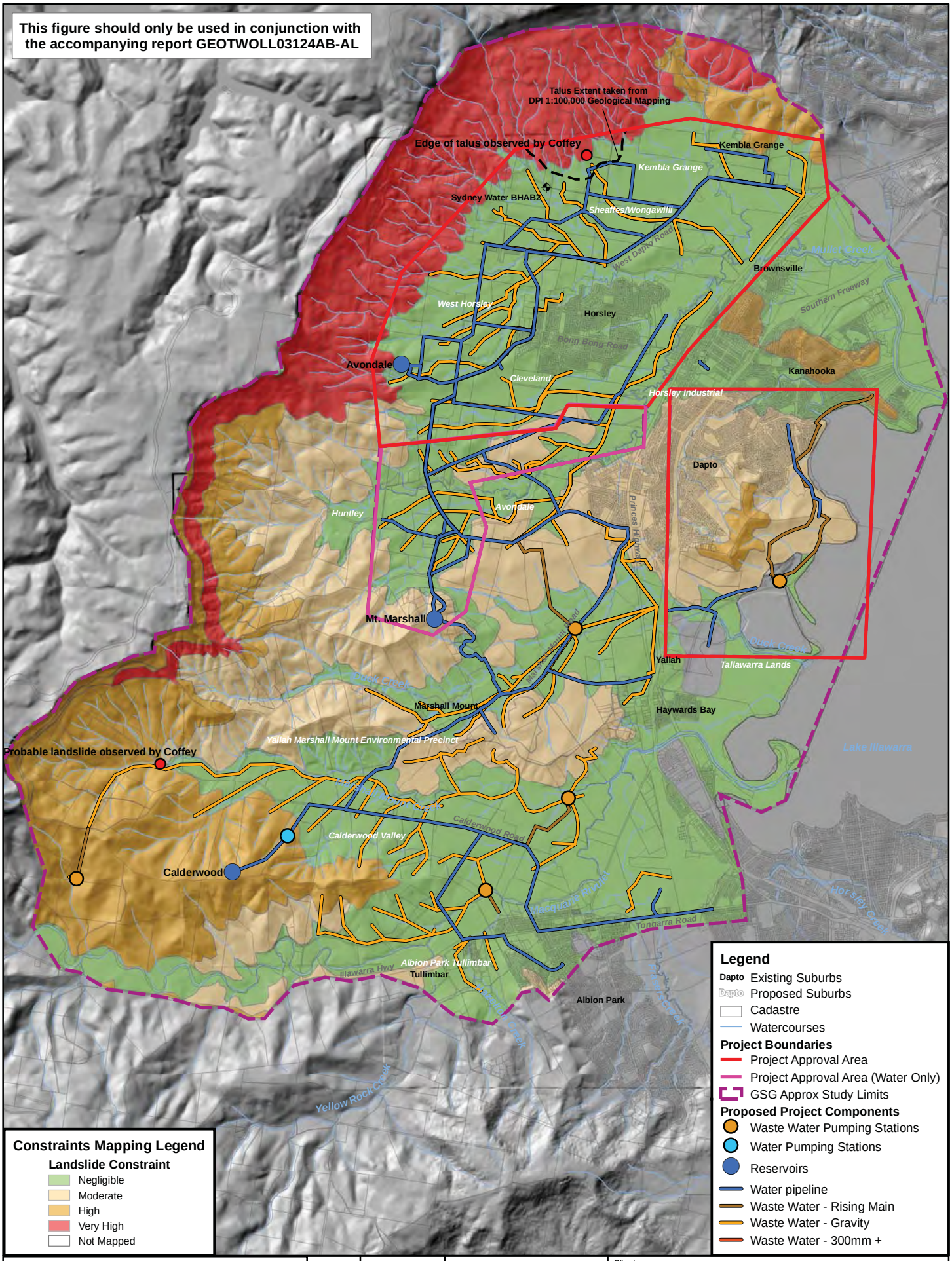


Drawn	LAE
Approved	SM
Date	May 10, 2011
Scale	1:75,000
Original Size	A4

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

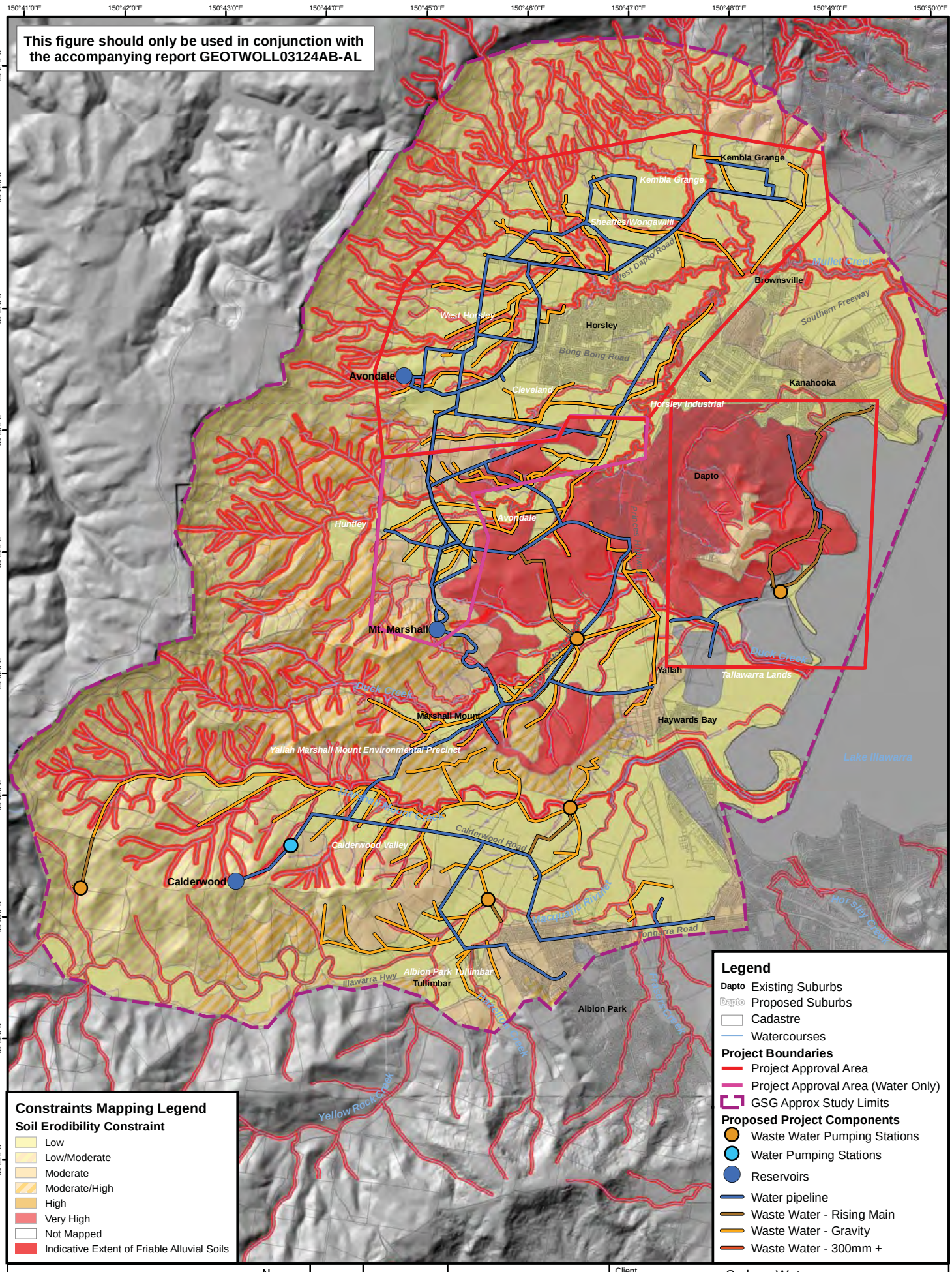
Client: Sydney Water

Project: WDURA and AGA
Geology, Soils and Groundwater Assessment

Title: **Landslide Constraint of the Study Area**

Project No.: GEOTWOLL03124AB

Figure No.: **Figure 4.2**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150°45'0"E
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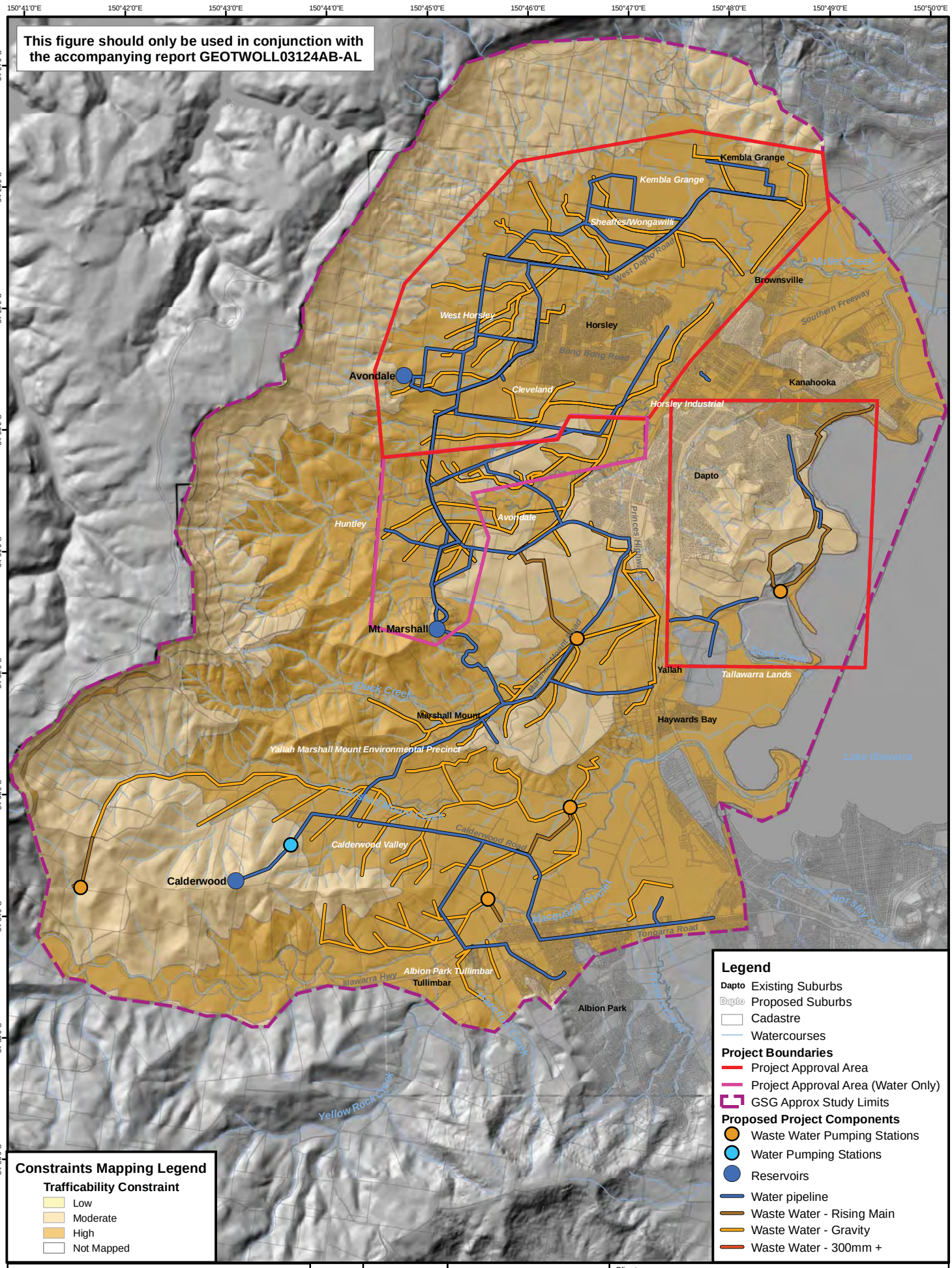
150°48'0"E
150°49'0"E
150°50'0"E
34°27'0"S
34°28'0"S
34°29'0"S
34°30'0"S
34°31'0"S
34°32'0"S
34°33'0"S
34°34'0"S
34°35'0"S
34°36'0"S
Kembla Grange
Kembla Grange
Sheaffes/Wongawilli
West Dapto Road
Mullet Creek
Brownsville
Southern Freeway
West Horsley
Horsley
Bong Bong Road
Avondale
Cleveland
Kanahooka
Horsley Industrial
Dapto
Huntley
Avondale
Princes Highway
Mt. Marshall
Duck Creek
Yallah
Tallawarra Lands
Duck Creek
Marshall Mount
Haywards Bay
Yallah Marshall Mount Environmental Precinct
Lake Illawarra
Calderwood Road
Calderwood Valley
Calderwood
Horsley Creek
Illawarra Hwy
Albion Park Tullimbar
Tullimbar
Albion Park
Yellow Rock Creek
Legend
Dapto Existing Suburbs
Dapto Proposed Suburbs
Cadastre
Watercourses
Project Boundaries
Project Approval Area
Project Approval Area (Water Only)
GSG Approx Study Limits
Proposed Project Components
Waste Water Pumping Stations
Water Pumping Stations
Reservoirs
Water pipeline
Waste Water - Rising Main
Waste Water - Gravity
Waste Water - 300mm +
Constraints Mapping Legend
Soil Erodibility Constraint
Low
Low/Moderate
Moderate
Moderate/High
High
Very High
Not Mapped
Indicative Extent of Friable Alluvial Soils
km
0 0.5 1 1.5 2
N
W E
S
Projection: MGA Zone 56
Source of data:
1. Constraints mapping based on Kiama 1:100,000 Soils Landscape Map units (Hazelton, 1992)
2. Indicative extent of friable alluvial soils mapped using Council-designated riparian corridor (where available)
3. Contours and cadastre supplied by Sydney Water
4. All other data supplied by Wollongong and Shellharbour City Councils
Drawn LAE
Approved SM
Date May 10, 2011
Scale 1:75,000
Original Size A4
coffey geotechnics
SPECIALISTS MANAGING THE EARTH
Client Sydney Water
Project WDURA and AGA
Geology, Soils and Groundwater Assessment
Title Soil Erodibility Constraint of the Study Area
Project No. GEOTWOLL03124AB
Figure No. Figure 4.3



Projection: MGA Zone 56

Source of data:
1. Constraints mapping based on Kiama 1:100,000 Soils Landscape Map units (Hazelton, 1992)
2. Contours and cadastre supplied by Sydney Water
3. All other data supplied by Wollongong and Shellharbour City Councils

Drawn	LAE
Approved	SM
Date	May 10, 2011
Scale	1:75,000
Original Size	A4

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

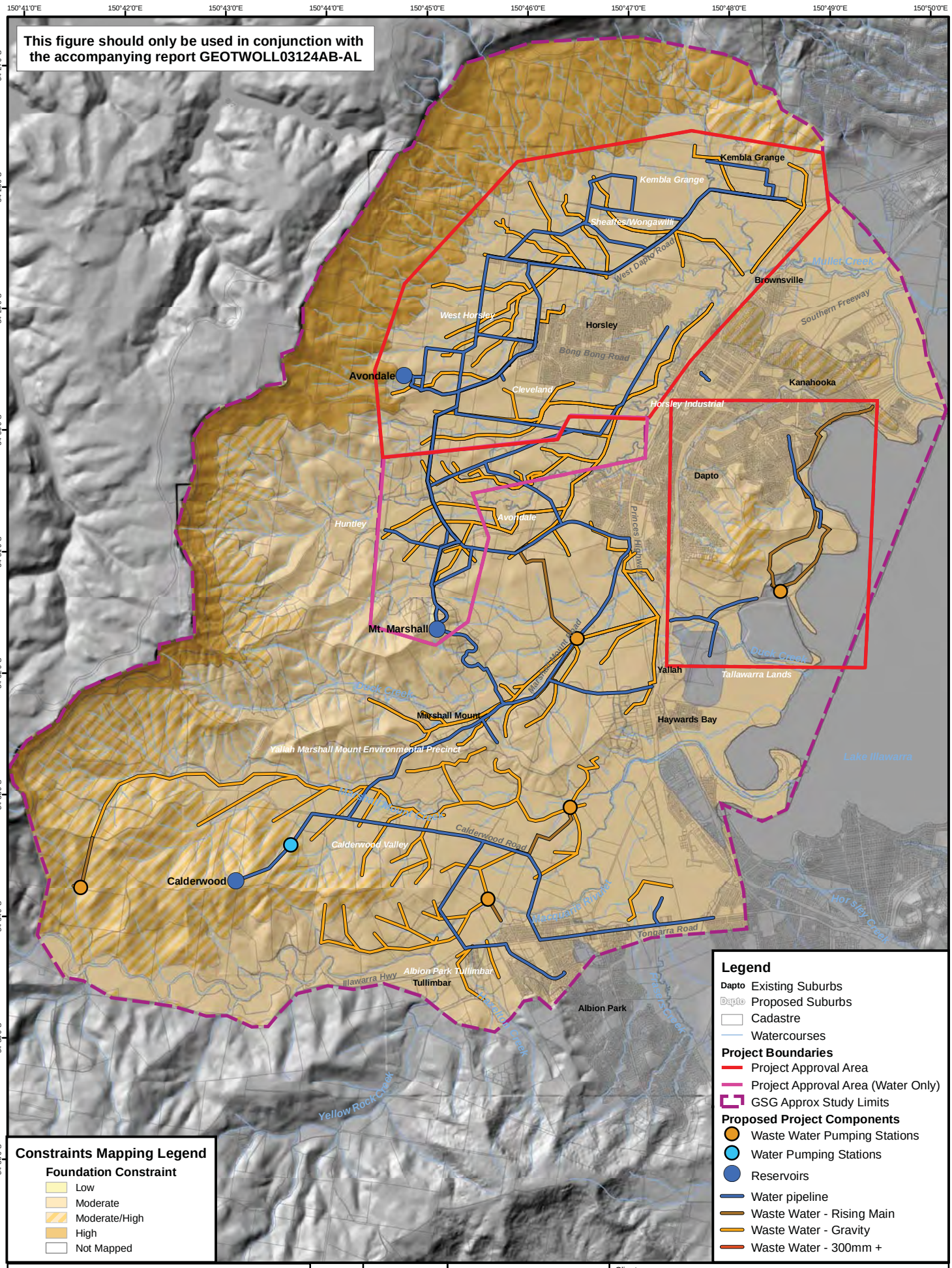
Client: Sydney Water

Project: WDURA and AGA
Geology, Soils and Groundwater Assessment

Title: **Trafficability Constraint of the Study Area**

Project No.: GEOTWOLL03124AB

Figure No.: **Figure 4.4**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34°28'0"S
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34°30'0"S
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34°32'0"S
34°33'0"S
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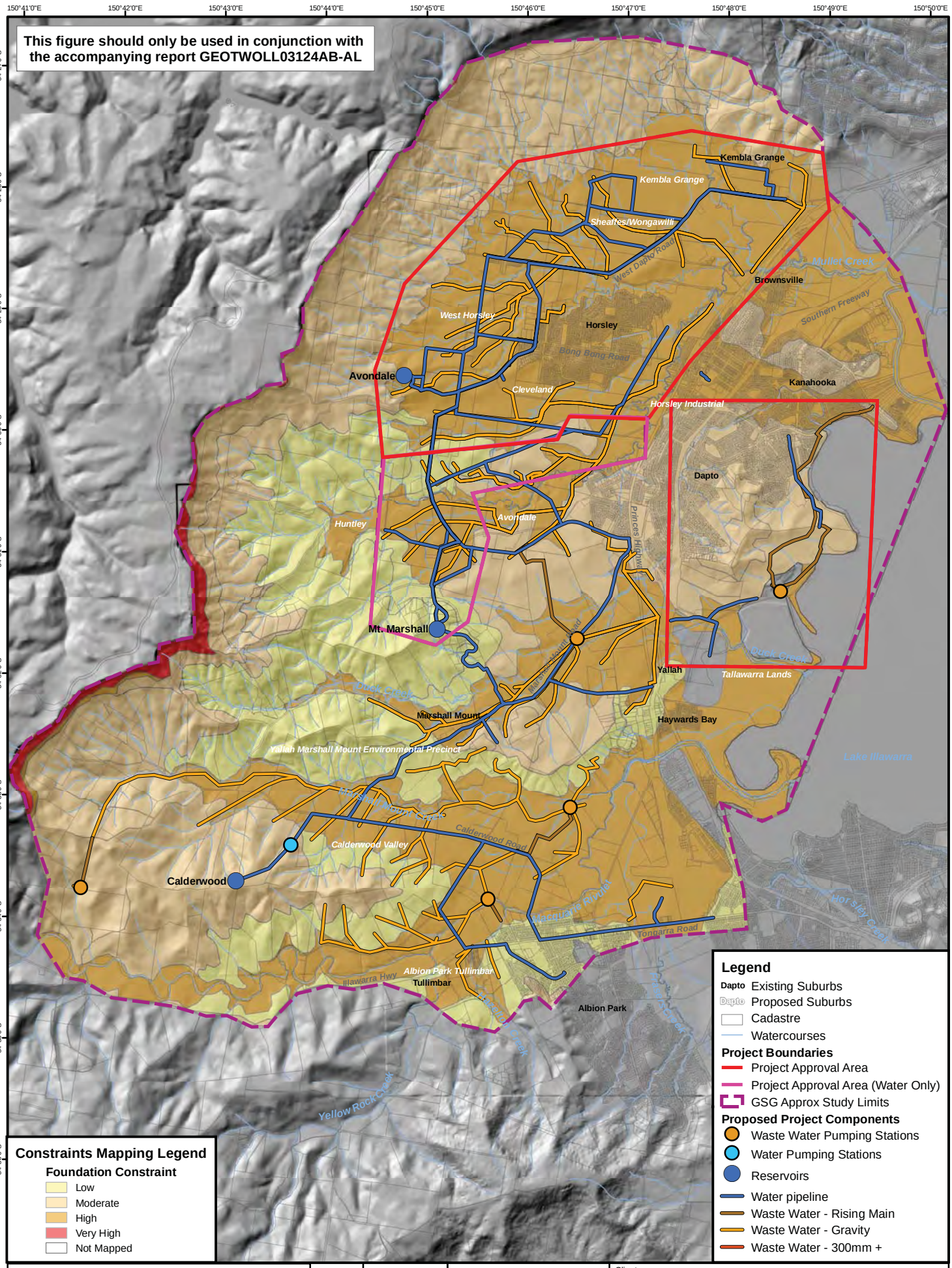
34°35'0"S
34°36'0"S
Kembla Grange
Kembla Grange
Sheaffes/Wongawilli
West Dapto Road
Millet Creek
Brownsville
West Horsley
Horsley
Southern Freeway
Bong Bong Road
Avondale
Cleveland
Kanahooka
Horsley Industrial
Dapto
Huntley
Avondale
Princes Highway
Mt. Marshall
Mullet Creek
Yallah
Tallawarra Lands
Duck Creek
Haywards Bay
Marshall Mount
Yallah Marshall Mount Environmental Precinct
Lake Illawarra
Calderwood Road
Calderwood Valley
Calderwood
Macquarie Rivulet
Tongarra Road
Horsley Creek
Albion Park Tullimbar
Illawarra Hwy
Tullimbar
Albion Park
Yellow Rock Creek
Constraints Mapping Legend
Foundation Constraint
Low
Moderate
Moderate/High
High
Not Mapped
Legend
Dapto Existing Suburbs
Dapto Proposed Suburbs
Cadastre
Watercourses
Project Boundaries
Project Approval Area
Project Approval Area (Water Only)
GSG Approx Study Limits
Proposed Project Components
Waste Water Pumping Stations
Water Pumping Stations
Reservoirs
Water pipeline
Waste Water - Rising Main
Waste Water - Gravity
Waste Water - 300mm +
km
0 0.5 1 1.5 2
N
W E
S
Projection: MGA Zone 56
Source of data:
1. Constraints mapping based on Kiama 1:100,000 Soils Landscape Map units (Hazelton, 1992)
2. Contours and cadastre supplied by Sydney Water
3. All other data supplied by Wollongong and Shellharbour City Councils
Drawn LAE
Approved SM
Date May 10, 2011
Scale 1:75,000
Original Size A4
coffey geotechnics
SPECIALISTS MANAGING THE EARTH
Client Sydney Water
Project WDURA and AGA
Geology, Soils and Groundwater Assessment
Title Foundation Constraint of the Study Area
Project No. GEOTWOLL03124AB
Figure No. Figure 4.5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34°30'0"S
34°31'0"S
34°32'0"S
34°33'0"S
34°34'0"S
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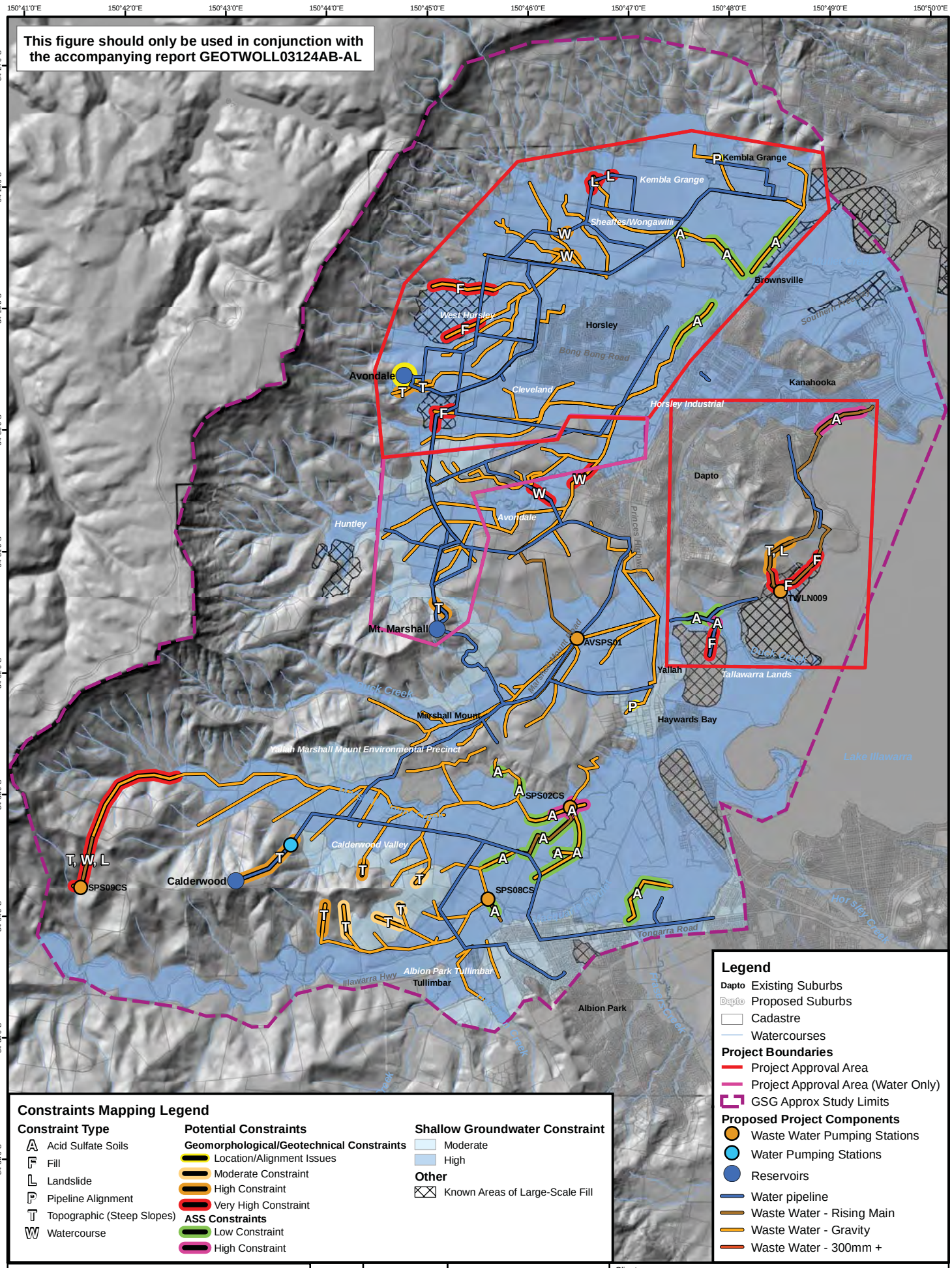
34°36'0"S
Kembla Grange
Kembla Grange
Sheaffes/Wongawilli
West Dapto Road
Mullet Creek
Brownsville
Southern Freeway
West Horsley
Horsley
Bong Bong Road
Avondale
Cleveland
Kanahooka
Horsley Industrial
Dapto
Huntley
Avondale
Princes Highway
Mt. Marshall
Duck Creek
Yallah
Tallawarra Lands
Marshall Mount
Haywards Bay
Yallah Marshall Mount Environmental Precinct
Lake Illawarra
Calderwood Road
Calderwood Valley
Calderwood
Macquarie Rivulet
Tongarra Road
Horsley Creek
Illawarra Hwy
Albion Park Tullimbar
Tullimbar
Albion Park
Yellow Rock Creek
Constraints Mapping Legend
Foundation Constraint
Low
Moderate
High
Very High
Not Mapped
Legend
Dapto Existing Suburbs
Dapto Proposed Suburbs
Cadastre
Watercourses
Project Boundaries
Project Approval Area
Project Approval Area (Water Only)
GSG Approx Study Limits
Proposed Project Components
Waste Water Pumping Stations
Water Pumping Stations
Reservoirs
Water pipeline
Waste Water - Rising Main
Waste Water - Gravity
Waste Water - 300mm +
km
0 0.5 1 1.5 2
N
W E
S
Projection: MGA Zone 56
Source of data:
1. Constraints mapping based on Kiama 1:100,000 Soils Landscape Map units (Hazelton, 1992)
2. Contours and cadastre supplied by Sydney Water
3. All other data supplied by Wollongong and Shellharbour City Councils
Drawn LAE
Approved SM
Date May 10, 2011
Scale 1:75,000
Original Size A4
coffey geotechnics
SPECIALISTS MANAGING THE EARTH
Client Sydney Water
Project WDURA and AGA
Geology, Soils and Groundwater Assessment
Title Rehabilitation Constraint of the Study Area
Project No. GEOTWOLL03124AB
Figure No. Figure 4.6


This figure should only be used in conjunction with the accompanying report GEOTWOLL03124AB-AL
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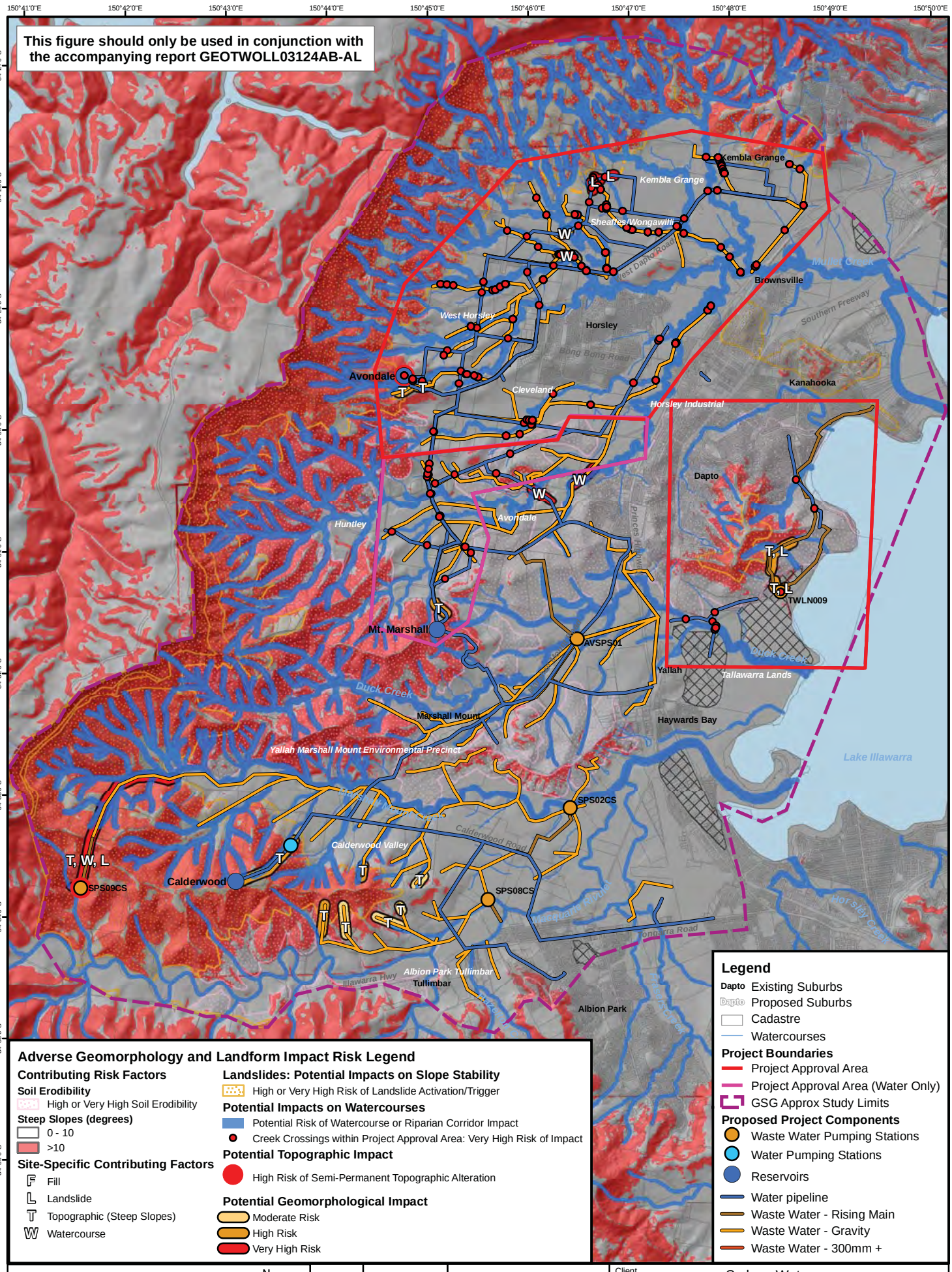
34°33'0"S
34°34'0"S
34°35'0"S
34°36'0"S
Kembla Grange
Sheaffes/Wongawilli
Brownsville
West Horsley
Horsley
Bong Bong Road
Avondale
Cleveland
Kanahooka
Horsley Industrial
Dapto
Huntley
Princes Highway
TWLN009
Mt. Marshall
AVSPS01
Yallah
Tallawarra Lands
Haywards Bay
Marshall Mount
Yallah Marshall Mount Environmental Precinct
Lake Illawarra
SPS02CS
Calderwood Valley
T, W, L
SPS09CS
Calderwood
SPS08CS
Tongarra Road
Albion Park Tullimbar
Tullimbar
Illawarra Hwy
Albion Park
Legend
Dapto Existing Suburbs
Dapto Proposed Suburbs
Cadastre
Watercourses
Project Boundaries
Project Approval Area
Project Approval Area (Water Only)
GSG Approx Study Limits
Proposed Project Components
Waste Water Pumping Stations
Water Pumping Stations
Reservoirs
Water pipeline
Waste Water - Rising Main
Waste Water - Gravity
Waste Water - 300mm +
Constraints Mapping Legend
Constraint Type
A Acid Sulfate Soils
F Fill
L Landslide
P Pipeline Alignment
T Topographic (Steep Slopes)
W Watercourse
Potential Constraints
Geomorphological/Geotechnical Constraints
Location/Alignment Issues
Moderate Constraint
High Constraint
Very High Constraint
ASS Constraints
Low Constraint
High Constraint
Shallow Groundwater Constraint
Moderate
High
Other
Known Areas of Large-Scale Fill
km
0 0.5 1 1.5 2
N
W E
S
Projection: MGA Zone 56
Source of data:
1. Potential constraints digitised by Coffey
2. Contours and cadastre supplied by Sydney Water
3. Fill digitised by Coffey and taken from Kiama 1:100,000 Soil Landscape Mapping and ASS 1:25,000 risk maps
4. All other data supplied by Wollongong and Shellharbour City Councils
Drawn LAE
Approved SM
Date May 10, 2011
Scale 1:75,000
Original Size A4
coffey geotechnics
SPECIALISTS MANAGING THE EARTH
Client Sydney Water
Project WDURA and AGA
Geology, Soils and Groundwater Assessment
Title Site-Specific Constraints of the Study Area
Project No. GEOTWOLL03124AB
Figure No. Figure 4.7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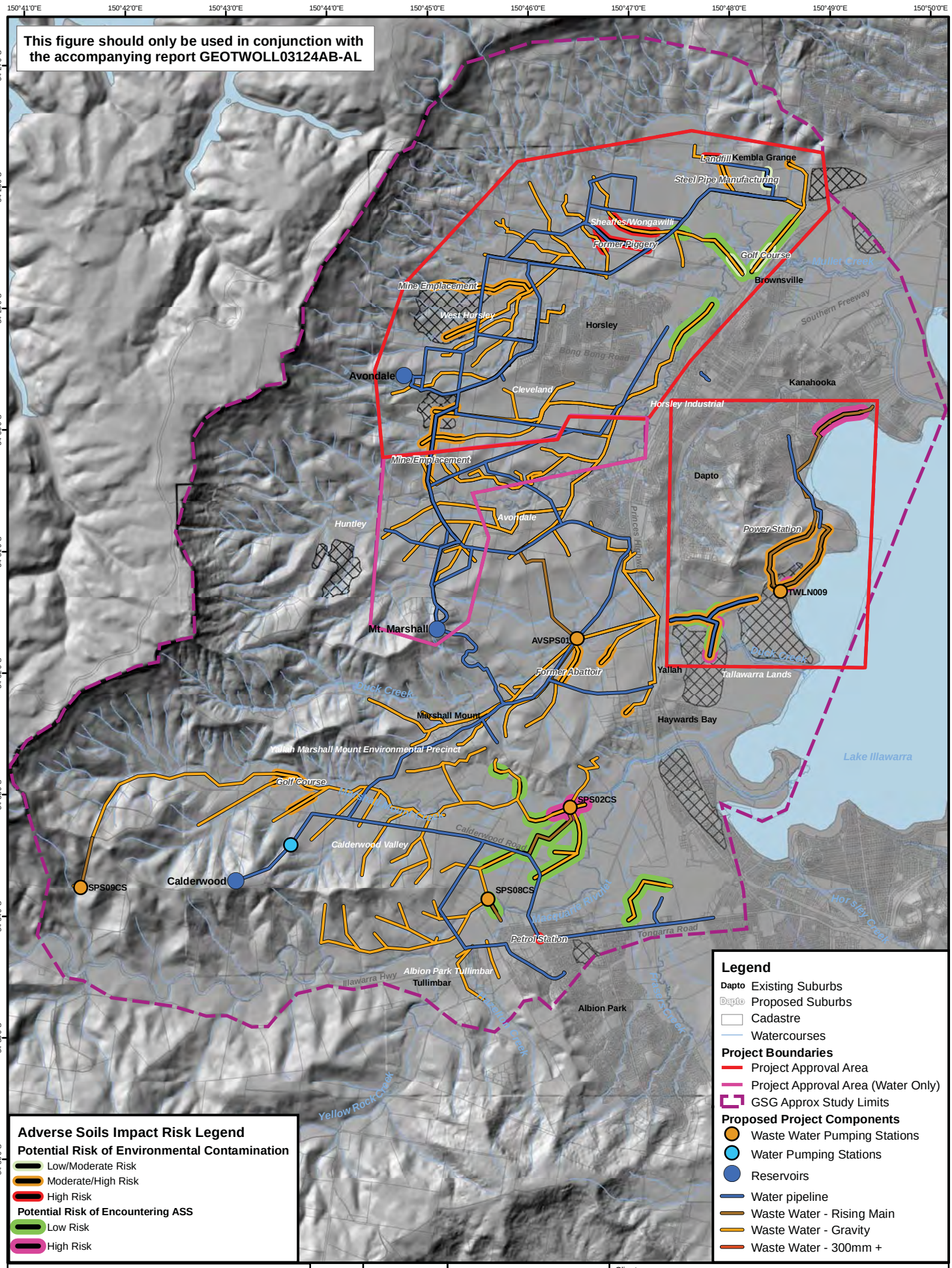
34°33'0"S
34°34'0"S
34°35'0"S
34°36'0"S
Kembla Grange
Kembla Grange
Sheaffes/Wongawilli
West Dapto Road
Brownsville
Miller Creek
Southern Freeway
West Horsley
Horsley
Bong Bong Road
Avondale
Cleveland
Kanahooka
Horsley Industrial
Dapto
Huntley
Avondale
Princes Highway
TWLN009
Mt. Marshall
AVSPS01
Yallah
Tallawarra Lands
Duck Creek
Marshall Mount
Haywards Bay
Yallah Marshall Mount Environmental Precinct
Lake Illawarra
SPS02CS
Calderwood Road
Calderwood Valley
T, W, L
SPS09CS
Calderwood
SPS08CS
Marquets Road
Horsley Creek
Albion Park Tullimbar
Tullimbar
Illawarra Hwy
Albion Park
Legend
Dapto Existing Suburbs
Dapto Proposed Suburbs
Cadastre
Watercourses
Project Boundaries
Project Approval Area
Project Approval Area (Water Only)
GSG Approx Study Limits
Proposed Project Components
Waste Water Pumping Stations
Water Pumping Stations
Reservoirs
Water pipeline
Waste Water - Rising Main
Waste Water - Gravity
Waste Water - 300mm +
Adverse Geomorphology and Landform Impact Risk Legend
Contributing Risk Factors
Soil Erodibility
High or Very High Soil Erodibility
Steep Slopes (degrees)
0 - 10
>10
Site-Specific Contributing Factors
Fill
Landslide
Topographic (Steep Slopes)
Watercourse
Landslides: Potential Impacts on Slope Stability
High or Very High Risk of Landslide Activation/Trigger
Potential Impacts on Watercourses
Potential Risk of Watercourse or Riparian Corridor Impact
Creek Crossings within Project Approval Area: Very High Risk of Impact
Potential Topographic Impact
High Risk of Semi-Permanent Topographic Alteration
Potential Geomorphological Impact
Moderate Risk
High Risk
Very High Risk
km
0 0.5 1 1.5 2
N
W E
S
Projection: MGA Zone 56
Source of data:
1. Potential risk of impact assessed by Coffey
2. Landslide and soil erodibility susceptibility based on Kiama 1:100,000 Soils Landscape Mapping
3. Contours and cadastre supplied by Sydney Water
4. All other data supplied by Wollongong and Shellharbour City Councils
Drawn LAE
Approved SM
Date May 10, 2011
Scale 1:75,000
Original Size A4
coffey geotechnics
SPECIALISTS MANAGING THE EARTH
Client Sydney Water
Project WDURA and AGA
Geology, Soils and Groundwater Assessment
Title Risk of Environmental Impact from Adverse Landform
Project No. GEOTWOLL03124AB
Figure No. Figure R1


This figure should only be used in conjunction with the accompanying report GEOTWOLL03124AB-AL
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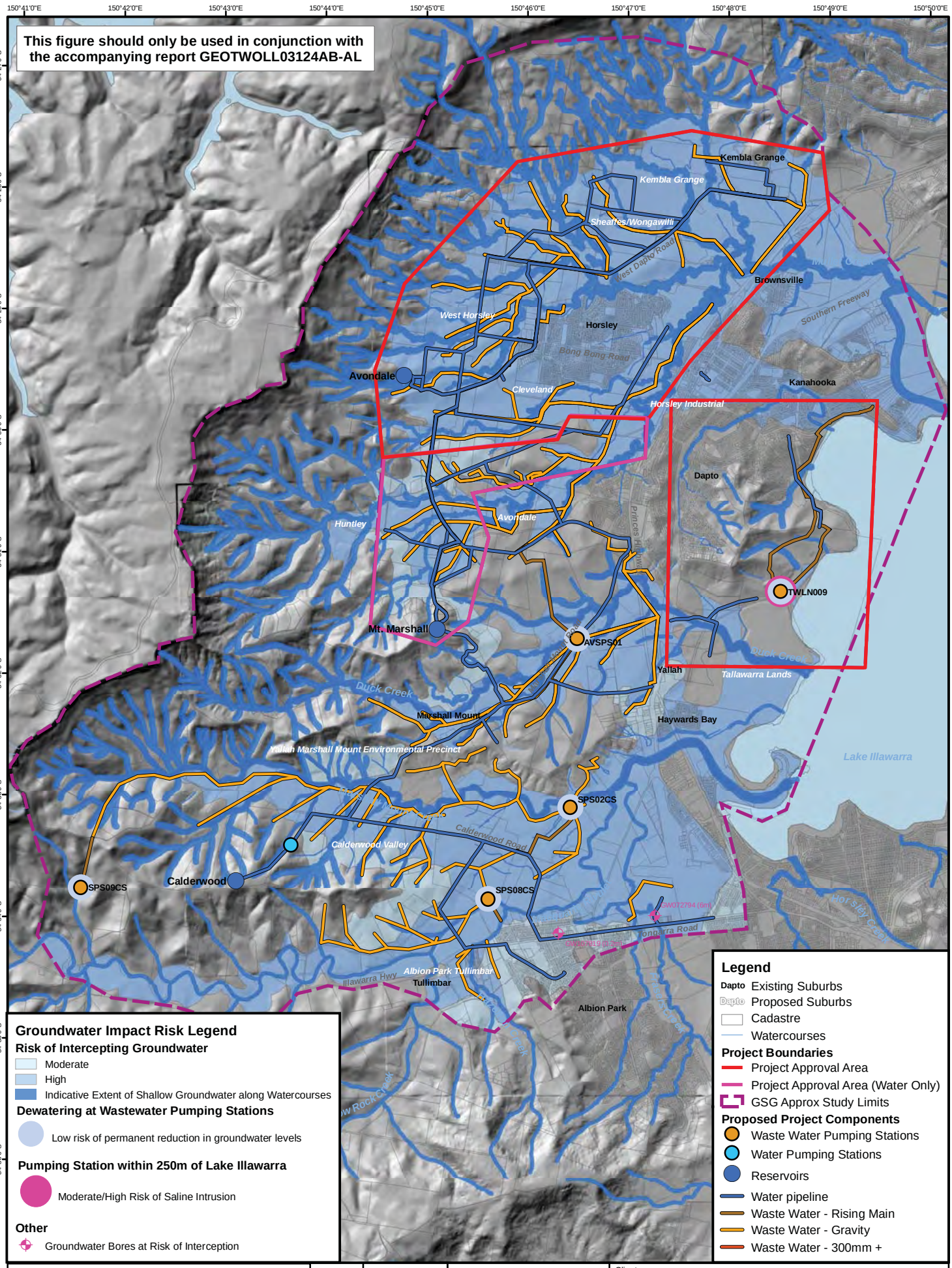
34°31'0"S
34°32'0"S
34°33'0"S
34°34'0"S
34°35'0"S
34°36'0"S
Landfill Kembla Grange
Steel Pipe Manufacturing
Sheahes/Wongawilli
Former Piggery
Golf Course
Brownsville
Mine Emplacement
West Horsley
Horsley
Bong Bong Road
Avondale
Cleveland
Kanahooka
Horsley Industrial
Mine Emplacement
Dapto
Huntley
Avondale
Princes Highway
Power Station
TWLN009
Mt. Marshall
AVSPS01
Former Abattoir
Yallah
Tallawarra Lands
Duck Creek
Marshall Mount
Haywards Bay
Yallah Marshall Mount Environmental Precinct
Lake Illawarra
Golf Course
SPS02CS
Calderwood Road
Calderwood Valley
SPS09CS
Calderwood
SPS08CS
Macquarie Rivulet
Petrol Station
Tongarra Road
Albion Park Tullimbar
Illawarra Hwy
Tullimbar
Albion Park
Yellow Rock Creek
Adverse Soils Impact Risk Legend
Potential Risk of Environmental Contamination
Low/Moderate Risk
Moderate/High Risk
High Risk
Potential Risk of Encountering ASS
Low Risk
High Risk
Legend
Dapto Existing Suburbs
Dapto Proposed Suburbs
Cadastre
Watercourses
Project Boundaries
Project Approval Area
Project Approval Area (Water Only)
GSG Approx Study Limits
Proposed Project Components
Waste Water Pumping Stations
Water Pumping Stations
Reservoirs
Water pipeline
Waste Water - Rising Main
Waste Water - Gravity
Waste Water - 300mm +
km
0 0.5 1 1.5 2
N
W E
S
Projection: MGA Zone 56
Source of data:
1. Potential risk of impact assessed by Coffey
2. Contours and cadastre supplied by Sydney Water
3. All other data supplied by Wollongong and Shellharbour City Councils
Drawn LAE
Approved SM
Date May 10, 2011
Scale 1:75,000
Original Size A4
coffey geotechnics
SPECIALISTS MANAGING THE EARTH
Client Sydney Water
Project WDURA and AGA
Geology, Soils and Groundwater Assessment
Title Risk of Environmental Impact from Adverse Soils
Project No. GEOTWOLL03124AB
Figure No. Figure R2


This figure should only be used in conjunction with the accompanying report GEOTWOLL03124AB-AL
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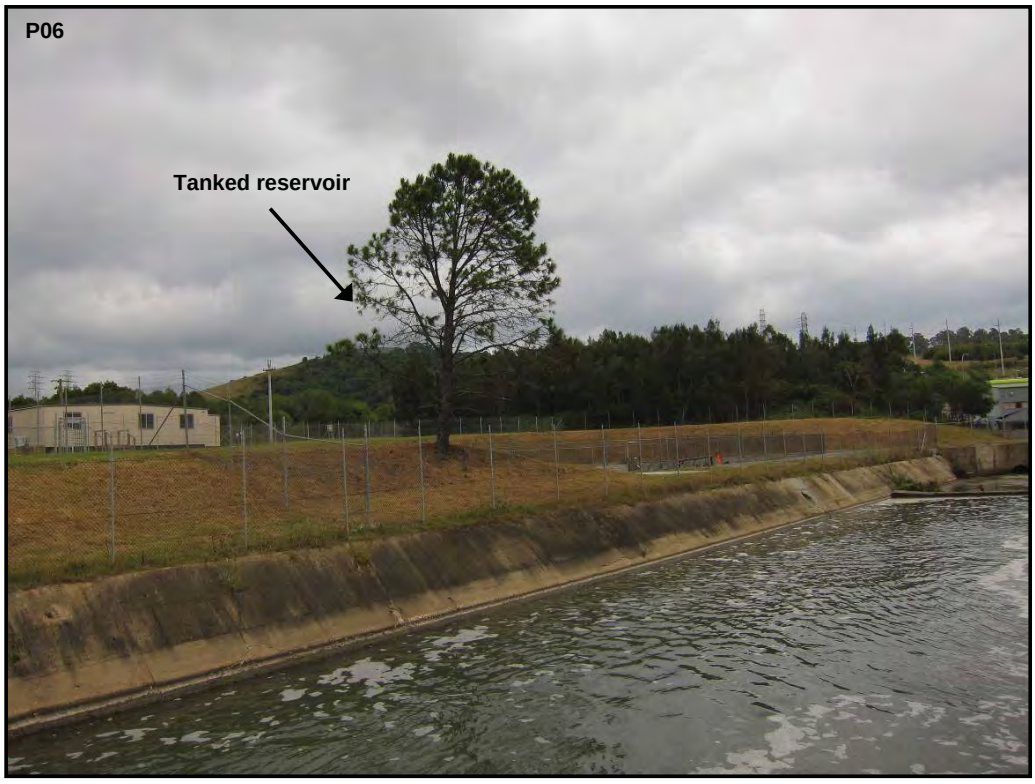
34°32'0"S
34°33'0"S
34°34'0"S
34°35'0"S
34°36'0"S
Kembla Grange
Kembla Grange
Sheaffes/Wongawilli
West Dapto Road
Brownsville
West Horsley
Horsley
Bong Bong Road
Southern Freeway
Avondale
Cleveland
Kanahooka
Horsley Industrial
Dapto
Huntley
Avondale
Princes Hwy
TWLN009
Mt. Marshall
AVSPS01
Duck Creek
Yallah
Tallawarra Lands
Duck Creek
Haywards Bay
Marshall Mount
Yallah Marshall Mount Environmental Precinct
Lake Illawarra
SPS02CS
Calderwood Road
Calderwood Valley
SPS09CS
Calderwood
SPS08CS
Albion Park Tullimbar
Tullimbar
Illawarra Hwy
Albion Park
Groundwater Impact Risk Legend
Risk of Intercepting Groundwater
Moderate
High
Indicative Extent of Shallow Groundwater along Watercourses
Dewatering at Wastewater Pumping Stations
Low risk of permanent reduction in groundwater levels
Pumping Station within 250m of Lake Illawarra
Moderate/High Risk of Saline Intrusion
Other
Groundwater Bores at Risk of Interception
Legend
Dapto Existing Suburbs
Dapto Proposed Suburbs
Cadastre
Watercourses
Project Boundaries
Project Approval Area
Project Approval Area (Water Only)
GSG Approx Study Limits
Proposed Project Components
Waste Water Pumping Stations
Water Pumping Stations
Reservoirs
Water pipeline
Waste Water - Rising Main
Waste Water - Gravity
Waste Water - 300mm +
km
0 0.5 1 1.5 2
N
W E
S
Projection: MGA Zone 56
Source of data:
1. Potential risk of impact assessed by Coffey
2. Groundwater depth based on Kiama 1:100,000 Soils Landscape Mapping
3. Contours and cadastre supplied by Sydney Water
4. All other data supplied by Wollongong and Shellharbour City Councils
Drawn LAE
Approved SM
Date May 10, 2011
Scale 1:75,000
Original Size A4
coffey geotechnics
SPECIALISTS MANAGING THE EARTH
Client Sydney Water
Project WDURA and AGA
Geology, Soils and Groundwater Assessment
Title Risk of Groundwater Impact
Project No. GEOTWOLL03124AB
Figure No. Figure R3

Appendix A

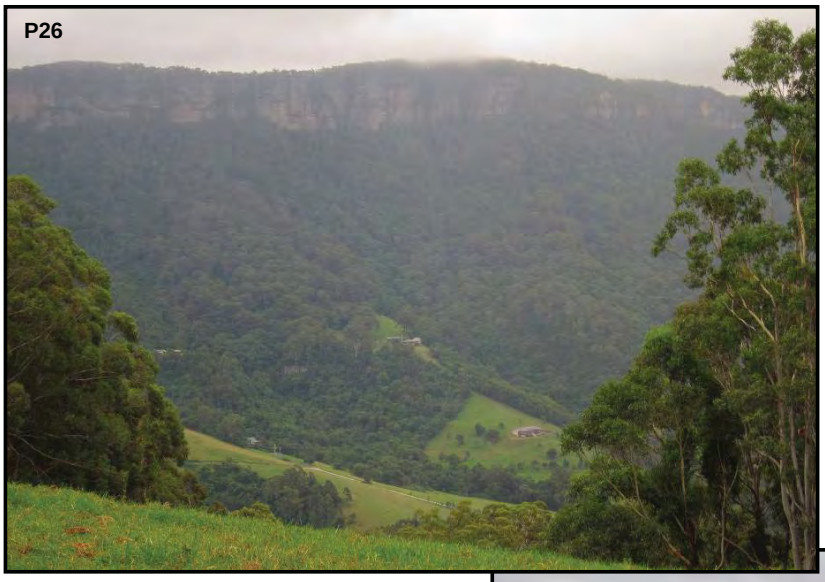
Site Visit Photographs

Tallawarra Power Station



View looking to the north from Tallawarra Power Station

drawn	**RH**	coffey geotechnics SPECIALISTS MANAGING THE EARTH	client:	**Sydney Water**
approved	**LAE**		project:	**WDURA and AGA Geology, Soils and Ground Water Assessment**
date	**10.05.2010**		title:	**Site 3: Tallawarra Power Station**
scale			project no.: GEOTWOLL03124AB-AL	figure no.: AB1
original size	**A4**			



Various views of the Calderwood Valley and surrounding slopes

drawn	**RH**	client:	**Sydney Water**
approved	**LAE**	project:	**WDURA and AGA Geology, Soils and Ground Water Assessment**
date	**10.05.2010**	title:	**Sites 6 & 8: Calderwood Valley A**
scale			
original size	**A4**	project no.: GEOTWOLL03124AB-AL	figure no.: AB2

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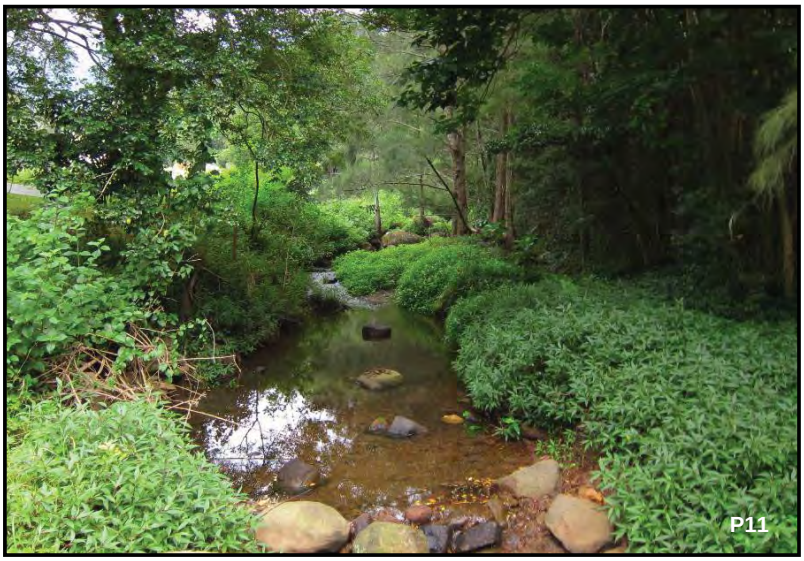
SPECIALISTS MANAGING THE EARTH

Right: View up-valley towards pumping station. Note steep slopes and incised gullies.

Left: Edge of steep valley slope



Right: Incised, boulder-filled creek eroding into hillside

drawn	**RH**	coffey geotechnics SPECIALISTS MANAGING THE EARTH	client:	**Sydney Water**
approved	**LAE**		project:	**WDURA and AGA Geology, Soils and Ground Water Assessment**
date	**10.05.2010**		title:	**Sites 5 & 6: Calderwood Valley B**
scale			project no.: GEOTWOLL03124AB-AL	figure no.: AB3
original size	**A4**			

Densely vegetated, steep side slopes above Calderwood Valley

Stepped land across slope above Calderwood Valley

drawn	**RH**	coffey geotechnics SPECIALISTS MANAGING THE EARTH	client:	**Sydney Water**
approved	**LAE**		project:	**WDURA and AGA Geology, Soils and Ground Water Assessment**
date	**10.05.2010**		title:	**Sites 7 & 8: Calderwood Valley C**
scale			project no.: GEOTWOLL03124AB-AL	figure no.: AB4
original size	**A4**			

River terraces in Calderwood Valley

View towards proposed location of Calderwood Reservoir

drawn	**RH**		client: **Sydney Water**
approved	**LAE**	coffey geotechnics SPECIALISTS MANAGING THE EARTH	project: **WDURA and AGA Geology, Soils and Ground Water Assessment**
date	**10.05.2010**		title: **Sites 9 & 10: Calderwood Valley C**
scale			project no.: GEOTWOLL03124AB-AL figure no.: AB5
original size	**A4**		

View of Marshall Mount Creek showing sinuous, deep incision of creekline and river terracing

Left: View towards Albion Park

Right: View along steep ridgeline to the west

drawn	**RH**		client: **Sydney Water**
approved	**LAE**	coffey geotechnics SPECIALISTS MANAGING THE EARTH	project: **WDURA and AGA Geology, Soils and Ground Water Assessment**
date	**10.05.2010**		title: **Sites 11 & 12**
scale			
original size	**A4**		project no.: GEOTWOLL03124AB-AL figure no.: AB6

Left: Looking towards Duck Creek wastewater pipeline alignment

Right: View down creek and across to Marshall Mt. & Cedars area. Creek has a poorly defined channel with pools and bars within clearly defined trench

Left: Creek crossing near wastewater pumping station

drawn	**RH**	client:	**Sydney Water**
approved	**LAE**	project:	**WDURA and AGA Geology, Soils and Ground Water Assessment**
date	**10.05.2010**	title:	**Sites 13, 14 &15**
scale			
original size	**A4**	project no.: GEOTWOLL03124AB-AL	figure no.: AB6

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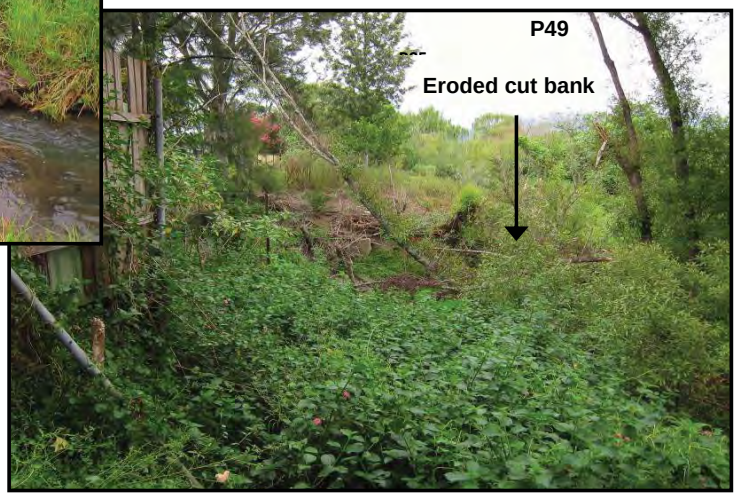
SPECIALISTS MANAGING THE EARTH

Above images: Cedars Estate



Above images: Creek behind Ena Road at wastewater pipeline crossing

drawn	**RH**		client: **Sydney Water**
approved	**LAE**	coffey geotechnics SPECIALISTS MANAGING THE EARTH	project: **WDURA and AGA Geology, Soils and Ground Water Assessment**
date	**10.05.2010**		title: **Sites 16 & 17**
scale			project no.: GEOTWOLL03124AB-AL figure no.: AB7
original size	**A4**		

Dimond skatepark off Bong Bong road showing floodplain

Wastewater alignment along creek showing floodplain and palaeochannels

drawn	**RH**	coffey geotechnics SPECIALISTS MANAGING THE EARTH	client: **Sydney Water**
approved	**LAE**		project: **WDURA and AGA Geology, Soils and Ground Water Assessment**
date	**10.05.2010**		title: **Sites 18 & 19: Floodplain**
scale			project no.: GEOTWOLL03124AB-AL figure no.: AB8
original size	**A4**		