Executive Summary

The Water Research Laboratory (WRL) of the University of New South Wales was commissioned by the Greater Taree City Council (GTCC) to undertake a hydrologic study of Pipeclay Canal and the adjoining Big Swamp floodplain. Pipeclay Canal flows into Cattai Creek, a north bank tributary of the Manning River, and is located 15 km upstream of the northern entrance of the Manning River. Draining into Pipeclay Canal, the Big Swamp floodplain includes approximately 2,000 hectares below 2 m Australian Height Datum (AHD) and is located immediately north of Cattai Wetlands. The Pipeclay Canal-Big Swamp floodplain system has been nominated for remediation by GTCC due to ongoing poor water quality from acid sulphate soils (ASS).

The primary aim of this hydrologic study is to provide a comprehensive scientific analysis of any proposed on-ground remediation activities. Additional outcomes from the study include a detailed literature review, the development of conceptual and computer models, an evidence-based assessment of the remediation works, prioritised actions for on-ground works and future recommendations. The outcomes from the study will also support the development of a Plan of Management.

Information was initially gathered to conceptually model the Big Swamp-Pipeclay system during wet and dry periods. In brief, the catchment above Pipeclay Canal comprises 1.3% of the total Manning River catchment. The floodplain experiences minor local catchment floods as well as major backwater flooding from the Manning River. Over the past 150 years the system has undergone major hydrologic modifications.

Historically, the Big Swamp floodplain was a shallow freshwater swamp, draining from Pipeclay Creek in the north to Cattai Creek in the south. Available literature suggests the freshwater Pipeclay Creek and the tidal/brackish Cattai Creek were hydrologically connected and periodically formed a continuous channel through the floodplain (as per schematic in Figure ES.1). These backswamp conditions provided an ideal setting for the accumulation of sulfidic sediments (termed potential acid sulfate soils).

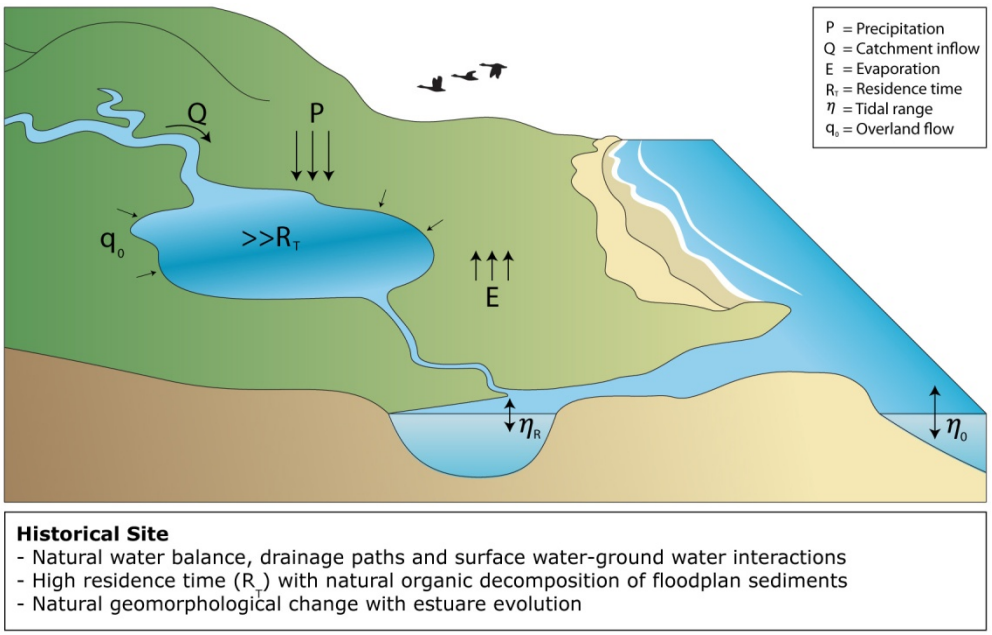

Figure ES.1 - Conceptual (Hydrology) Model of the Historical Big Swamp-Pipeclay System Pre-1820

European settlement of this region commenced in the 1820s. Since the 1840s, large areas of native vegetation were cleared and minor drainage lines constructed. The Big Swamp Drainage Scheme was completed in 1905 and designed to pass upland inflows from the catchment directly downstream to Cattai Creek. This included the construction of an large canal (approximately 6.5 km long, 15 m wide, 1.2 m deep) through the Big Swamp floodplain, dividing the floodplain into eastern and western sides. The canal is flanked by large continuous levees on both sides with sub-drains and tidal floodgates draining the floodplain (Figure ES.2). Additional floodgates and drainage lines were installed during later years.

The drainage works have had a deleterious impact on surface water and groundwater quality. The canal, drains and floodgates lowered the groundwater table and oxidised the sulfidic sediments (termed active acid sulfate soils) creating acidic water with high concentrations of heavy metals. The site is now recognised as a major acid hotspot with approximately 2500 hectares mapped as high risk acid sulphate soils.

Despite the water quality problems on the Big Swamp floodplain, limited field data was available to characterise the basic hydrology of the site. To overcome this knowledge gap, targeted field campaigns were undertaken to measure surface water, groundwater, topography, bathymetry, hydro-geologic and meteorologic variables. Additional field campaigns were undertaken to understand the surface and groundwater regimes, including acid dynamics, during prolonged dry conditions and following a minor flood events.

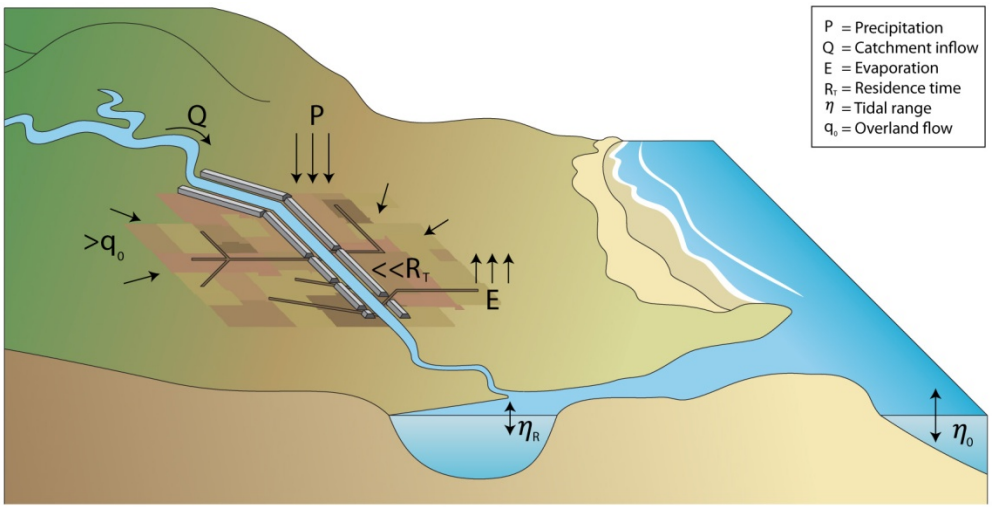

Figure ES.2 - Conceptual (Hydrology) Model of the Big Swamp-Pipeclay System Post 1905 Including the Big Swamp Drainage Scheme

The field investigations showed that the entire floodplain is impacted by acid sulphate soil discharges with extreme acidity measurements recorded during wet and dry conditions. Subsurface investigations indicated that acidic groundwater is quickly transported to adjacent drains. During prolonged dry periods evaporation lowers the groundwater table and acid concentrations increase across the floodplain. During these dry periods, catchment inflows are

limited and tidal waters penetrate the length of Pipeclay Canal. This results in increased acid neutralisation and dilution, although the floodplain and surface waters remain acidic.

A detailed field campaign was undertaken in January 2013 in response to widespread rainfall in the Pipeclay Canal catchment. Surface water measurements from this event highlighted how acid is transported across the site as flood waters recede. Over a 15 day period, surface water pH decreased from slightly acidic (pH ~5) to extremely acidic (pH ~3) with high total acidity and discharges recorded. The most acidic measurements were obtained in the south-eastern and south-western regions of the Big Swamp floodplain but acidic discharges were measured in surface waters as far as 7 kilometers downstream of Pipeclay Canal (at the junction of Tappin Creek and the Manning River).

Despite the on-going poor water quality, it was determined through stakeholder consultation that the remediation of the entire Big Swamp was not feasible within the scope of this study. As such, an evidence based assessment method was developed to determine which sub-catchments of the floodplain should be prioritised for remediation. The assessment method includes various factors such as groundwater acidity, surface water transport, sub-catchment size and potential restoration methods. Sub-catchment zones in the south-western and south-eastern areas of the Big Swamp floodplain were rated the highest priority areas for remediation actions. Private properties located within these zones were acquired during this study or are currently going through the acquisition process (Figure ES.3).

A series of on-ground remediation works were recommended for the nominated properties. These works are focused on reducing acid production, limiting acid transport, neutralising and diluting acidic waters and removing hydraulic structures, where feasible. As only a portion of the site will be remediated, the works were also designed to not reduce local or regional drainage during or immediately after flooding (Figure ES.4).

A computer model of the Big Swamp floodplain, Pipeclay Canal and Cattai Creek system was developed and calibrated for this study. The model was primarily designed to test specific proposed remediation strategies and determine on-ground impacts. The modelling results indicated that removing all tidal floodgates along Pipeclay Canal would have implications on a limited area of the Big Swamp floodplain and tidal inundation would be largely focused in the south-western paddocks. As this is a prioritised zone, further scenario modelling was undertaken to test alternative on-ground works and to ensure that the paddocks to the north remain arable. Scenario testing of remedial strategies was also undertaken for the prioritised south-eastern areas.

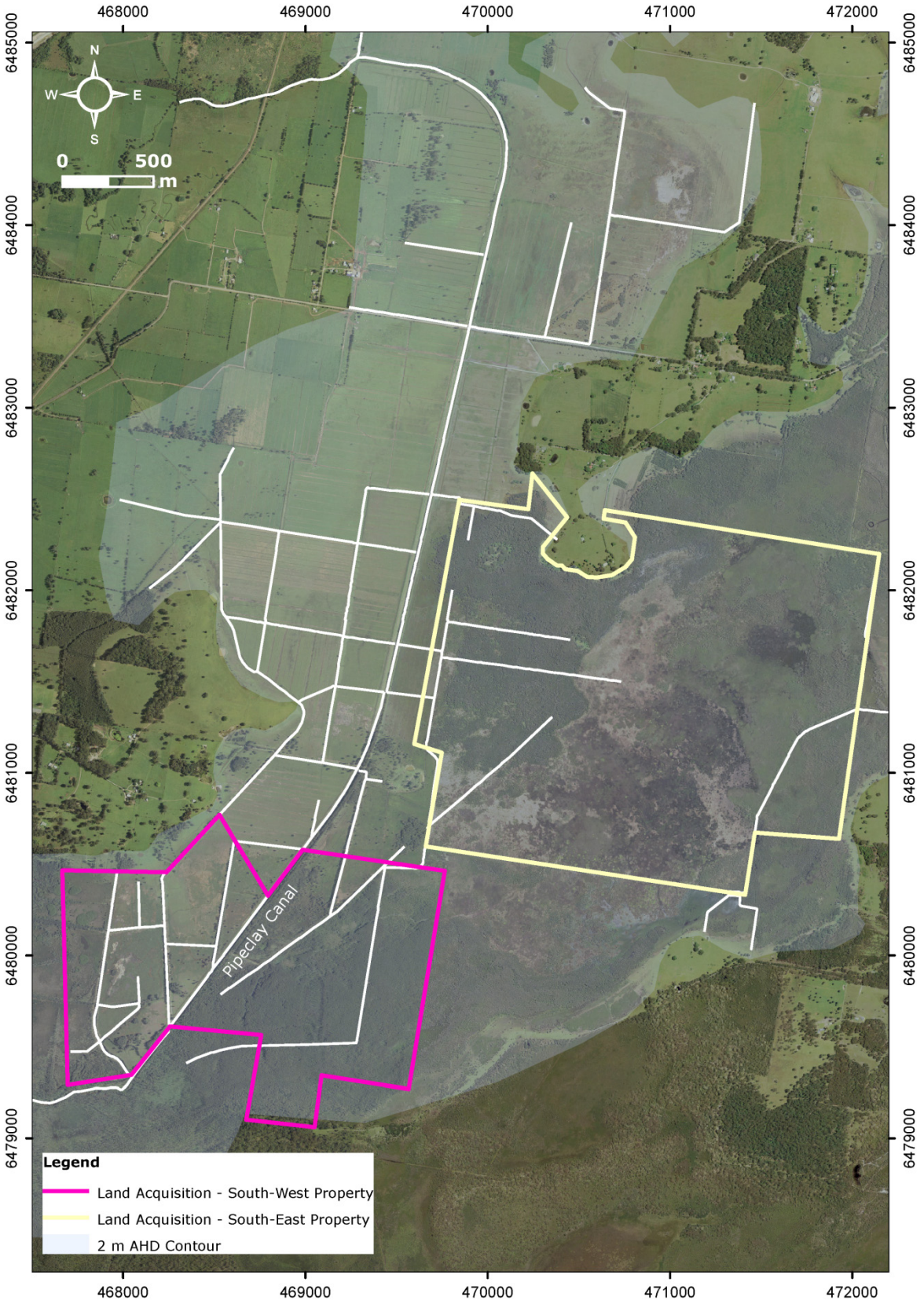

Figure ES.3 - Proposed Acquisition Areas for the Pipeclay-Big Swamp Floodplain

The computer modelling results have direct implications for future land management. The modelling indicates that the proposed on-ground works should achieve the stated aims by reducing acid generation and transport in the south-western properties. This would be achieved through a combination of tidal inundation, retaining shallow surface waters onsite, encouraging organic matter decomposition, removing/altering existing drains and floodgates, and hydrologically isolating the restored areas from the arable land to the north. Conversely, limited on-ground works are proposed for the south-eastern properties as several landholders remain upstream of the acquired properties and require the drainage network for flood mitigation (Figure ES.5). In this area, the primary recommendation is to remove internal levee bunds along the tidal drains to encourage rewetting and limit overland drainage of acquired properties.

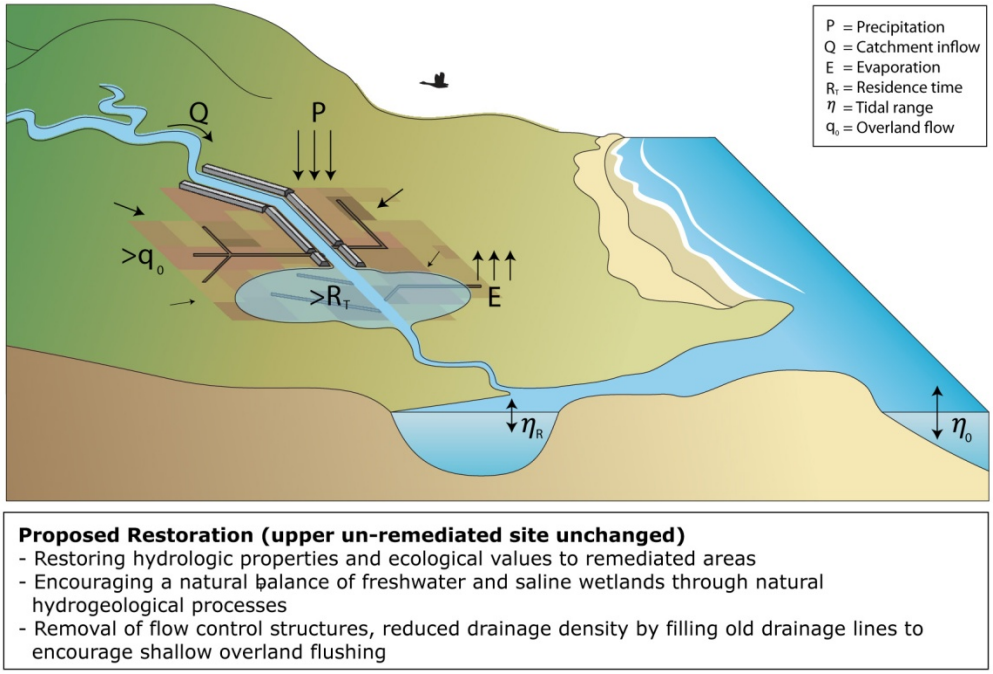

Figure ES.4 - Conceptual (Hydrology) Model of the Big Swamp-Pipeclay System with Proposed On-Ground Remedial Works

Based on the outcomes of the study various recommendations are provided. Important recommendations include detailed on-ground works, onsite monitoring and a staged works program. The field investigations for this study highlight the need for continuous monitoring to ensure that future acid discharge events are measured. As only a portion of the floodplain will be remediated, the full restoration of the Big Swamp floodplain is strongly recommended.

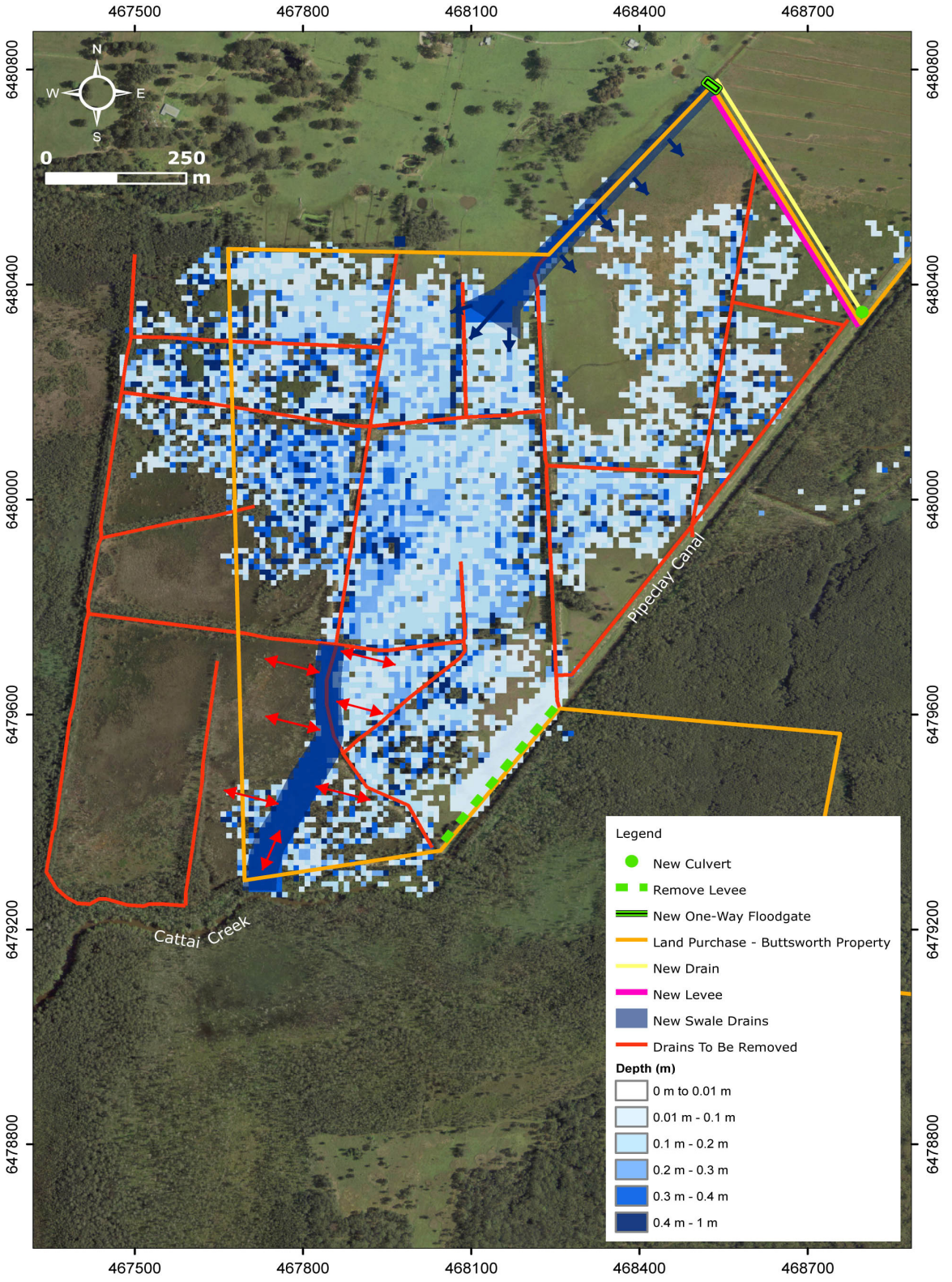

Figure ES.5 - Proposed Remedial Works for the South-Western Property Including a Representative Modelling Prediction of Inundation Coverage as a Result of the Works