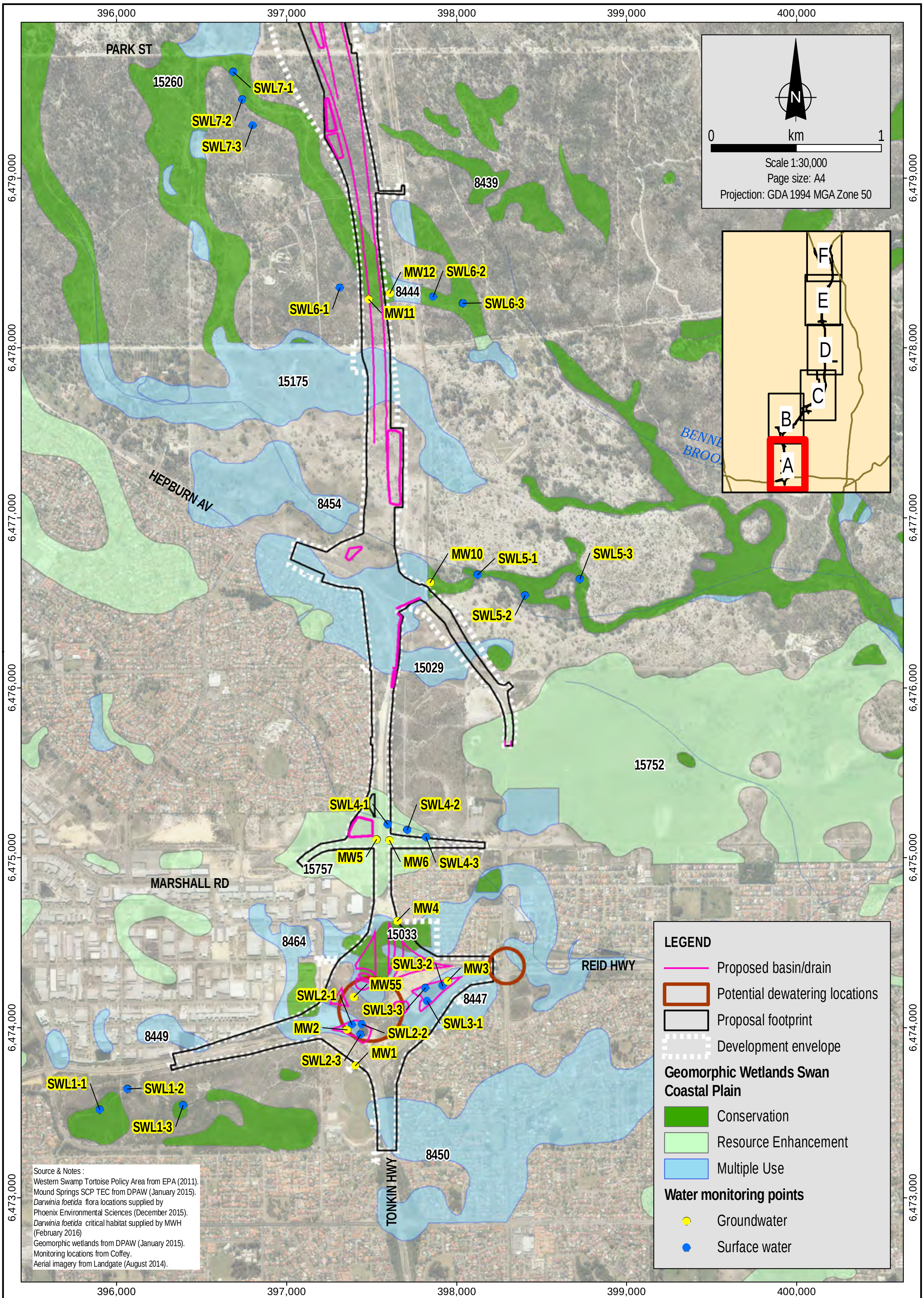
The Public Environmental Review (PER) for the proposal identified *Darwinia foetida*, Claypans of the Swan Coastal Plain, Communities of Tumulus Springs and CCWs as significant environmental values with the potential to be impacted by the proposal. The relevant environmental values are described in the PER (Coffey, 2015a) and the condition EMP.

2.4 Environmental Policies, Strategies and Criteria

Relevant guidelines were reviewed to establish regulatory requirements associated with the protection of the identified environmental values to meet the condition environmental outcomes.

The following guidelines were used to determine the requirements in undertaking this baseline survey:

- The Department of Water's (DOW) Better Urban Water Management Guidance Note 7 Managing the hydrology and hydrogeology of water dependent ecosystems in urban development (DOW, 2008)
- Department of Environment Regulation's (DER) Treatment and management of soil and water in acid sulfate soil landscapes (DER, 2015).
- Department of Environment and Regulation Contaminated Sites Guidelines: Assessment and Management of Contaminated Sites (DER, 2014).
- Australian Standard AS 5667.11:1998 Water Quality-Sampling – Guidance on Sampling of Groundwaters.
- National Environment Protection Council 1999 (amended 2013) National Environment Protection (Assessment of Site Contamination) Measure (NEPM), Schedule B2: Guideline on Data Collection, Sample Design and Reporting.



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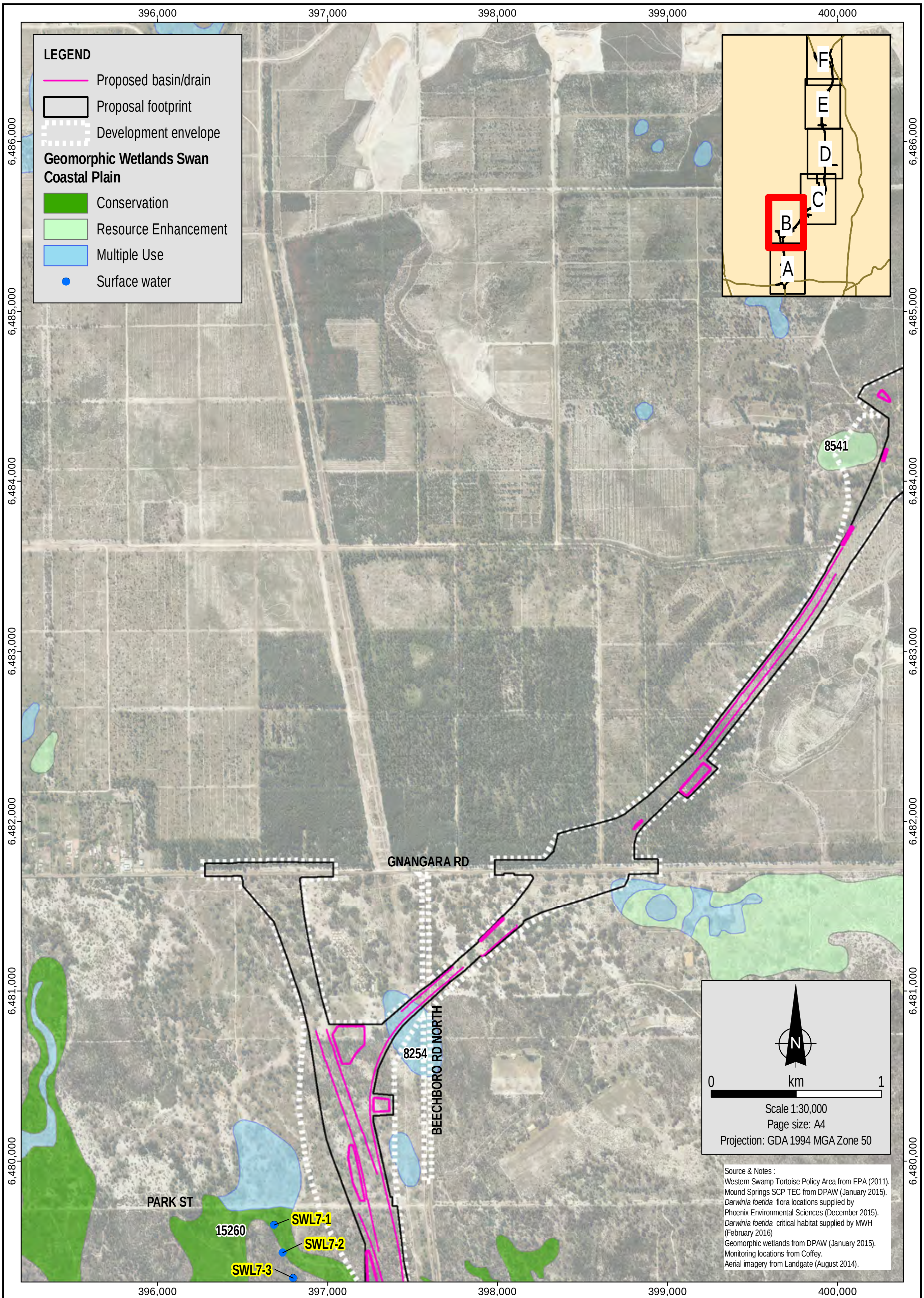
Date: 09.03.2017 MXD: 4483AA_69_GIS002_8 File Name: 4483AA_63_F002A_GIS	**Perth-Darwin National Highway** Baseline Survey Plan - Flora and Vegetation - Inland Waters Environmental Quality - Hydrological Processes	**Monitoring network for groundwater and surface water features** **Map 1 of 6**	Figure No: **2A**



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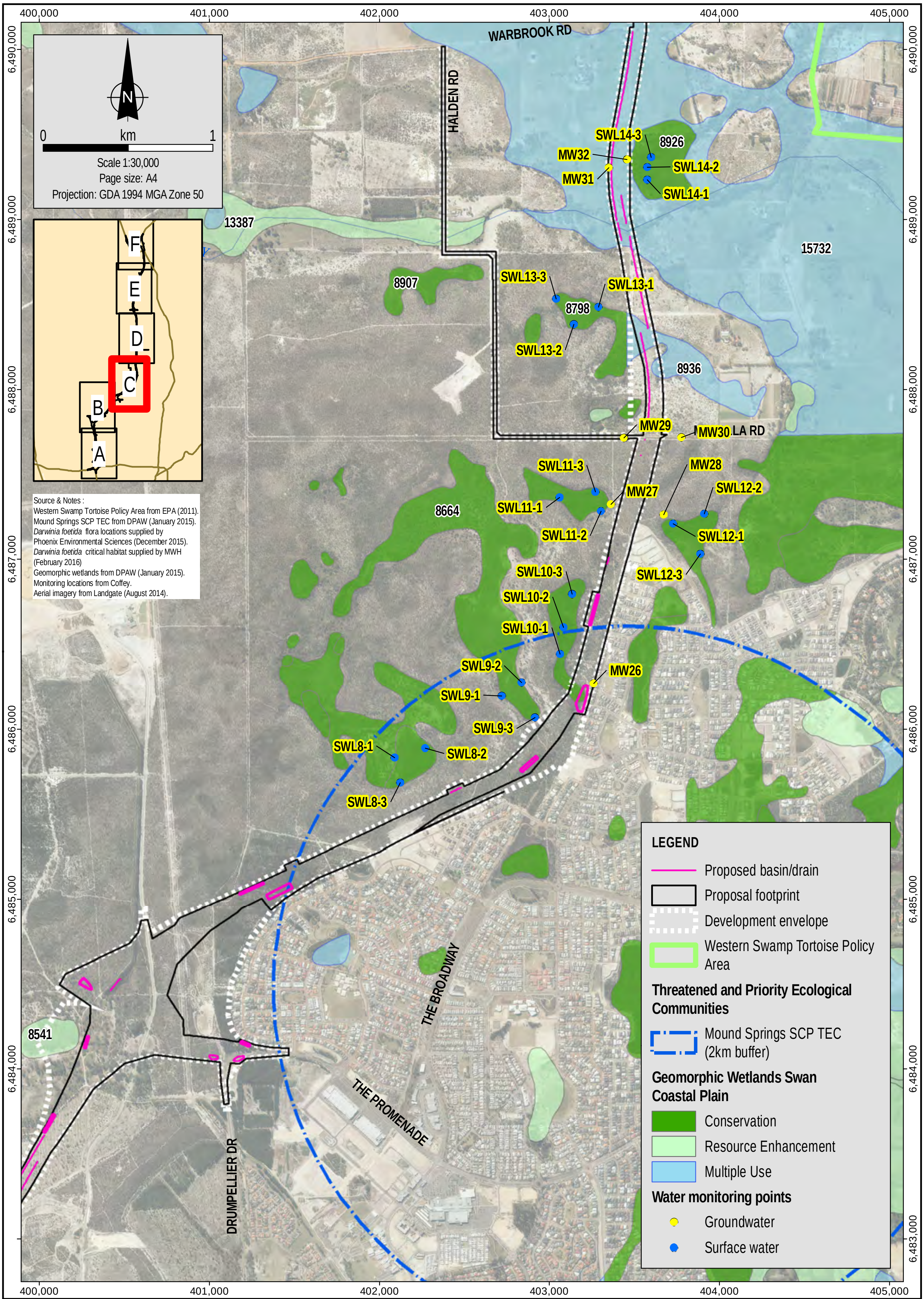

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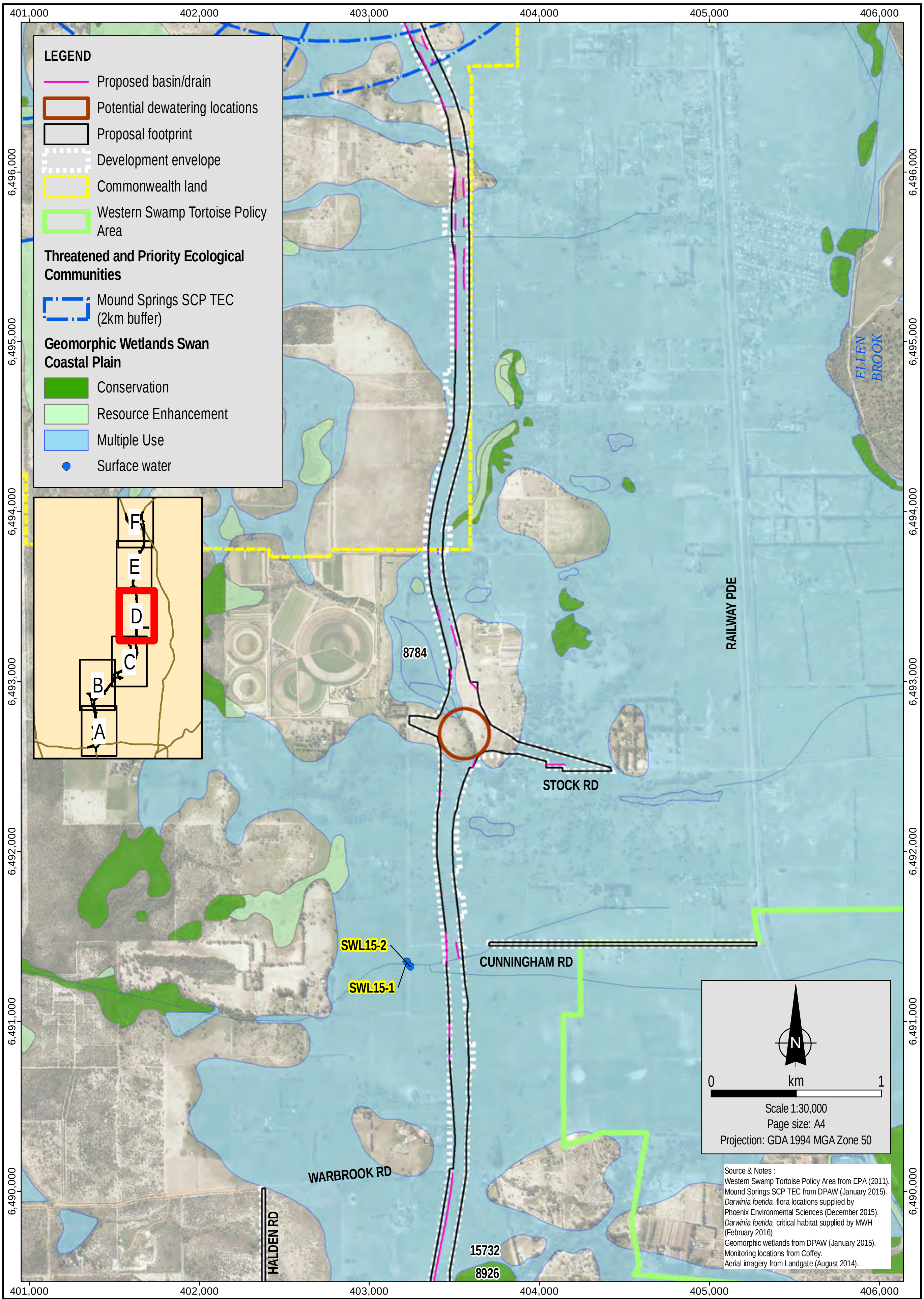

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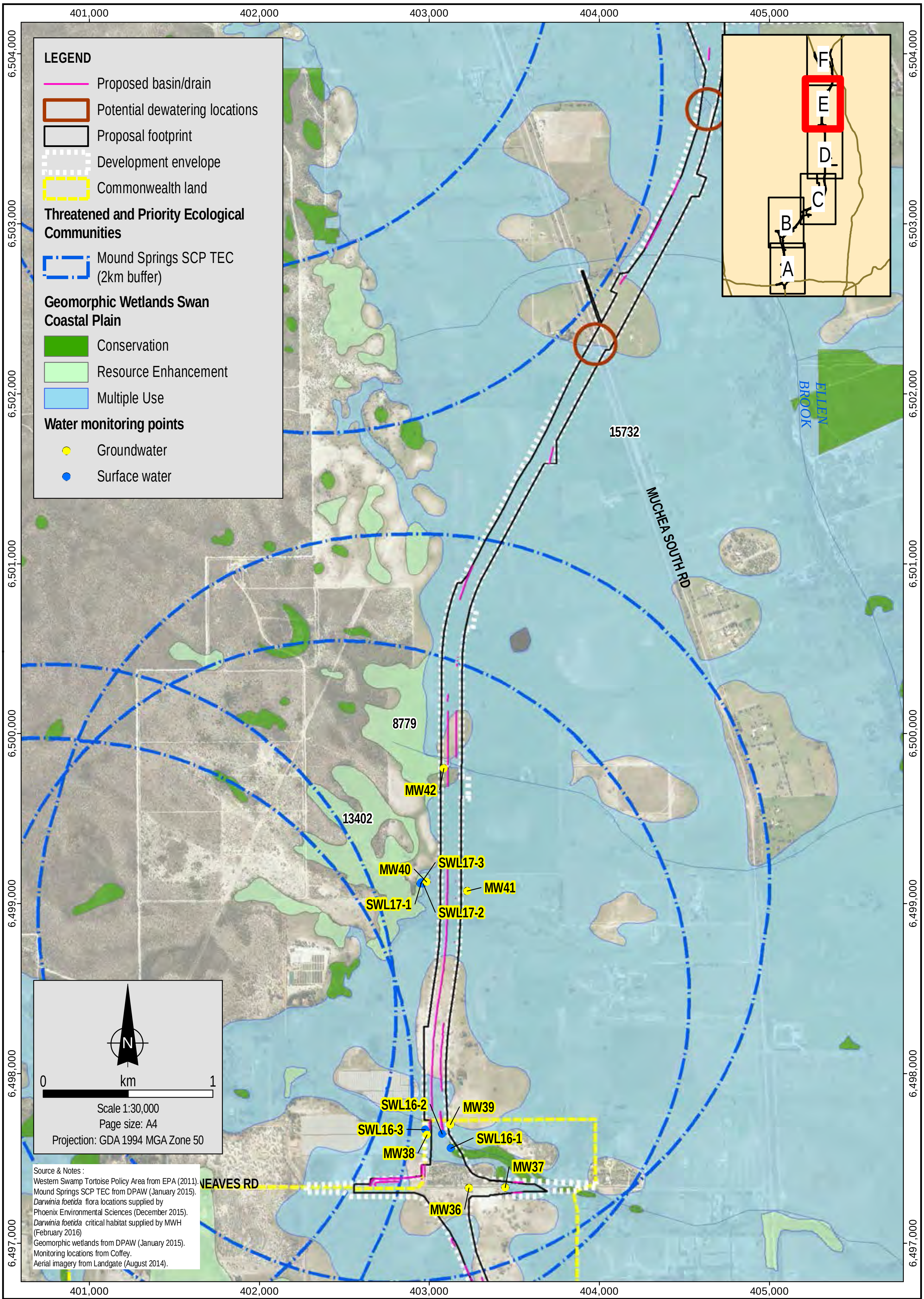
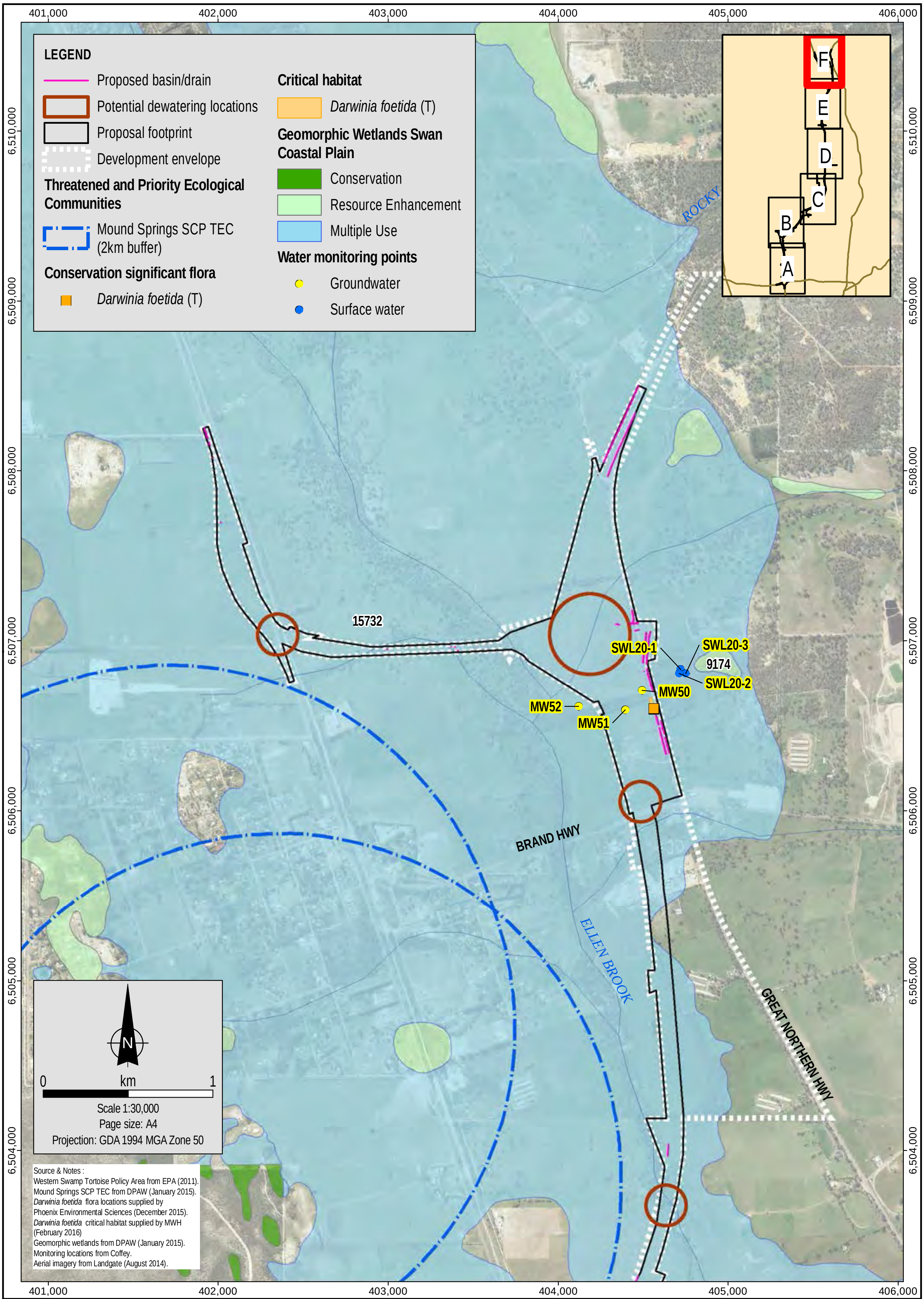
Date: 06.03.2017 MXD: 4483AA_69_GIS002_6 File Name: 4483AA_63_F002D_GIS	**Perth-Darwin National Highway** Baseline Survey Plan - Flora and Vegetation - Inland Waters Environmental Quality - Hydrological Processes	**Monitoring network for groundwater and surface water features** **Map 4 of 6**	Figure No:	**2D**



NorthLinkWA	coffey A TETRA TECH COMPANY	Date: 09.03.2017 MXD: 4483AA_69_GIS002_8 File Name: 4483AA_63_F002E_GIS	Perth-Darwin National Highway Baseline Survey Plan - Flora and Vegetation - Inland Waters Environmental Quality - Hydrological Processes	Monitoring network for groundwater and surface water features Map 5 of 6	Figure No: 2E



NorthLinkWA	coffey A TETRA TECH COMPANY	Date: 09.03.2017 MXD: 4483AA_69_GIS002_8 File Name: 4483AA_63_F002F_GIS	Perth-Darwin National Highway Baseline Survey Plan - Flora and Vegetation - Inland Waters Environmental Quality - Hydrological Processes	Monitoring network for groundwater and surface water features Map 6 of 6	Figure No: 2F

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3 SURVEY METHOD

3.1 Groundwater and Surface Water Baseline Survey Program

To obtain required baseline data, the baseline survey commenced in December 2015 and will continue for a minimum of 12 months and then until construction commences. The baseline survey comprises monthly survey events.

The analytical suite selected was primarily based on key indicators of ASS disturbance. This ASS analytical suite is complemented by a secondary analytical suite reflecting contaminants of potential concern (COPC) associated with nearby land uses. Sampling and analysis of the full analytical suite is required for every survey event to establish a robust baseline.

The following sections provide an overview of the baseline survey for survey events 1 and 2 and the program for ongoing survey events until commencement of construction.

3.1.1 Survey Event 1

Survey event 1 was comprised of the following tasks:

- Desktop assessment of existing well construction details and previous sampling methods.
- Submission of Bore Access Request form to Department of Water.
- Review and evaluation of existing groundwater survey wells, including:
  - Location of existing groundwater survey wells.
  - Assessment of well condition for suitability to be used for baseline sampling.
  - Gauging groundwater survey wells to assess depth and standing water level.
  - Assessing accessibility and marking locations identified as requiring installation of new groundwater survey wells.

The review and evaluation of the existing groundwater well network determined that the existing well network was unsuitable due to inappropriate screen depth (i.e. screens were at a depth where potential 'initial' impact from road construction may not be identified) and locations. Accordingly, monitoring at these wells was discontinued. Critical data gaps were identified within the existing groundwater survey network, resulting in additional survey wells being installed. The baseline survey was revised based on the identified gaps and implemented in part for survey event 2 and in full for survey events 3 and onwards.

3.1.2 Survey Event 2

Survey event 2 was comprised of the following tasks:

- Additional groundwater survey wells installed. Table 3 details the groundwater well installation method for survey event 2.
- Soil conditions logged during drilling (to be presented as bore logs in the final baseline survey report).
- Surveying additional survey wells to GDA94 MGA Zone 50 and Australian Height Datum (AHD).
- Gauging groundwater survey wells and recorded standing water levels.
- Conducting groundwater sampling using dedicated HYDRAsleeve for each monitoring location.

- Measuring physicochemical water quality for all survey sites (pH, Temperature, Electrical Conductivity, Dissolved Oxygen and Redox Potential), using a calibrated (calibrated by the supplier prior to use) in-situ smarTROLL Multiparameter Water Quality meter (copies of the calibration certification included in sampling reports).
- Remaining parameters (refer to Table 4) to be laboratory analysed including pH and Electrical Conductivity.

Table 3 Groundwater survey well installation method

Activity	Details
Review of service plans	Service plans of the area from 'Dial Before You Dig' were reviewed prior to marking out and clearing sampling locations.
Service location	Service location was organised and supervised by Coffey to clear each soil bore and groundwater monitoring well location. Each location was cleared to 2 mbgs using non-destructive digging (NDD) (where geology allowed) prior to mechanical drilling.
Drilling method	Motorised drilling of soil bores was undertaken by Strataprobe Pty Ltd under the supervision of Coffey using solid auger drilling techniques where geology allowed.
Soil logging	Soil type classifications and descriptions are based on the Unified Soil Classification System (USCS).
Well construction	All monitoring wells were installed using 50 mm diameter Class 18 un-plasticised polyvinyl chloride (uPVC) with 3 m slotted screen. Screens were installed to allow 2 m of submerged screen below the standing water level and 1 m above. Monitoring wells were installed to a depth of between 5 and 7 mbgs depending on where groundwater was encountered. Each monitoring well was backfilled with gravel to 0.5 m above the slotted screen, above which a 0.5 m long bentonite seal was established with the remainder of the hole backfilled with cuttings. Monitoring wells were finished with either a steel monument, or in the case of trafficable areas, a flush-mounted steel gatic cover.
Well survey	All new groundwater monitoring wells were surveyed for positional coordinates to Map Grid of Australia (MGA) and elevation from top of casing to metres above Australian Height Datum (mAHD) by professional surveyors, PGS Hope Pty Ltd.
Decontamination procedure	Drilling equipment was decontaminated between sampling locations using laboratory grade detergent and deionised water.
Waste disposal	Soil cuttings generated from the soil investigation were returned to hole. Where surplus soil cuttings were present, cuttings were removed from site by the drilling contractor and disposed of accordingly.

3.1.3 Survey Events 3 and Onwards

Survey events 3 and onwards until commencement of construction will follow the baseline survey program outlined in Table 4 and detailed in Sections 3.1.3.1 and 3.1.3.2.

Table 4 Baseline survey program for survey events 3 and onwards

Location	Parameters to be analysed	Methodology	Frequency
All locations	**In-situ measurements:**	**Groundwater:**	Monthly

Location	Parameters to be analysed	Methodology	Frequency
	pH, conductivity (EC), dissolved oxygen, temperature, total dissolved solids (TDS). **Laboratory analysis:** pH, EC, turbidity. Major anions and cations – Na, K, Ca, Mg, Cl, SO_4, CO_3, HCO_3. Total acidity and total alkalinity. 12 dissolved and total metals (Al, As, Cd, Cr, Cu, Fe, Pb, Mn, Hg, Ni, Se, Zn). Nutrients – Total N, NO_3, NO_2, NH_3, Total P and Filterable Reactive Phosphorus (FRP). Total Recoverable Hydrocarbons (TRH), benzene, toluene, ethylbenzene, xylene (BTEX) – all locations (survey event 3, 6 and 12 only). Bacteria (Thermotolerant bacteria, *E. coli*) – P1 locations. Organochlorine pesticides (OCPs), organophosphorus pesticides (OPP) – all locations (survey event 3 only).	• Gauge 27 groundwater survey wells and record standing water levels. • Measure physicochemical water quality in-situ (pH, Temperature, Electrical Conductivity, Dissolved Oxygen and Redox Potential), using a calibrated water quality meter. • Collect groundwater samples using a passive sampling device or other industry accepted method deemed suitable for groundwater survey purposes. **Surface water:** • Measure physicochemical water quality at the 18 surface water locations and collect samples, if surface water is present. Note observations if no surface water is present at the time of survey. • To ensure a representative and comparable baseline dataset, three surface water samples are to be collected from each wetland sampling location. Note: TRH/BTEX will be sampled for at all locations during survey event 3, 6 and 12 in order to gather baseline data. Based on field evidence (with the exception of SIMs metals) TPH/BTEX is not considered a priority chemical of potential concern, however, during the construction phase monitoring of these parameters may be required (e.g. in the event of a fuel or chemical leak/spill). For baseline purposes, the post-summer round (March 2016) will provide the most conservative baseline result which coincides with groundwater lows. OCP/OPPs will be sampled at all groundwater locations during survey event 3 in order to gather baseline data. Although not considered a priority chemical of potential concern due to the residential/agricultural setting through which the road development envelope is proposed, it is considered prudent to prove the baseline of these chemicals nonetheless. Survey for TRH/BTEX and OCP/OPP was discontinued after survey event 3 as there were no detections (with the exception of MW55 which is located on the south-eastern boundary of Lot 299 Victoria Avenue an identified contaminated site (Coffey, 2015b)) above the Limit of Reporting for all TRH/BTEX and OCP/OPP analytes. Survey for TRH/BTEX was reintroduced at survey event 6 and will be measured again in survey event 12.	

3.1.3.1 Groundwater Sampling Method

Table 5 details the groundwater sampling method. Groundwater survey sites are shown in Figure 2.

Table 5 Groundwater sampling method

Activity	Details
Groundwater quality monitoring	Water quality at the allocated groundwater sampling locations will be analysed by a multi parameter water meter for water quality parameters (pH, oxidative/reduction potential, DO, temperature and electrical conductivity).
Sampling method	HydraSleeve Standard Operating Procedure (SOP) will be implemented as the groundwater sampling method (Appendix B). Collection of QC samples will include one field duplicate and one interlab duplicate (at a rate of one per twenty samples), collection of one combined field and rinsate blank (one per day of fieldwork) and one trip blank (one per esky).
Decontamination procedure	All non-disposable sampling equipment (IP and water quality meter) will be decontaminated with laboratory grade detergent and rinsed with deionised water between sample locations. Dedicated nitrile gloves and disposable HydraSleeves will be used for each location.
Sample preservation	Samples will be collected in laboratory supplied bottles containing appropriate preservatives and immediately stored in an insulated cooler chilled with ice upon sampling and ice bricks during air freight to the laboratory. Samples collected for analysis of metals will be filtered in the field using 0.45 µm disposable filters. Samples will be submitted to the National Association of Testing Authorities (NATA) accredited laboratory accompanied by chain of custody (COC) documentation.
Waste disposal	Groundwater recovered during the purging of monitoring wells will be returned to ground.

3.1.3.2 Surface Water Sampling Method

Table 6 details the surface water sampling method. Surface water survey sites are shown in Figure 2.

Table 6 Surface water sampling method

Activity	Details
Surface water quality monitoring	Water quality at the allocated surface water sampling locations will be analysed by a multi parameter water meter for water quality parameters (pH, oxidative/reduction potential, DO, temperature and electrical conductivity).
Sampling method	Surface water sampling will be undertaken using a sampling pole with attached dedicated container to collect samples from the centre of each lake. The bottle will be immersed to a depth of approximately 15 cm, laying it flat with its mouth towards the flow of the water. Water will then be decanted directly into laboratory supplied sample containers. Note: for metal analysis, bottles will not be rinsed and will be filled by decanting from another, rinsed bottle.
Decontamination procedure	Water monitoring equipment such as the multi parameter water meter will be rinsed with laboratory grade detergent and rinsed with deionised water between sample locations. The sample containers used with the sample pole will be replaced between sampling locations to prevent cross contamination. Dedicated disposable nitrile gloves will be used during the collection of each sample.

Activity	Details
Sample preservation	Samples will be collected in laboratory supplied bottles containing appropriate preservatives and immediately stored in an insulated cooler chilled with ice bricks upon sampling and during road freight to the laboratory. Samples for total metals analysis were not filtered. Samples will be submitted to the laboratory accompanied by COC documentation.
Waste disposal	Surface water samples taken for field water quality analysis will be returned to each location after sampling.

3.1.4 Survey Events 13 and Onwards

From survey event 13 and onwards until commencement of construction, surface water levels will be measured and recorded at SWL1 and SWL20 due to those sites' proximity to CCWs (SWL1) and *Darwinia foetida* and Claypans of the Swan Coastal Plain TEC (SWL20).

Only SWL1 was considered an appropriate surface water level survey site for CCWs. Surface water survey sites next to CCWs identified as dry or unable to be accessed during the previous survey events were not considered appropriate sites for monitoring of surface water levels due to the seasonal absence of water and issues with access. SWL13 and SWL14 were not considered as surface water level sites, as they have access issues.

3.1.5 Laboratory Analysis Program

Groundwater and surface water samples have been and will be analysed for the following:

- Physicochemical parameters measured in-situ (using a water quality meter): pH, EC, TDS, dissolved oxygen, temperature.
- Parameters for laboratory analysis:
  - Physicochemical parameters: pH, EC and turbidity.
  - Major anions and cations – Na, K, Ca, Mg, Cl, SO_4, CO_3, HCO_3.
  - Total acidity.
  - Total alkalinity.
  - 12 dissolved metals (dissolved Al, As, Cd, Cr, Cu, Fe, Pb, Mg, Hg, Ni, Se, Zn).
  - Nutrients – total N, NO_3, NO_2, NH_3, Total P and FRP.
  - OCPs/OPP (survey event 3 only).
  - TRH (survey events 3, 6 and 12 only).
  - BTEX (survey events 3, 6 and 12 only).

Survey event 2 was conducted prior to the revised baseline survey program. As a result it did not include collection and analysis of the full analytical suite – only physiochemical parameters were measured. OCPs/OPP have not been undertaken since survey event 3. TRH/BTEX will be analysed only in survey events 3, 6 and 12.

3.1.6 Quality Assurance and Quality Control

All QA/QC procedures shall meet the requirements of the National Environment Protection (Assessment of Site Contamination) Measure (NEPM) (Schedule B2): Guideline on Data Collection, Sample Design and Reporting as follows:

- Collection of QA/QC samples to include one field duplicate sample (at a rate of one per twenty samples), collection of equipment rinsate samples (one per day of fieldwork), field blanks (one per day of fieldwork) and trip blanks (one per esky).
- Standardised field sampling forms detailing each phase of the investigation will be completed and appended to the final baseline survey report. Sample collection, sample storage and chain-of-custody procedures will align with best practice methods.
- Sampling equipment will be decontaminated (where necessary for non-dedicated sample equipment) between sampling locations in order to prevent cross-contamination.
- All equipment used for this investigation will be calibrated and calibration certificates appended to the report.
- Laboratories accredited by the National Association of Testing Authorities (NATA) for the full analytical suite will be used. NATA accredits laboratories on a parameter by parameter basis and the laboratories must provide quantitative evidence of their ability and competence to produce reliable results against recognised benchmarks (i.e. NATA proficiency programs, other national and international proficiency programs, and performance against certified reference materials). Accredited laboratories are able to demonstrate the ability to produce reliable, repeatable results for a range of parameters within a range of sample matrices.

3.1.7 Schedule

The baseline survey is currently conducted on a monthly basis, commencing December 2015 and will continue for a minimum of 12 months and then until construction commences.

3.2 Surface Water Flow Features Baseline Survey Method

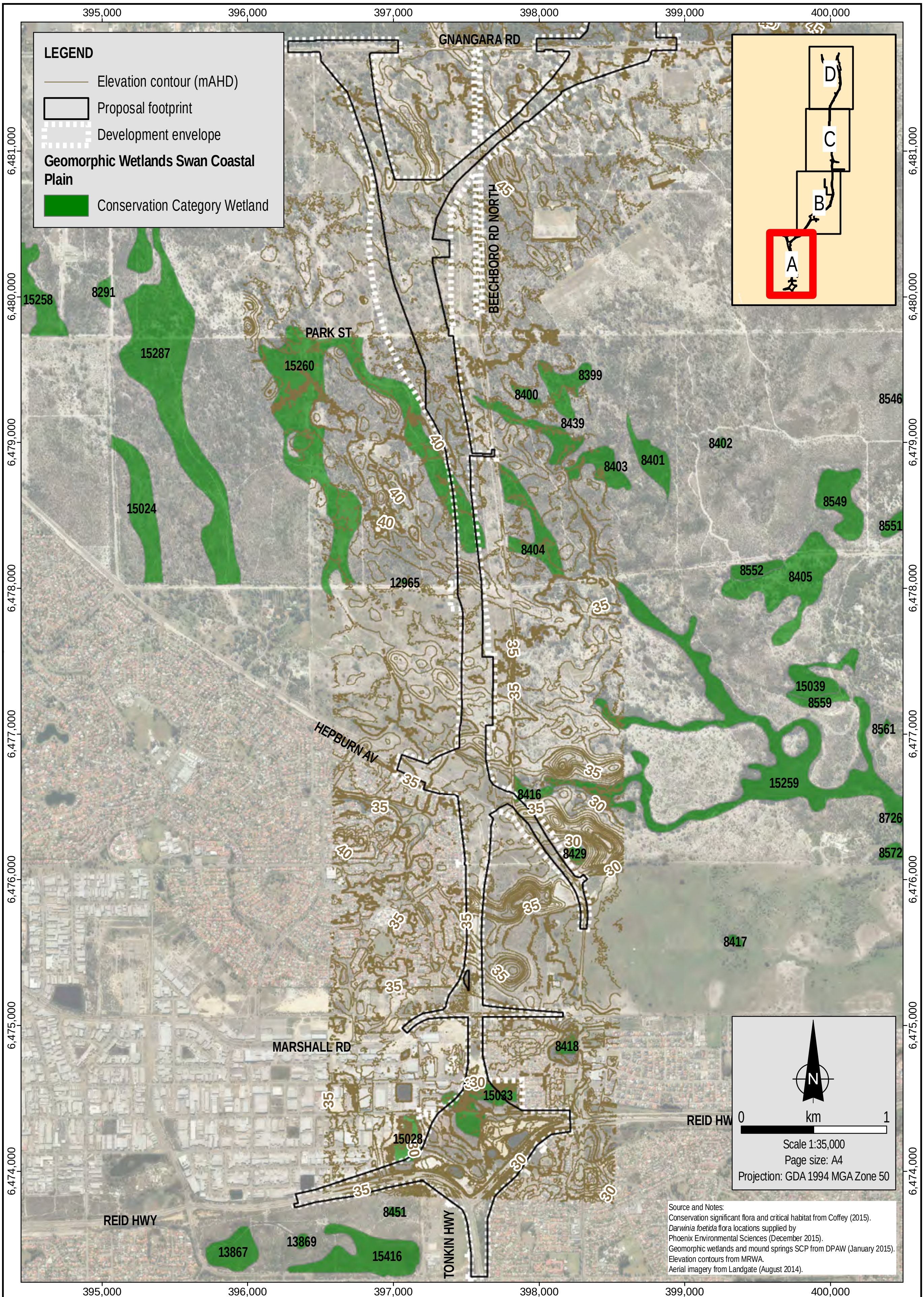
Detailed ground survey data from MRWA obtained through LiDAR survey will be used to identify surface water flow features for *Darwinia foetida*, Claypans of the Swan Coastal Plain, Communities of Tumulus Springs and CCWs. LiDAR data provided by MRWA were captured using an airborne laser sensor on board a fixed wing aircraft.

Topographical contours at 1 m intervals clipped to the vicinity of the development envelope and *Darwinia foetida*, Claypans of the Swan Coastal Plain, Communities of Tumulus Springs and CCWs are shown in Figure 3. The specific location of the Community of Tumulus Springs relevant to this plan is shown in Figure 6 of Ministerial Statement 1036.

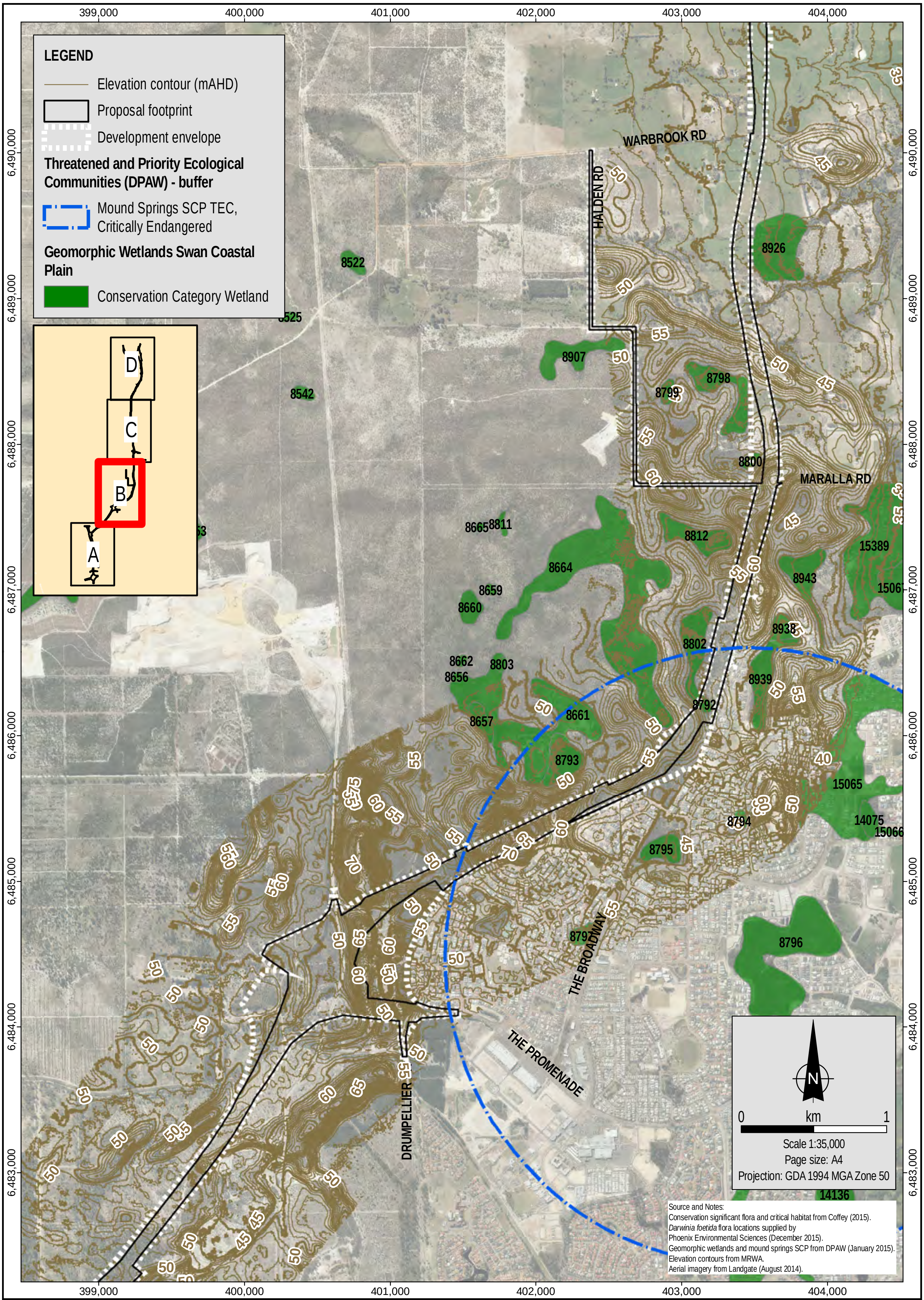
For *Darwinia foetida*, the elevation contours shown on Figure 3 will be used to identify the local catchment area for the known population of *Darwinia foetida*, relevant proposal activities with the potential to impact surface water flows and the environmental criteria based on the assessment.

For Claypans of the Swan Coastal Plain, Communities of Tumulus Springs and CCWs, the elevation contours shown on Figure 3 will be used to identify potential impacts by changes to surface water flows, determine what aspects are not reliant on surface water flows and relevant environmental criteria based on the assessment.

These assessments of surface water flow direction and local catchments for each of the environmental values identified will be presented in the Condition EMP, which is required to be approved prior to construction of the proposal.



NorthLinkWA	coffey A TETRA TECH COMPANY	Date: 01.03.2017 MXD: 4483AA_69_GIS003_2 File Name: 4483AA_69_F003A_GIS	Perth-Darwin National Highway Baseline Survey Plan - Flora and Vegetation - Inland Waters Environmental Quality - Hydrological Processes	LiDAR contours - 1 m	Figure No: 3A



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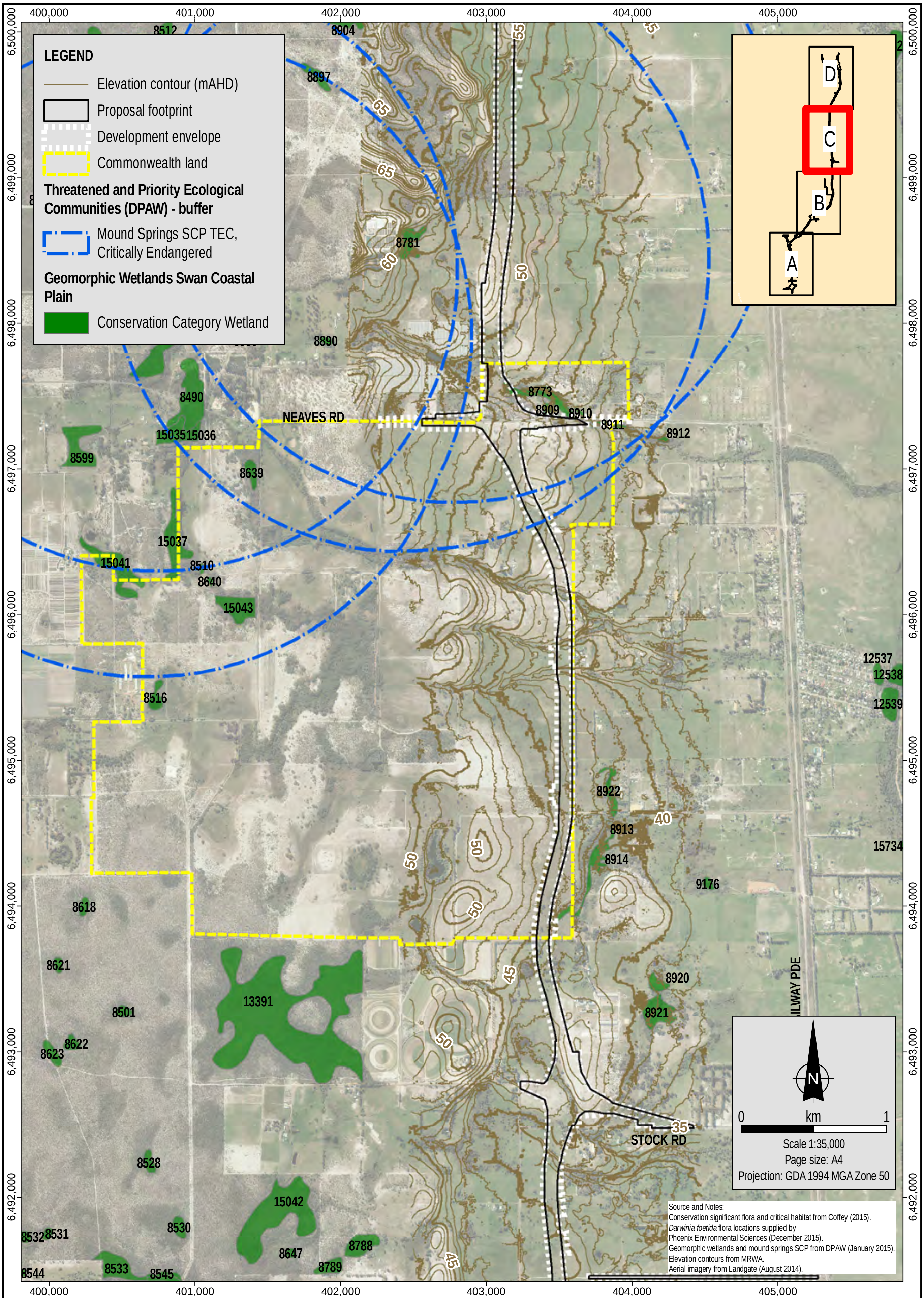

NorthLinkWA

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A TETRA TECH COMPANY

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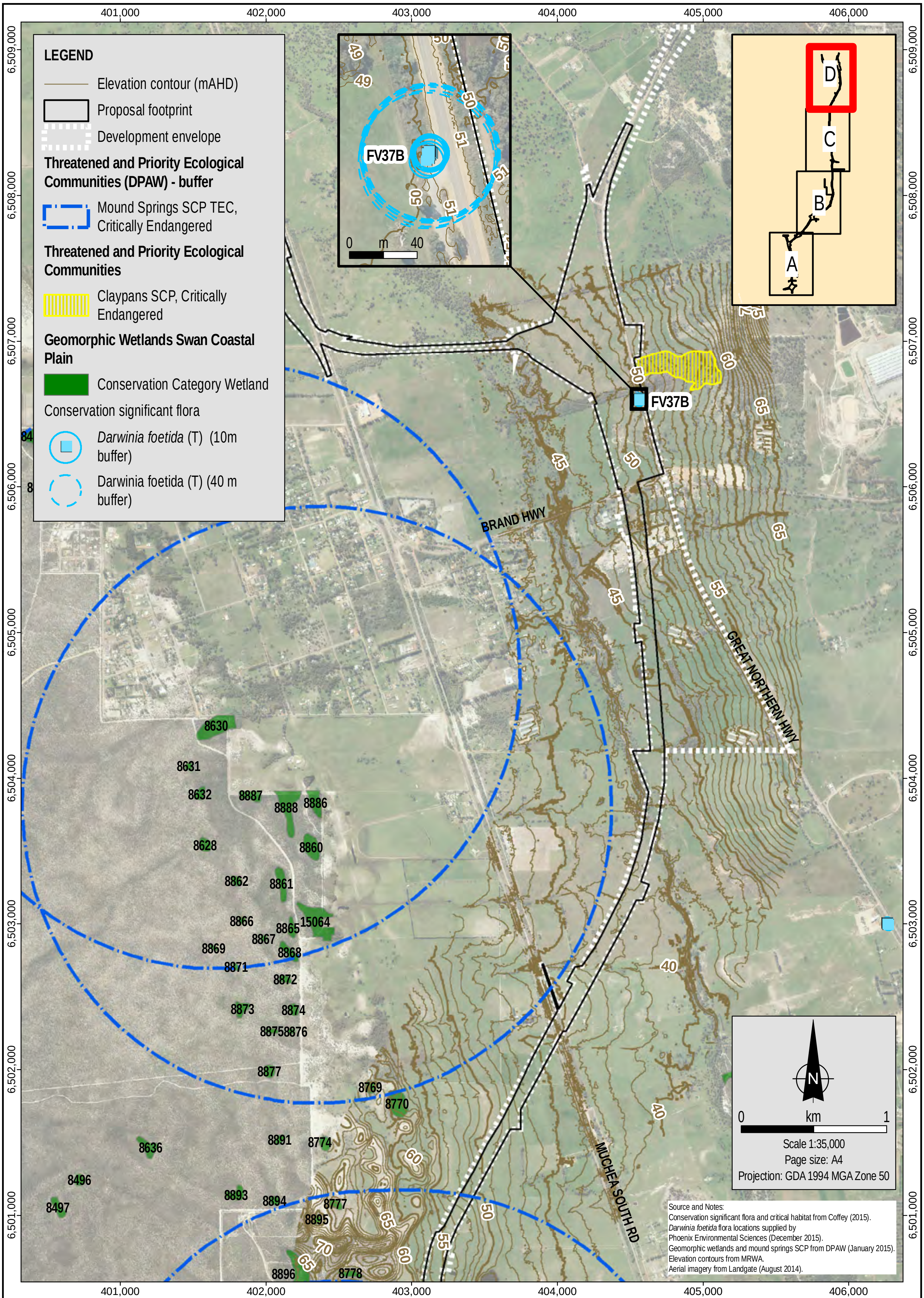
MXD:	4483AA_69_GIS003_2
File Name:	4483AA_69_F003C_GIS

Perth-Darwin National Highway

Baseline Survey Plan - Flora and Vegetation - Inland Waters Environmental Quality - Hydrological Processes

LiDAR contours - 1 m

Figure No: **3C**



NorthLinkWA	coffey A TETRA TECH COMPANY	Date: 01.03.2017 MXD: 4483AA_69_GIS003_2 File Name: 4483AA_69_F003D_GIS	Perth-Darwin National Highway Baseline Survey Plan - Flora and Vegetation - Inland Waters Environmental Quality - Hydrological Processes	LiDAR contours - 1 m	Figure No: 3D

4 REPORTING

4.1 Groundwater and Surface Water Baseline Survey Reporting

Upon completion of the final groundwater and surface water survey event a baseline survey report will be provided to the CEO of the OEPA in accordance with conditions 14-6(1) and 14-6(2). The report will present data collected including an assessment of groundwater and surface water quality along with groundwater standing water levels against available criteria and trend analysis.

The baseline survey report will identify exceedances of applicable published criteria and determine site-specific threshold criteria applicable for incorporation into monitoring regimes implemented during the construction and operation phases.

Prior to completion of the groundwater and surface water baseline survey and at the time of development of the Condition EMP, survey data to date will be used to define interim trigger and threshold criteria. Upon completion of the baseline survey report, interim trigger and threshold criteria defined in the Condition EMP will be updated with final groundwater and surface water baseline survey data provided in the baseline survey report.

4.2 Surface Water Flow Features Reporting

The assessment of surface water flow features will be conducted as part of the development of the Condition EMP. Results of the assessment will be provided to the CEO of the OEPA within the Condition EMP in accordance with conditions 14-6(1) and 14-6(2).

Results of the assessment will determine site specific threshold criteria applicable for incorporation into monitoring regimes implemented during the construction and operation phases.

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5 REFERENCES

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APPENDIX A

Groundwater and Surface Water Survey Site Locations

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Table A1 Approximate location of groundwater and surface water survey sites

Survey location	Easting	Northing
SWL1	396,794	6,473,484
SWL2	397,250	6,474,043
SWL3	397,840	6,474,198
SWL4	398,223	6,476,207
SWL5	397,869	6,476,648
SWL6	397,350	6,478,642
SWL7	397,119	6,479,313
SWL8	402,258	6,485,793
SWL9	402,863	6,486,129
SWL10	403,075	6,486,308
SWL11	403,280	6,487,337
SWL12	403,699	6,487,200
SWL13	403,436	6,488,368
SWL14	403,531	6,489,328
SWL15	403,525	6,493,945
SWL16	403,300	6,497,522
SWL17	403,016	6,499,812
SWL20	402,896	6,506,926
MW1	397,404	6,473,780
MW2	397,353	6,473,993
MW3	397,931	6,474,284
MW4	397,648	6,474,628
MW5	397,525	6,475,109
MW6	397,606	6,475,106
MW10	397,844	6,476,609
MW11	397,483	6,478,289
MW12	397,607	6,478,318
MW26	403,202	6,486,100
MW27	403,396	6,487,245
MW28	403,508	6,487,227
MW29	403,529	6,487,742
MW30	403,653	6,487,735
MW31	403,348	6,489,247

Survey location	Easting	Northing
MW32	403,471	6,489,244
MW36	403,409	6,497,286
MW37	403,642	6,497,313
MW38	402,979	6,497,722
MW39	403,130	6,497,629
MW40	403,061	6,499,002
MW41	403,180	6,498,985
MW42	403,052	6,499,347
MW50	404,561	6,506,693
MW51	404,259	6,506,563
MW52	404,171	6,506,658
MW55	397,396	6,474,180

Note: eastings and northings are in GDA94 MGA Zone 50.

APPENDIX B

HydraSleeve Standard Operating Procedure

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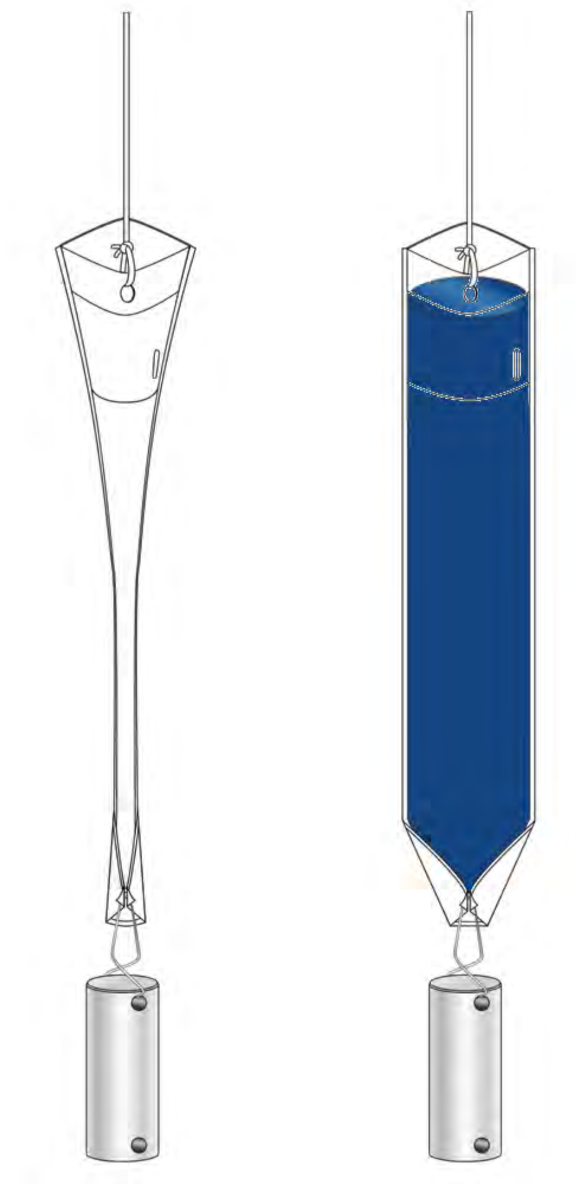
HYDRASleeve™

Simple by Design US Patent No. 6,481,300; No. 6,837,120 others pending

Standard Operating Procedure:
Sampling Ground Water with a HydraSleeve



This Guide should be used in addition to field manuals appropriate to sampling device (i.e., HydraSleeve or Super Sleeve).

Find the appropriate field manual on the HydraSleeve website at http://www.hydrasleeve.com.

For more information about the HydraSleeve, or if you have questions, contact:
GeoInsight, 2007 Glass Road, Las Cruces, NM 88005, 1-800-996-2225, info@hydrasleeve.com.

Table of Contents

Introduction

The HydraSleeve is classified as a no-purge (passive) grab sampling device, meaning that it is used to collect ground-water samples directly from the screened interval of a well without having to purge the well prior to sample collection. When it is used as described in this Standard Operating Procedure (SOP), the HydraSleeve causes no drawdown in the well (until the sample is withdrawn from the water column) and only minimal disturbance of the water column, because it has a very thin cross section and it displaces very little water (<100 ml) during deployment in the well. The HydraSleeve collects a sample from within the screen only, and it excludes water from any other part of the water column in the well through the use of a self-sealing check valve at the top of the sampler. It is a single-use (disposable) sampler that is not intended for reuse, so there are no decontamination requirements for the sampler itself.

The use of no-purge sampling as a means of collecting representative ground-water samples depends on the natural movement of ground water (under ambient hydraulic head) from the formation adjacent to the well screen through the screen. Robin and Gillham (1987) demonstrated the existence of a dynamic equilibrium between the water in a formation and the water in a well screen installed in that formation, which results in formation-quality water being available in the well screen for sampling at all times. No-purge sampling devices like the HydraSleeve collect this formation-quality water as the sample, under undisturbed (non-pumping) natural flow conditions. Samples collected in this manner generally provide more conservative (i.e., higher concentration) values than samples collected using well-volume purging, and values equivalent to samples collected using low-flow purging and sampling (Parsons, 2005).

Applications of the HydraSleeve

The HydraSleeve can be used to collect representative samples of ground water for all analytes (volatile organic compounds [VOCs], semi-volatile organic compounds [SVOCs], common metals, trace metals, major cations and anions, dissolved gases, total dissolved solids, radionuclides, pesticides, PCBs, explosive compounds, and all other analytical parameters). Designs are available to collect samples from wells from 1” inside diameter and larger. The HydraSleeve can collect samples from wells of any yield, but it is especially well-suited to collecting samples from low-yield wells, where other sampling methods can’t be used reliably because their use results in dewatering of the well screen and alteration of sample chemistry (McAlary and Barker, 1987).

The HydraSleeve can collect samples from wells of any depth, and it can be used for single-event sampling or long-term ground-water monitoring programs. Because of its thin cross section and flexible construction, it can be used in narrow, constricted or damaged wells where rigid sampling devices may not fit. Using multiple HydraSleeves deployed in series along a single suspension line or tether, it is also possible to conduct in-well vertical profiling in wells in which contaminant concentrations are thought to be stratified.

As with all groundwater sampling devices, HydraSleeves should not be used to collect ground-water samples from wells in which separate (non-aqueous) phase hydrocarbons (i.e., gasoline, diesel fuel or jet fuel) are present because of the possibility of incorporating some of the separate-phase hydrocarbon into the sample.

Description of the HydraSleeve

The HydraSleeve (Figure 1) consists of the following basic components:

- A suspension line or tether (A.), attached to the spring clip or directly to the top of the sleeve to deploy the device into and recover the device from the well. Tethers with depth indicators marked in 1-foot intervals are available from the manufacturer.
- A long, flexible, 4-mil thick lay-flat polyethylene sample sleeve (C.) sealed at the bottom (this is the sample chamber), which comes in different sizes, as discussed below with a self-sealing reed-type flexible polyethylene check valve built into the top of the sleeve (B.) to prevent water from entering or exiting the sampler except during sample acquisition.
- A reusable stainless-steel weight with clip (D.), which is attached to the bottom of the sleeve to carry it down the well to its intended depth in the water column. Bottom weights available from the manufacturer are 0.75” OD and are available in three sizes: 5 oz. (2.5” long); 8 oz. (4” long); and 16 oz. (8” long). In lieu of a bottom weight, an optional top weight may be attached to the top of the HydraSleeve to carry it to depth and to compress it at the bottom of the well (not shown in Figure 1);
- A discharge tube that is used to puncture the HydraSleeve after it is recovered from the well so the sample can be decanted into sample bottles (not shown).
- Just above the self-sealing check valve at the top of the sleeve are two holes which provide attachment points for the spring clip and/or suspension line or tether. At the bottom of the sample sleeve are two holes which provide attachment points for the weight clip and weight.

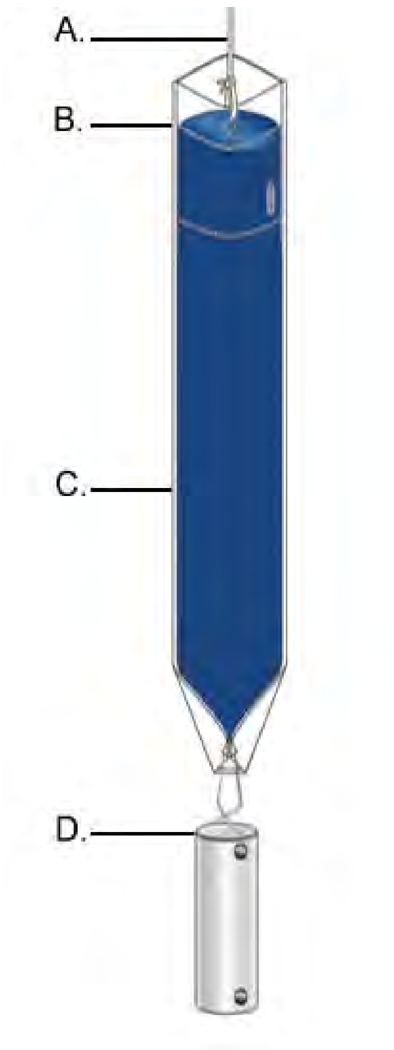


Figure 1. HydraSleeve components.

> **Note:** The sample sleeve and the discharge tube are designed for one-time use and are disposable. The spring clip, weight and weight clip may be reused after thorough cleaning. Suspension cord is generally disposed after one use although, if it is dedicated to the well, it may be reused at the discretion of the sampling personnel.

Selecting the HydraSleeve Size to Meet Site-Specific Sampling Objectives

It is important to understand that each HydraSleeve is able to collect a finite volume of sample because, after the HydraSleeve is deployed, you only get one chance to collect an undisturbed sample. Thus, the volume of sample required to meet your site-specific sampling and analytical requirements will dictate the size of HydraSleeve you need to meet these requirements.

The volume of sample collected by the HydraSleeve varies with the diameter and length of the HydraSleeve. Dimensions and volumes of available HydraSleeve models are detailed in Table 1.

Table 1. Dimensions and volumes of HydraSleeve models.

Diameter	Volume	Length	Lay-Flat Width	Filled Dia.
2-Inch HydraSleeves				
Standard 625-ml HydraSleeve	625 ml	< 30”	2.5”	1.4”
Standard 1-Liter HydraSleeve	1 Liter	38”	3”	1.9”
1-Liter HydraSleeve SS	1 Liter	36”	3”	1.9”
2-Liter HydraSleeve SS	2 Liters	60”	3”	1.9”
4-Inch HydraSleeves				
Standard 1.6-Liter HydraSleeve	1.6 Liters	30”	3.8”	2.3”
Custom 2-Liter HydraSleeve	2 Liters	36”	4”	2.7”

HydraSleeves can be custom-fabricated by the manufacturer in varying diameters and lengths to meet specific volume requirements. HydraSleeves can also be deployed in series (i.e., multiple HydraSleeves attached to one tether) to collect additional sample to meet specific volume requirements, as described below.

If you have questions regarding the availability of sufficient volume of sample to satisfy laboratory requirements for analysis, it is recommended that you contact the laboratory to discuss the minimum volumes needed for each suite of analytes. Laboratories often require only 10% to 25% of the volume they specify to complete analysis for specific suites of analytes, so they can often work with much smaller sample volumes that can easily be supplied by a HydraSleeve.

HydraSleeve Deployment

Information Required Before Deploying a HydraSleeve

Before installing a HydraSleeve in any well, you will need to know the following:

- The inside diameter of the well
- The length of the well screen
- The water level in the well
- The position of the well screen in the well
- The total depth of the well

The inside diameter of the well is used to determine the appropriate HydraSleeve diameter for use in the well. The other information is used to determine the proper placement of the HydraSleeve in the well to collect a representative sample from the screen (see HydraSleeve Placement, below), and to determine the appropriate length of tether to attach to the HydraSleeve to deploy it at the appropriate position in the well.

Most of this information (with the exception of the water level) should be available from the well log; if not, it will have to be collected by some other means. The inside diameter of the well can be measured at the top of the well casing, and the total depth of the well can be measured by sounding the bottom of the well with a weighted tape. The position and length of the well screen may have to be determined using a down-hole camera if a well log is not available. The water level in the well can be measured using any commonly available water-level gauge.

HydraSleeve Placement

The HydraSleeve is designed to collect a sample directly from the well screen, and it fills by pulling it up through the screen a distance equivalent to 1 to 1.5 times its length. This upward motion causes the top check valve to open, which allows the device to fill. To optimize sample recovery, it is recommended that the HydraSleeve be placed in the well so that the bottom weight rests on the bottom of the well and the top of the HydraSleeve is as close to the bottom of the well screen as possible. This should allow the sampler to fill before the top of the device reaches the top of the screen as it is pulled up through the water column, and ensure that only water from the screen is collected as the sample. In short-screen wells, or wells with a short water column, it may be necessary to use a top-weight on the HydraSleeve to compress it in the bottom of the well so that, when it is recovered, it has room to fill before it reaches the top of the screen.

Example

2” ID PVC well, 50’ total depth, 10’ screen at the bottom of the well, with water level above the screen (the entire screen contains water).

Correct Placement (figure 2): Using a standard HydraSleeve for a 2” well (2.6” flat width/1.5” filled OD x 30” long, 650 ml volume), deploy the sampler so the weight (an 8 oz., 4”-long weight with a 2”-long clip) rests at the bottom of the well. The top of the sleeve is thus set at about 36” above the bottom of the well. When the sampler is recovered, it will be pulled upward approximately 30” to 45” before it is filled; therefore, it is full (and the top check valve closes) at approximately 66” (5 ½ feet) to 81” (6 ¾ feet) above the bottom of the well, which is well before the sampler reaches the top of the screen. In this example, only water from the screen is collected as a sample.

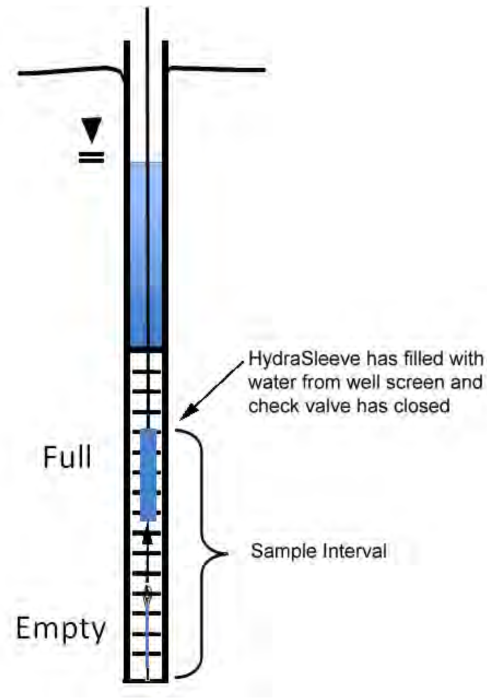


Figure 2. Correct placement of HydraSleeve.

Incorrect Placement (figure 3): If the well screen in this example was only 5' long, and the HydraSleeve was placed as above, it would not fill before the top of the device reached the top of the well screen, so the sample would include water from above the screen, which may not have the same chemistry.

The solution? Deploy the HydraSleeve with a top weight, so that it is collapsed to within 6" to 9" of the bottom of the well. When the HydraSleeve is recovered, it will fill within 39" (3 ¼ feet) to 54" (4 ½ feet) above the bottom of the well, or just before the sampler reaches the top of the screen, so it collects only water from the screen as the sample.

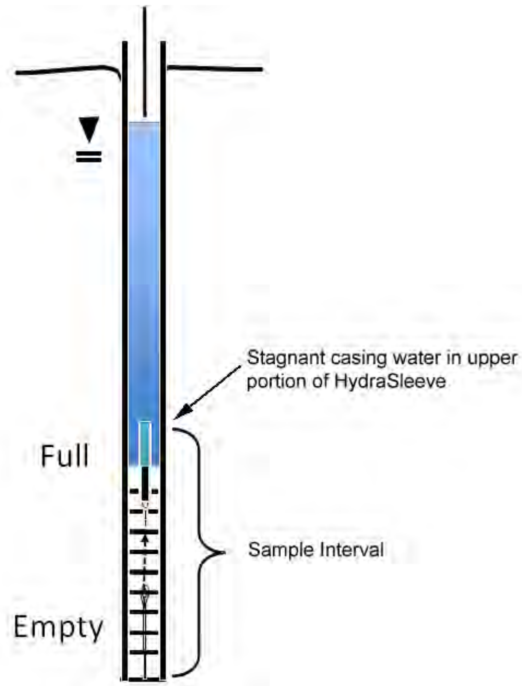


Figure 3. Incorrect placement of HydraSleeve.

This example illustrates one of many types of HydraSleeve placements. More complex placements are discussed in a later section.

Procedures for Sampling with the HydraSleeve

Collecting a ground-water sample with a HydraSleeve is a simple one-person operation.

Note: Before deploying the HydraSleeve in the well, collect the depth-to-water measurement that you will use to determine the preferred position of the HydraSleeve in the well. This measurement may also be used with measurements from other wells to create a ground-water contour map. If necessary, also measure the depth to the bottom of the well to verify actual well depth to confirm your decision on placement of the HydraSleeve in the water column.

Measure the correct amount of tether needed to suspend the HydraSleeve in the well so that the weight will rest on the bottom of the well (or at your preferred position in the well). Make sure to account for the need to leave a few feet of tether at the top of the well to allow recovery of the sleeve

Note: Always wear sterile gloves when handling and discharging the HydraSleeve.

I. Assembling the HydraSleeve

1. Remove the HydraSleeve from its packaging, unfold it, and hold it by its top.

2. Crimp the top of the HydraSleeve by folding the hard polyethylene reinforcing strips at the holes.

3. Attach the spring clip to the holes to ensure that the top will remain open until the sampler is retrieved.

4. Attach the tether to the spring clip by tying a knot in the tether.

Note: Alternatively, attach the tether to one (NOT both) of the holes at the top of the Hydrasleeve by tying a knot in the tether.

5. Fold the flaps with the two holes at the bottom of the HydraSleeve together and slide the weight clip through the holes.

6. Attach a weight to the bottom of the weight clip to ensure that the HydraSleeve will descend to the bottom of the well.

II. Deploying the HydraSleeve

1. Using the tether, carefully lower the HydraSleeve to the bottom of the well, or to your preferred depth in the water column

   During installation, hydrostatic pressure in the water column will keep the self-sealing check valve at the top of the HydraSleeve closed, and ensure that it retains its flat, empty profile for an indefinite period prior to recovery.

Note: Make sure that it is not pulled upward at any time during its descent. If the HydraSleeve is pulled upward at a rate greater than 0.5'/second at any time prior to recovery, the top check valve will open and water will enter the HydraSleeve prematurely.

2. Secure the tether at the top of the well by placing the well cap on the top of the well casing and over the tether.

Note: Alternatively, you can tie the tether to a hook on the bottom of the well cap (you will need to leave a few inches of slack in the line to avoid pulling the sampler up as the cap is removed at the next sampling event).

III. Equilibrating the Well

The equilibration time is the time it takes for conditions in the water column (primarily flow dynamics and contaminant distribution) to restabilize after vertical mixing occurs (caused by installation of a sampling device in the well).

- Situation: The HydraSleeve is deployed for the first time or for only one time in a well

  The HydraSleeve is very thin in cross section and displaces very little water (<100 ml) during deployment so, unlike most other sampling devices, it does not disturb the water column to the point at which long equilibration times are necessary to ensure recovery of a representative sample.

  In most cases, the HydraSleeve can be recovered immediately (with no equilibration time) or within a few hours. In regulatory jurisdictions that impose specific requirements for equilibration times prior to recovery of no-purge sampling devices, these requirements should be followed.

- Situation: The HydraSleeve is being deployed for recovery during a future sampling event

  In periodic (i.e., quarterly or semi-annual) sampling programs, the sampler for the current sampling event can be recovered and a new sampler (for the next sampling event) deployed immediately thereafter, so the new sampler remains in the well until the next sampling event.

Thus, a long equilibration time is ensured and, at the next sampling event, the sampler can be recovered immediately. This means that separate mobilizations, to deploy and then to recover the sampler, are not required. HydraSleeves can be left in a well for an indefinite period of time without concern.

IV. HydraSleeve Recovery and Sample Collection

1. Hold on to the tether while removing the well cap.

2. Secure the tether at the top of the well while maintaining tension on the tether (but without pulling the tether upwards)

3. Measure the water level in the well.

4. In one smooth motion, pull the tether up between 30” to 45” (36” to 54” for the longer HydraSleeve) at a rate of about 1’ per second (or faster).

   The motion will open the top check valve and allow the HydraSleeve to fill (it should fill in about 1 to 1.5 times the length of the HydraSleeve). This is analogous to coring the water column in the well from the bottom up.

   When the HydraSleeve is full, the top check valve will close. You should begin to feel the weight of the HydraSleeve on the tether and it will begin to displace water. The closed check valve prevents loss of sample and entry of water from zones above the well screen as the HydraSleeve is recovered.

5. Continue pulling the tether upward until the HydraSleeve is at the top of the well.

6. Decant and discard the small volume of water trapped in the Hydrasleeve above the check valve by turning the sleeve over.

V. Sample Collection

> **Note:** Sample collection should be done immediately after the HydraSleeve has been brought to the surface to preserve sample integrity.

1. Remove the discharge tube from its sleeve.

2. Hold the HydraSleeve at the check valve.

3. Puncture the HydraSleeve just below the check valve with the pointed end of the discharge tube

4. Discharge water from the HydraSleeve into your sample containers.

Control the discharge from the HydraSleeve by either raising the bottom of the sleeve, by squeezing it like a tube of toothpaste, or both.

5. Continue filling sample containers until all are full.

Measurement of Field Indicator Parameters

Field indicator parameter measurement is generally done during well purging and sampling to confirm when parameters are stable and sampling can begin. Because no-purge sampling does not require purging, field indicator parameter measurement is not necessary for the purpose of confirming when purging is complete.

If field indicator parameter measurement is required to meet a specific non-purging regulatory requirement, it can be done by taking measurements from water within a HydraSleeve that is not used for collecting a sample to submit for laboratory analysis (i.e., a second HydraSleeve installed in conjunction with the primary sample collection HydraSleeve [see Multiple Sampler Deployment below]).

Alternate Deployment Strategies

Deployment in Wells with Limited Water Columns

For wells in which only a limited water column exists to be sampled, the HydraSleeve can be deployed with an optional top weight instead of a bottom weight, which collapses the HydraSleeve to a very short (approximately 6” to 9”) length, and allows the HydraSleeve to fill in a water column only 36” to 45” in height.

Multiple Sampler Deployment

Multiple sampler deployment in a single well screen can accomplish two purposes:

- It can collect additional sample volume to satisfy site or laboratory-specific sample volume requirements.
- It can accommodate the need for collecting field indicator parameter measurements.
- It can be used to collect samples from multiple intervals in the screen to allow identification of possible contaminant stratification.

It is possible to use up to 3 standard 30” HydraSleeves deployed in series along a single tether to collect samples from a 10’ long well screen without collecting water from the interval above the screen.

The samplers must be attached to the tether at both the top and bottom of the sleeve. Attach the tether at the top with a stainless-steel clip (available from the manufacturer). Attach the tether at the bottom using a cable tie. The samplers must be attached as follows (figure 4):

- The first (attached to the tether as described above, with the weight at the bottom) at the bottom of the screen
- The second attached immediately above the first
- The third (attached the same as the second) immediately above the second

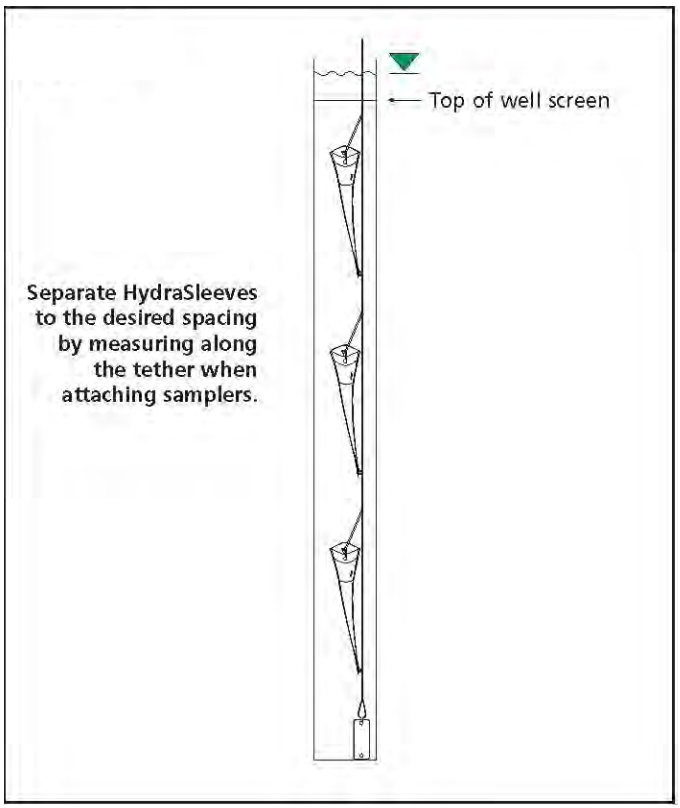


Figure 4. Multiple HydraSleeve deployment.

Alternately, the first sampler can be attached to the tether as described above, a second attached to the bottom of the first using a short length of tether (in place of the weight), and the third attached to the bottom of the second in the same manner, with the weight attached to the bottom of the third sampler (figure 5).

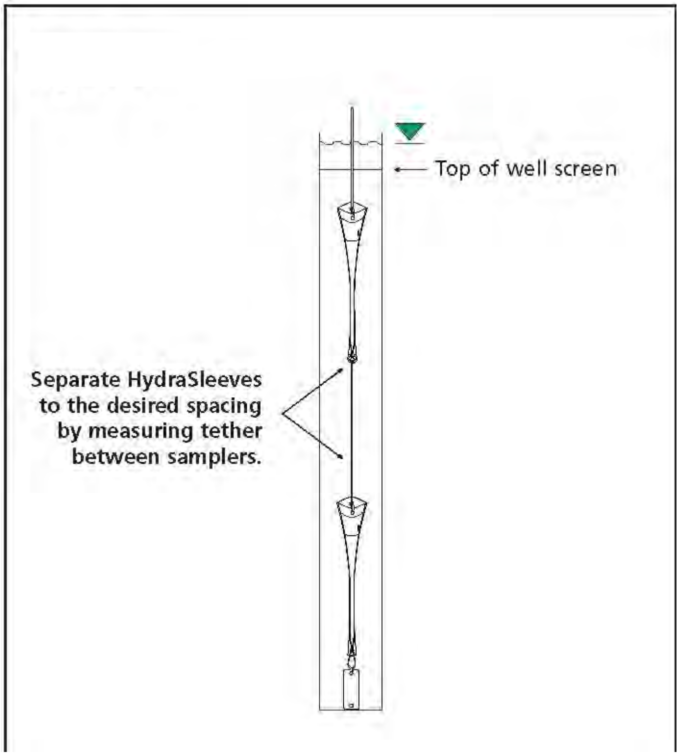


Figure 5. Alternative method for deploying multiple HydraSleeves.

In either case, when attaching multiple HydraSleeves in series, more weight may be required to hold the samplers in place in the well than would be required with a single sampler. Recovery of multiple samplers and collection of samples is done in the same manner as for single sampler deployments.

Post-Sampling Activities

The recovered HydraSleeve and the sample discharge tubing should be disposed as per the solid waste management plan for the site. To prepare for the next sampling event, a new HydraSleeve can be deployed in the well (as described previously) and left in the well until the next sampling event, at which time it can be recovered.

The weight and weight clip can be reused on this sampler after they have been thoroughly cleaned as per the site equipment decontamination plan. The tether may be dedicated to the well and reused or discarded at the discretion of sampling personnel.

References

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