CELEBRATING 40 YEARS 1982 - 2022

J. WYNDHAM PRINCE
CONSULTING CIVIL INFRASTRUCTURE ENGINEERS
& PROJECT MANAGERS

PO Box 4366
Penrith Westfield 2750
02 4720 3300
jwp@jwprince.com.au
www.jwprince.com.au

SUSTAINABLE CERTIFICATION ISO 9001 ISO 45001 ISO 14001

Our Ref: 110965.04-Westlink ST2 Trunk Drainage - Response to SW comments.docx
PJM:pjm

6 Oct 2023

ESR Australia

Level 24, 88 Phillip Street
Sydney, NSW 2000

Attn: Grace Macdonald

Subject: Westlink Stage 2 - Drainage Channel Works DA Design Plans (Council Ref: SSD-9138102)

Dear Grace,

We have updated the detailed concept design for the Westlink Stage 2 naturalised trunk drainage channel in close consultation with AT&L who have prepared DA stage design plans for the Stage 2 On Lot Civil Works Package. The Stage 2 Trunk Drainage design is presented in a set of concept engineering plans which should be referenced in conjunction with this letter (Ref: JWP Plan Numbers 110965-04-CD001-A to CD072-A)

An advance set of the DA plans (JWP Ref 110965-04 HSK01 - HSK05) was previously issued to Sydney Water for comment on (or soon after) 3rd August 2023 in support of a formal request from ESR to relocate the proposed naturalised trunk drainage channel to the northern boundary of Lot 3 in DP 250002. Sydney Water issued a letter providing in principle endorsement of the proposal on 28 August 2023. The letter contained a detailed list of stormwater related design and documentation requirements for the relocated channel. A copy of the Sydney Water letter is provided in Attachment A.

The engineering concept designs for the naturalised trunk drainage channel (Ref: JWP Plan Numbers 110965-04-CD001-A to CD072-A) were subsequently refined to address Sydney Waters' requirements. The design response to each of the matters raised is provided in Attachment B.

Should you have any queries regarding this matter please do not hesitate to contact me.

Yours faithfully

PETER MEHL

Director

encl:

Attachment A Sydney Water letter of in-principle endorsement for the proposed Stage 2 Channel realignment (28 Aug 2023)

Attachment B Design Response to the design and documentation requirements outlined by Sydney Water in their letter of 28 Aug 2023.

ATTACHMENT B

Sydney Water Requirements: as documented in Attachment 1 of their letter dated 28 Aug 2023 relating to the proposed Trunk Drainage Channel Realignment.

JWP comments on behalf of ESR are provided in Column 3

Item No	SW Requirements:	ESR Comment:
	This list defines what Sydney Water expect to be included in the SSD submission regarding the proposed realignment of trunk drainage. Additional documentation may be required during the assessment period.	The SW requirements generally represent the level of detail required to support both the concept and detailed design phases of the Trunk drainage elements. The responses below provide clarification on which parts would be addressed for the SSD DA purposes and which parts will follow during the Construction Approvals phase.
	Design Requirements	
1	Critical culvert levels should be obtained from TfNSW for the Mamre Road culverts and must be maintained as minimum levels and considered a design constraint unless otherwise agreed by TfNSW.	Strategic design stage culvert sizes, locations and levels were adopted for the DA stage design for the Westlink Stage 2 drainage channel in consultation with the Mamre Road and Abbotts Road intersection strategic design team and Transport for NSW. The strategic design option resulting in the highest culvert headwater level was adopted for the DA stage channel design.
2	The hydraulic performance of the Mamre Road culverts should be carefully assessed and may require a splayed entry do the angles surrounding the culvert. This should be assessed and the failsafe operation and potential overland flows for events greater than the design standard documented.	A hydraulic assessment of the Mamre Road culverts, including the Trunk Drainage Channel entry and exit arrangements and failsafe overflow operations was undertaken by AT&L in support of the Mamre Road and Abbotts Road intersection strategic design using the 12D Culvert Design tool. Details of this assessment are provided in **Attachment B1**. A Tuflow 2D assessment will be undertaken by JWP in support of the trunk drainage channel detailed design stage and this will confirm design performance.

Item No	SW Requirements:	ESR Comment:
3	Written in principle agreement is required from TfNSW and TransGrid regarding the potential realignment of the channel and culverts.	ESR is working with Transport for NSW on the delivery of the Mamre Road and Abbotts Road intersection as approved under SSD-9138102. The intersection is currently under design with TfNSW which has adopted this culvert location. The design specifications under this process will be resolved with consultation with Sydney Water and Transport for NSW. This DA reflects the design discussions to date. As updates occur under this process, the detailed design of this trunk drainage connection will be updated to reflect the updated levels prior to construction. ESR has reached out to Transgrid regarding the trunk drainage channel. At the time of lodgement, no correspondence has been received.
4	At this stage no response has been received with regard to utilising the maintenance track for access to the IOP but it is suggested that as a minimum you should seek appropriate advice from your tankering company to include their requirements in design of the maintenance path.	Following confirmation of the likely IOP tanker sizes and frequency of operations in consultation with Remondis, suitable swept path assessments for a 15m vehicle have been applied for the design shown in AT&L Plan 20-748-C6121. IOP related design has been undertaken in consultation with Aquatec. Also, refer to JWP plans 110965-04-CD012-B and AT&L plans 20-748-C6122 for details of the connection to Aldington Road.
5	Adequate forward entry and exit must be designed for regarding maintenance track east of Mamre Rd. For example, this could be through turning head or loop road.	An IOP facility is located adjacent to the trunk drainage channel at The Mamre Road end. Channel maintenance vehicles can utilise the IOP turnaround area until this is decommissioned, at which point a smaller permanent dedicated turning area is to be constructed. An outline of the permanent pavement alignment is indicated on JWP Plan 110965-04-CD011-B
	Drawing Requirements	
6	Proposed naturalised trunk drainage design must adhere to the design guidelines provided in Sydney Water's Draft Stormwater Scheme Infrastructure Design Guidelines (Dec, 2022).	Noted
7	The drawings for naturalised trunk drainage must demonstrate how the waterway integrates functionally into the surrounding development area and with existing surface levels downstream of the development site.	The DA stage Trunk Drainage plans (JWP Ref: 110965-04-CD001 to CD072-A) include existing site contours on adjoining lands, indicative batter and retaining wall extents on plans and a Typical Channel Cross section that demonstrates there will be a sensible interface to the existing/retained landforms adjacent to the channel (including in the future channel extension west of Mamre Road)
8	As the proposal affects alignment downstream of the site, all drawings (as specified below) must demonstrate functional design resolution of the full length of proposed channel realignment.	Refer to the note above.

Item No	SW Requirements:	ESR Comment:
	Plan drawings must show:	
9	• Alignment and relationship to adjacent development (including upstream and downstream of the subject site)	The DA stage, Stage 2 Drainage Channel works plans (JWP Ref: 110965-04-CD001- CD072-A) address this requirement
10	• Corridor width per the Mamre Rd Precinct Stormwater Scheme Plan.	The Scheme plan nominates a corridor width of 25m downstream of Aldington Road. A Channel formation width of 20m is proposed for Stage 2 consistent with the SW previously agreed 20 m channel width for Westlink Stage 1, noting that all other design objectives are achieved [Ref: **Attachment B2** - Westlink Stage1 Meeting Minutes (no 11) -12/7/23 - Item 5.1]. The peak 1% AEP (1 in 100 yr) flows upstream of Mamre Road are a maximum of 7.4 m^3/s at the Mamre Road end which are comfortably contained in a 20 m wide channel compliant with Sydney Water's Draft Stormwater Scheme Infrastructure Design Guidelines (Dec 2022). The details of the channel hydraulic performance are reported on JWP Plan No. 110965-04-CD040-B
11	• Low flow channel alignment showing sinuosity per guidelines.	The proposed channel sinuosity is indicated on the DA stage, Stage 2 Drainage Channel works plans (JWP Ref: 110965-04-CD001-CD072-A) and is compliant with Sydney Water's Draft Stormwater Scheme Infrastructure Design Guidelines (Dec 2022).
12	• Interface with any service utilities (note that sections must be provided where services intersect/run parallel within the trunk drainage corridor to demonstrate feasibility)	Indicative service locations, based on the concept designs that supported this infrastructure, have been included on the DA stage Stage 2 Drainage Channel works plans (JWP Ref: 110965-04-CD011-B and CD040-B).
13	• Indicative location of any proposed instream features e.g. Drop structures.	No drop structures or other instream features are required for the Stage 2 Drainage Channel.
14	• Location of proposed waterway crossings/paths/other social amenity features	No waterway crossings/paths/other social amenity features are currently proposed within the Stage 2 Drainage Channel corridor. At this stage, the Mamre Road and Abbotts Road strategic concept design does not provide for any pedestrian or cycle link along the eastern side of Mamre Road. Should one be proposed in the future, a short extension of the maintenance path would provide a suitable connection between Mamre Road and Aldington Road.
15	• Location of proposed access location and maintenance tracks including demonstration that max grades will not be exceeded.	The proposed access track and its connection to Aldington Road are indicated on the DA stage, Stage 2 Drainage Channel works plans (JWP Ref: 110965-04-CD001-CD072-A). Indicative design grades have been added to the plans to demonstrate compliance with SW requirements.

Item No	SW Requirements:	ESR Comment:
16	• Location of proposed stormwater connections to the naturalised trunk drainage	Stormwater connections at the Aldington Road end of the channel and at the proposed OSD basin outlet for Stage 2, which is located approximately 50 m east of Mamre Road, are indicated on the DA stage, Stage 2 Drainage Channel works plans (JWP Ref: 110965-04-CD001-CD072-A). No other pipe connections are proposed for Stage 2.
17	• Location and spot heights of any retaining wall structures proposed along the corridor (these are to be minimised).	The channel inlet and outlet headwall locations and a section of retaining wall along the northern boundary with Lot 2 are indicated on the DA stage, Stage 2 Drainage Channel works plans (JWP Ref: 110965-04-CD001-CD072-A). Spot Heights have been added to these walls for clarity. The Large Format Industrial "sheds" to be constructed on either side of the channel will likely require substantial walls to be constructed just outside of the drainage easement as indicated on the typical channel section (Ref: JWP Plan 110965-04-CD040-A)
	Cross sections:	
18	• Cross sections of the trunk drainage channel to demonstrate the functional placement of the feature in the developed landscape, including adjacent property where the boundary is shared.	The DA stage Trunk Drainage plans include existing site contours on adjoining lands and indicative batter and or wall extents on plans. A series of Channel Cross sections at a 15 m spacing along the channel are indicated on JWP Plan No.'s 110965-04-CD050 and CD051-A. The cross sections demonstrate that there will be a sensible interface to the existing/retained landforms adjacent to the channel.
19	• Cross sections should generally be provided at approximately 100m intervals or as required to highlight significant changes in site grades, alignment and any atypical situations.	Trunk Drainage Channel Cross Sections have been provided at 15 m intervals along the Stage 2 Channel Corridor and are indicated on JWP Plan No's 110965-04-CD050 and CD051-A
20	• Cross sections should show 'worst case situations' e.g. where retaining walls are unavoidable/highest point of a proposed retaining wall.	The channel cross sections discussed in Item 19, provide suitable details along the channel corridor to demonstrate the complete design interface on the channel boundaries.
21	• Where necessary, cross sections should also be provided where services are proposed across the channel	The only proposed service crossing of the trunk drainage channel is a gravity sewer at channel chainage 315 near Mamre Road. This is indicated on the channel profile (JWP plan No 110965-04-CD040-B). And is well clear of the channel formation.
22	• Cross sections must extend beyond the channel boundaries to show the proposed interface with development adjacent the trunk drainage corridor.	The DA stage, Stage 2 Drainage Channel works plans (JWP Ref: 110965-04-CD001-CD072-A) meet this requirement.

Item No	SW Requirements:	ESR Comment:
23	• Where the proposed channel is higher than adjacent land details will be provided to demonstrated how this land will be drained without causing artificial ponding on the land.	The trunk drainage channel profile indicated on JWP Plan No 110965-04-CD040-B demonstrates that the channel formation is slightly higher than the existing levels on Lot 2, on the channel's northern side, for a distance of approximately 80 m. A small retaining wall with a maximum height of 0.5 m is proposed to ensure channel flows do not break out onto Lot 2. The existing site contours in this area demonstrate the land drains directly to Mamre Road to the west and, as a consequence, the small wall will not create trapped low points that cause ponding on Lot 2.
24	• Cross sections must show adherence to the typical detail for naturalised trunk drainage (compound channel) as provided in Appendix A of the Draft Stormwater Scheme Infrastructure Design Guideline (Dec, 2022).	The typical channel cross section (Ref: JWP Plan 110965-04-CD040-B) included in the DA stage, Stage 2 Drainage Channel works plans meet this requirement.
	Long sections:	
25	• Long sections of trunk drainage channel inverts and top of bank along each reach that demonstrate adherence to max grades and/or inclusion of drop structures as required.	The DA stage, Stage 2 Drainage Channel works plans (JWP Ref: 110965-04-CD040-B) meet this requirement.
26	• Long sections must demonstrate tie in with critical points i.e. existing grades at upstream and downstream points of the development.	The DA stage, Stage 2 Drainage Channel works plans (JWP Ref: 110965-04-CD040-B) meet this requirement. Indicative Mamre Road culvert levels have been adopted at the DA stage for the Westlink Stage 2 drainage channel in consultation with the Mamre Road design team and TfNSW (refer to comments at Items 1 and 2 for further details).
27	• Long sections should include any proposed major infrastructure crossing or parallel with trunk drainage within the corridor.	The DA stage, Stage 2 Drainage Channel works plan (JWP Ref: 110965-04-CD040-B) meets this requirement.
28	• Pipe longsections for lines connecting to the trunk drainage channels.	A pipeline longitudinal section for the connection of the proposed OSD basin to the Trunk Drainage Channel was developed in collaboration with AT&L and is provided on JWP Plan 110965-04-CD060-A. It demonstrates that the OSD basin is hydraulically independent of the trunk drainage channel.
	Modelling Requirements	
	Hydrologic Modelling	

Item No	SW Requirements:	ESR Comment:
29	Sydney Water modelling indicates the peak 1% AEP as 4.3 m3/s at the upstream end of the channel and 5.1 m3/s at the Mamre Road culverts. Unless modelling indicates higher flowrates, these values shall be used as the peak flows for channel design.	AT&L hydrologic modelling (Ref AT&L Stormwater Management Strategy Report: R009-02-20-748 confirms that 1% AEP post development flows are 4.9 m^3/s at the upstream end of the channel and 6.5 m^3/s at the Mamre Road culverts. For DA design purposes the more conservative pre-development 1% AEP flow rate at Mamre Road of 7.4 m^3/s has been adopted in the design of the trunk drainage channel.
30	Acceptable digital hydrologic methods are runoff routing, storage routing and time area models such as XP-Rafts, RORB, WBNM and Drains (ILSAX). Use of the Rational Method is not appropriate.	AT&L utilised a DRAINS model adopting RAFTS hydrological routing methods for the hydrological assessment adopted for the Stage 2 Drainage Channel design. (Ref AT&L Stormwater Management Strategy Report: R009-02-20-748)
31	ARR2019 methodology and rainfall data shall be used to assess the 5%, 1%, 0.2% AEP and PMF flowrates, although when assessing the function of the low flow channel more frequent storm events will be required. This can vary, depending on location in the catchment but will typically fall between the 12EY and 4EY critical events.	ARR2019 methodology and rainfall data were used to assess 5% and 1% AEP flow rates for the DA stage channel designs (Ref AT&L Stormwater Management Strategy Report: R009-02-20-748). The 1% AEP flow rate dictates channel form and performance. The additional storm events specified will be assessed in support of the detailed design stage for the channel.
32	Use IL/CL loss model Rural Pervious IL 37.1mm CL 0.94mm Developed Pervious IL 14.8mm CL 0.94mm Impervious (All) IL 1.0 mm CL 0 mm	The SW-nominated Initial and continuing loss rates were adopted in the hydrological modelling that supports the trunk drainage channel design (Ref AT&L Stormwater Management Strategy Report: R009-02-20-748).
33	Where the time of concentration is required, the minimum time is 5 minutes with a maximum of 20 minutes, noting that times over 14 minutes will require justification. Use of the Kinematic Wave equation is limited to flow paths no longer than 30m and shall be over surfaces that are homogeneous in surface and grade.	The SW-nominated parameters were adopted in the hydrological modelling that supports the trunk drainage channel design (Ref AT&L Stormwater Management Strategy Report: R009-02-20-748)
34	Accurately drawn catchment sketches will be provided that show the natural catchments with the developed catchment overlaid, with clear definition between them. Each catchment area and changes between natural and developed to tabulated on the sketch.	Existing and Developed catchment plans for the catchments that encompass the proposed Stage 2 trunk drainage channel are indicated on AT&L Plans 20-748-C5061-D and 20-748-C5065-D respectively. In addition, the AT&L Stormwater Strategy Report: R009-02-20-748) tabulates and compares existing and developed catchment areas

Item No	SW Requirements:	ESR Comment:
35	To facilitate effective operation of the Scheme Plan, wetlands and storage ponds catchments cannot be varied by more than ±10% of their area as shown in the Sydney Water wetland catchments layer.	The catchment area redistributions arising from the Westlink development were identified and reported to Sydney Water at the Stage 1 trunk drainage channel design stage. The proposed redistribution was endorsed by Sydney Water on 30/6 (Ref: **Attachment B2** - Westlink Stage1 Meeting Minutes (no 11) -12/7/23 – Item 8]. Notwithstanding, the AT&L Stormwater Strategy Report R009-02-20-748 tabulates and compares existing and developed catchment areas and confirms that Sydney Waters requirement is achieved for the Stage 2
36	Critical 1% AEP hydrographs shall be provided at site upstream and downstream locations with the developed site hydrograph superimposed over the existing site hydrograph. Given the requirement of onsite stormwater detention, upstream developed catchment hydrographs cannot be assumed to match the natural hydrograph due to the additional volume of runoff discharge due to urbanisation. This information will be utilised in assessing any cumulative impacts of OSD.	This requirement is valid where pre-development catchments are directed to common floodways or culverts that are retained in the post-development circumstance for realistic comparison purposes. The existing landforms on the east side of Mamre Road south of Abbotts Road generally side slope to multiple small depressions and culverts that are to be consolidated into a few key concentrated trunk drainage points at Mamre Road. A comparison of pre and post-development flow hydrographs in these circumstances is not meaningful. Nevertheless, the Drains modelling undertaken by AT&L in support of the design demonstrates that post-development discharges at Mamre Road are similar to Sydney Waters specified 1% AEP peak flow rates. Note that long term volumetric considerations are already taken into account with the flow duration curves. (Ref AT&L Stormwater Management Strategy Report: R009-02-20-748).
	Hydraulic modelling	
37	The hydraulic operation of the trunk drainage system is important for the safety of the area being developed as well as for achieving the environmental, cultural and stream health benefits. Applying current best practice is a prerequisite to achieving sustainable and effective naturalised trunk drainage.	Agreed.
38	Before final endorsement of any proposal, all flow paths and channels shall be modelled using industry standard 1D/2D models refined to a suitable resolution to define flood flow extents and provide accurate shear force representations. Acceptable hydraulic modelling software is TUFLOW, HEC- RAS 2D and Mike-21. Other software may be permissible but should be referred to the Regional Stormwater Authority before establishing the model.	A hydraulic assessment was developed in support of the DA stage, Stage 2 Drainage Channel works plans (JWP Ref: 110965-04-CD040-CD076-A). This was undertaken using HEC RAS 1D to represent a typical portion of the channel. Details of this assessment are documented on JWP Plan 110965-04-CD040-B. A TUFLOW 2D assessment will be undertaken by JWP in support of the trunk drainage channel detailed design stage and this will confirm design performance.

Item No	SW Requirements:	ESR Comment:
39	It is recommended that initial channel sizing justification could be undertaken using basic Mannings models with reference to the standard drawings in the Draft Stormwater Scheme Infrastructure Design Guideline (Dec, 2022). This publication also provides acceptable channel roughness values, grades and sinuosity requirements.	Refer to the response at Item 38.
40	As a minimum, trunk drainage channels shall be modelled using 5%, 1%, 0.2% AEP and PMF critical flows of the developed catchment. As described above, additional frequent flows are required to assess shear forces within the low flow channels. Shear flow modelling is only required for the developed case with the whole channel assessed using the 5% and 1% AEP critical flows.	The hydrologic and hydraulic assessment developed in support of the DA stage, Stage 2 Drainage Channel works plans adopted 1% AEP flows for channel concept design purposes. The full range of storm events specified will be modelled at the trunk drainage channel detailed design stage to confirm design performance.
41	Drop structures must be supported by hydraulic modelling or calculations. Sydney Water's preferences are as follows:	No drop structures are required for the Stage 2 drainage channel.
42	• Chutes – Chute (eWater), Hec-Ras (1D) or industry standard rock sizing calculations for chutes.	Refer to the response at Item 41.
43	• Vertical drop structures - Hec-Ras (1D)	Refer to the response at Item 41.
44	Result mapping of the channels shall show:	The specified result mapping will be provided in support of the trunk drainage channel detailed design stage.
45	• flood extents and velocities for 1%, 0.2% AEP and PMF flood extents.	To be provided at detailed design stage
46	• flood planning area i.e. the area below the flood planning level.	To be provided at detailed design stage
47	• flood hazard and the flood constraints that apply to the land – utilising ARR 2019 hazard definitions.	To be provided at detailed design stage
48	• model topographical roughness mapping.	To be provided at detailed design stage
49	• where naturalised channels interface with major creek systems hydraulic categories shall be mapped to ensure mainstream flood conditions are not adversely impacted.	Not relevant to Westlink Stage 2
50	Climate change design flood modelling sensitivity analysis comparing the 0.2% AEP flood event as a proxy for assessing sensitivity to an increase in rainfall intensity of flood producing rainfall events due to climate change.	To be provided at detailed design stage. The channel cross-section and HEC RAS 1D assessment of the 1% AEP flood reported on JWP Plan No. 110965-04-CD040-B demonstrate the substantial capacity of the channel to convey significant additional flow. A 0.2% AEP flood is expected to be contained within the channel.

Item No	SW Requirements:	ESR Comment:
51	Street/site drainage, that connects to the trunk drainage, shall be modelled to ensure that it is not adversely impacted by 1% AEP critical flows in the trunk drainage channels. Points of connection shall be minimised with typical connection points on the downstream side of road crossings. On-grade pit inlet capacities should be carefully assessed as most "real life" kerb inlets have limited capacity, often not reflected in the curves provided in hydraulic models.	To be provided at detailed design stage A pipeline longitudinal section for the connection of the proposed OSD basin to the Trunk Drainage Channel was developed in collaboration with AT&L and is provided on JWP Plan 110965-04-CD060-A. It demonstrates that the OSD basin is hydraulically independent of the trunk drainage channel.

ATTACHMENTS

Attachment B1 Mamre Road and Abbotts Road intersection strategic design - 12D Culvert Design tool summary report. (Source AT&L)

Attachment B2 Westlink Stage1 Meeting Minutes (no 11) -12/7/23

12d Dynamic Culvert Analysis V14 (Build14.1.030)

Project: 23 1091 MRU Stage 2 Stormwater
Created: Thu Sep 7 10:34:57 2023
User: Roxanne.M
Generated by: 12D Model
Version: 14.0C2k

Culvert Data

	Culvert #1	Culvert #2
Model Name	--	--
StringName	--	--
Node Name	--	--
Link Name	--	--
Culvert Type	Box	Box
Culvert Inlet Type	No Inlet Control	No Inlet Control
Culvert Size	0.600 x 3.300	0.600 x 3.300
Culvert Cells	1.000	1.000
Culvert Length	60.000	60.000
Culvert US Invert	41.911	41.911
Culvert DS Invert	41.311	41.311
Culvert Slope	1.000	1.000
Culvert n	0.013	0.013
Culvert Entrance Loss	0.400	0.400
Culvert Exit Loss	1.000	1.000
Culvert Other Loss	0.000	0.000

Culvert Sediment	0.000	0.500
Culvert Choke	100.000	100.000

Weir Data

Weir Type	Roadway Overtopping
Weir Crest Level	43.558
Weir Max Depth	0.232
Weir Max Width	128.000
Weir Discharge Coeff	1.700
Weir Profile	Chainage Elevation

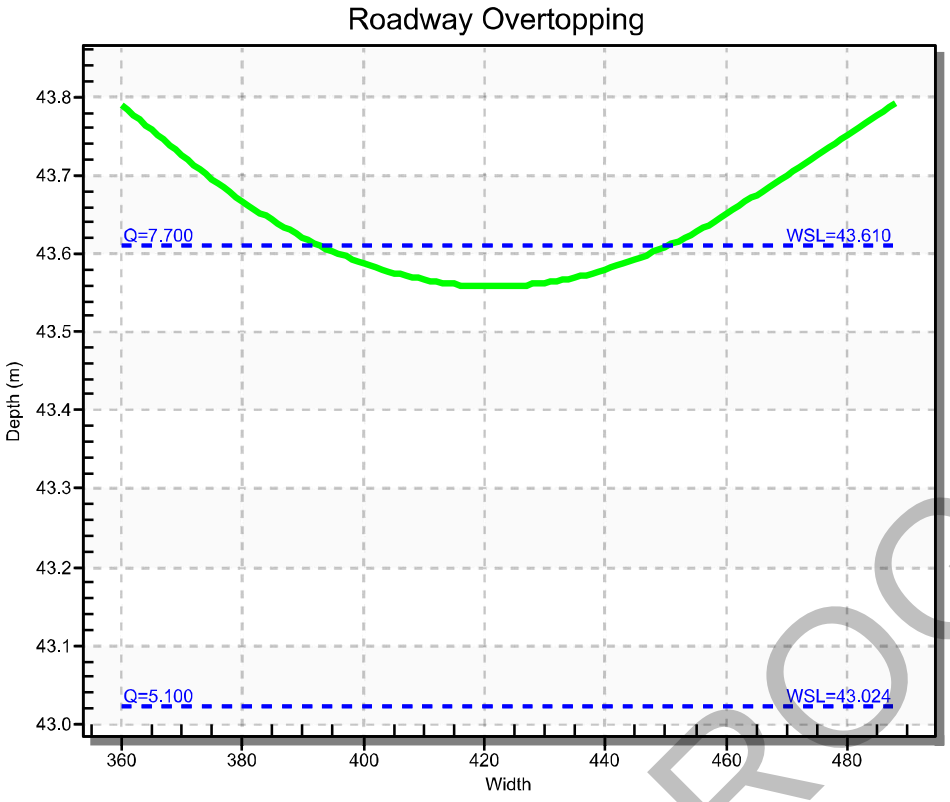
Width	Height
360.000	43.789
361.000	43.783
362.000	43.777
363.000	43.770
364.000	43.764
365.000	43.758
366.000	43.751
367.000	43.745
368.000	43.739
369.000	43.732
370.000	43.726
371.000	43.720
372.000	43.713
373.000	43.707
374.000	43.701
375.000	43.695
376.000	43.689
377.000	43.684
378.000	43.678
379.000	43.673

380.000	43.667
381.000	43.662
382.000	43.657
383.000	43.652
384.000	43.647
385.000	43.643
386.000	43.638
387.000	43.634
388.000	43.630
389.000	43.625
390.000	43.621
391.000	43.617
392.000	43.614
393.000	43.610
394.000	43.606
395.000	43.603
396.000	43.600
397.000	43.596
398.000	43.593
399.000	43.590
400.000	43.588
401.000	43.585
402.000	43.582
403.000	43.580
404.000	43.578
405.000	43.576
406.000	43.574
407.000	43.572
408.000	43.570
409.000	43.568
410.000	43.567
411.000	43.565
412.000	43.564
413.000	43.563
414.000	43.562
415.000	43.561

416.000	43.560
417.000	43.559
418.000	43.559
419.000	43.559
420.000	43.558
421.000	43.558
422.000	43.558
423.000	43.558
424.000	43.558
425.000	43.559
426.000	43.559
427.000	43.560
428.000	43.560
429.000	43.562
430.000	43.562
431.000	43.563
432.000	43.565
433.000	43.566
434.000	43.568
435.000	43.569
436.000	43.571
437.000	43.573
438.000	43.575
439.000	43.577
440.000	43.579
441.000	43.582
442.000	43.584
443.000	43.587
444.000	43.589
445.000	43.592
446.000	43.595
447.000	43.599
448.000	43.602
449.000	43.605
450.000	43.608
451.000	43.612

452.000	43.616
453.000	43.620
454.000	43.624
455.000	43.628
456.000	43.632
457.000	43.637
458.000	43.641
459.000	43.646
460.000	43.651
461.000	43.655
462.000	43.660
463.000	43.665
464.000	43.670
465.000	43.675
466.000	43.680
467.000	43.685
468.000	43.690
469.000	43.695
470.000	43.700
471.000	43.705
472.000	43.710
473.000	43.715
474.000	43.720
475.000	43.725
476.000	43.730
477.000	43.735
478.000	43.740
479.000	43.745
480.000	43.750
481.000	43.755
482.000	43.760
483.000	43.765
484.000	43.770
485.000	43.775
486.000	43.780
487.000	43.785

488.000	43.790



Tailwater Data

Tailwater Mode	Min(Yn, Yc)

Results: Design Flow = 5.100 (Actual Flow = 5.100)

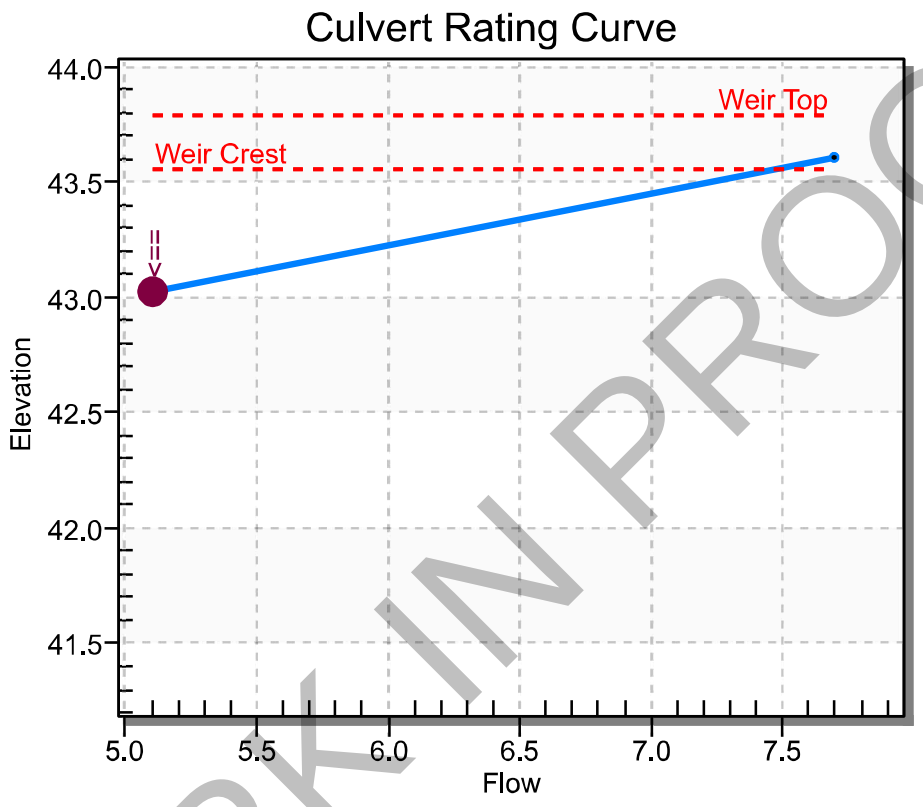
	Culvert #1	Culvert #2	Weir
Max US WSL	43.024	43.024	--
Max Flow	4.657	0.443	0.000
Qfull	6.110	0.340	13.7100
% full	76.0	131.0	0.0000
Depth	0.600	0.600	0.0000
d/D ratio	0.83	1.00	0.0000
Velocity	2.840	1.356	--
Flow Area	1.640	0.327	0.0000
Wetted Perimeter	4.294	5.731	--
Top Width	3.300	3.300	--
Froude No.	1.286	1.375	--

Critical Depth	0.588	0.100	--
Critical Slope	1.05	0.33	--
v^2/2g	0.411	0.094	--
Specific Energy	0.908	0.193	--
Normal Depth	0.394	0.098	--
Flow Type	--	S2	--
Control Type	Inlet	Outlet	--
Link HGL US	42.911	42.987	--
Link HGL DS	41.705	41.911	--
Depth US	1.000	1.076	--
Depth DS	0.394	0.600	--
Velocity US	2.35	1.34	--
Velocity DS	3.58	1.37	--
Top Width US	3.300	3.300	--

Results: Design Flow = 7.700 (Actual Flow = 7.700)

	Culvert #1	Culvert #2	Weir
Max US WSL	43.610	43.610	--
Max Flow	6.472	0.536	0.692
Qfull	6.110	0.340	13.7100
% full	106.0	159.0	5.0474
Depth	0.600	0.600	0.0520
d/D ratio	1.00	1.00	0.0260
Velocity	3.277	1.624	--
Flow Area	1.975	0.330	2.0140
Wetted Perimeter	7.537	6.800	--
Top Width	3.300	3.300	--
Froude No.	1.352	0.000	--
Critical Depth	0.600	0.100	--
Critical Slope	1.94	0.48	--
v^2/2g	0.547	0.134	--
Specific Energy	1.146	0.234	--
Normal Depth	0.597	0.100	--

Flow Type	--	--	--
Control Type	Inlet	Outlet	--
Link HGL US	43.393	43.557	--
Link HGL DS	41.911	41.911	--
Depth US	1.482	1.646	--
Depth DS	0.600	0.600	--
Velocity US	3.27	1.62	--
Velocity DS	3.94	1.62	--
Top Width US	3.300	3.300	--



Project Meeting Minutes

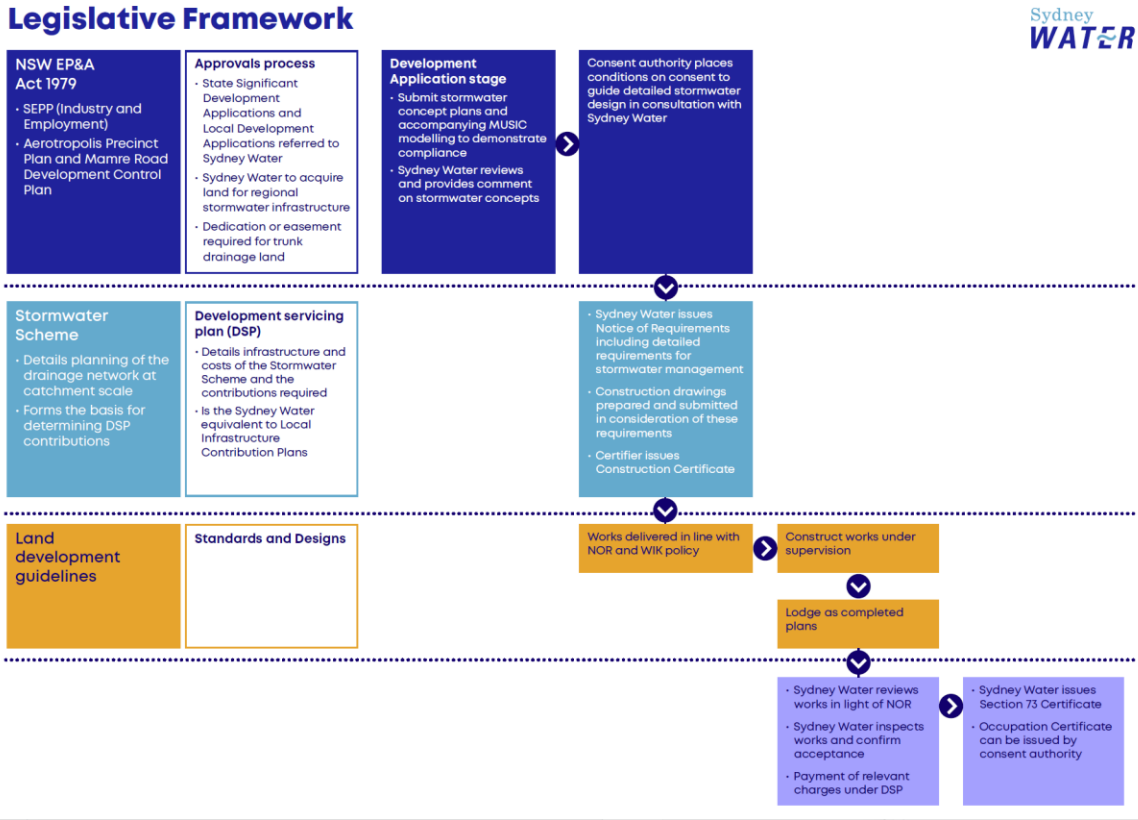
ATTACHMENT B2

Project name:	Westlink – Stage 1	**Meeting number:**	11
Purpose:	Trunk Drainage - Design Coordination with Sydney Water		
Date:	12/07/23	**Time: 9:00-9:30**	
Attendees:	Grace Macdonald, ESR (GM)	Jacob Dickson, ESR (JD)	
		Peter Gillam, Sydney Water (PG)	
	Daniel Cunningham, Sydney Water (DC)	John Molteno, Sydney Water (JM)	
	Lubna Thalib, Sydney Water (LT)	Peter Mehl, JWP (PM)	
		Daniel Gardiner, JWP (DG)	
Apologies:	Anna Thompson, Sydney Water (AT); Christian McNally, Sydney Water (CM); Daniel Galea, ESR (DG)		
Prepared by:	Daniel Gardiner		
Distribution:	As per attendees above plus:		

#	ITEM	ACTION	DATE
1.	**Interim Connection to Downstream Private Property**		
1.1.	Sydney Water advised ESR on 26/4 that there were three preferences: 1. Utilise existing open drainage swale next to Abbots Rd. - ESR Response: The Existing Driveway on Lot 2 sets the hydraulic control for the significant flows expected. Its lowest point is about 0.9 m above the likely channel invert so the channel will pond water in the interim unless there is a relieving pipe outlet. 2. Construct the ultimate natural drainage channel to Mamre Rd – Sydney Water to assist in negotiations with downstream landowner. – ESR advise that they have attempted to contact the downstream landowner on a range of matters including most recently on managing noise and vibration during construction and he refuses to communicate. In addition, the development condition requiring completed designs within 2 months precludes this approach. 3. A temporary Underground Pipe adjacent to Abbotts Rd to Mamre Rd. - ESR response: a large diameter pipe is already proposed as part of the Abbotts Road concept plans. We can easily cross-connect the channel to that system to avoid creating an interim pond in the channel. Given the constraints to Options 1 and 2. This is ESR's preferred option. AT requested that contact details of adjoining landowner to be provided by ESR. SWC questioned the need for a large pipe in Abbott Road running parallel to the future drainage channel. PM pointed out that the catchment flows currently surcharged onto the roadway and the new road designs prepared by AT&L for Abbots Road needed to provide for an oversized pipe system in the interim to comply with Safe Design requirements for these interim circumstances. AT advised that SWC had liaised with Council regarding the Abbotts and Aldington designs and supported the Option 3 pipe solutions provided that:		

	• there was certainty that the drainage work in Abbotts Road would progress at the right time to ensure there was a means of discharge when this was required. • the design documentation clearly demonstrated both the interim and permanent design solutions. • There was no potential for the proposed widening of Abbotts Road at the Adlington intersection to impinge on the Trunk drainage corridor. GM confirmed that the ESR's Stage 1 PC was conditional on the Abbotts Road upgrade being operational. Instrument to the Consent is linked in the minutes **here.** Conditions relating to road upgrades are Conditions B4 – B9. In addition, Developer side deeds were in place that would ensure all potential contingencies were covered to ensure this occurred. GM also confirmed that the Abbotts Road design already included an allowance for the intersection widening. SWC were to confirm the position with their Abbotts Road team and advise.	SWC	
2.	**Maintenance Path**		
2.1.	A separate maintenance only path is proposed on the north side of the channel. It is noted that a shared path will also be provided in the adjacent road verge for pedestrians and cyclists. This will allow the maintenance path to be graded more steeply to efficiently navigate the intended drop structures. A maximum Longitudinal gradient of 10% is proposed for the maintenance path. SWC confirmed 10% grade is fine for the access road along the channel. The maintenance road must be designed such that the long-term integrity is not compromised in wet weather conditions. (i.e. cement stabilisation may be required). TBC at a later stage of design. SWC requested the design consider whether the maintenance path could be moved north at the location of the drop structures to avoid having the retaining walls. JWP confirmed by email 7/6 that the batter slopes would likely need to be steeper than 1:3 to avoid having the maintenance track retaining wall.	JWP (Integrate into Design) Note	
3.	**Base Flow Channel**		
3.1.	It is proposed to adopt the 4EY flows in sizing the base flow channel. This is consistent with Sydney Waters advice to DPE on 20 Dec 2022. (as outlined in a letter from Stantec to AT&L dated 8/2/23) A maximum depth of 1 m is proposed for the base flow channel. Sydney Water confirms this low flow rate is fine to design to so long as the design can achieve a low flow meander per the design guidelines. Note that our design guidelines specify capacity to convey a **minimum** of 50% of the 12EY flow (appropriate for large catchments).	JWP (Integrate into Design)	
4.	**Drop Structures**		
4.1.	A maximum drop height of 0.9 m is proposed. The overall gradient of this portion of the channel is quite steep. Utilising the preferred 0.5 m drops will result in many more drops and associated rockwork and much less vegetated channel. SWC confirmed support for this approach	JWP (Integrate into Design)	
5.	**Channel Width**		
5.1.	Would a reduced channel with be permitted for Stage 1 if we can demonstrate that the flows are contained, and the design complies with the technical guidelines?		

	SWC was inclined to agree with a reduced channel width (down to a min 20 m) where flows permitted. SWC was currently reviewing the precinct hydrology modelling to confirm appropriate modelling parameters. To allow advancement of the channel design within the required timeframes for Stage 1: • SW (PG) provided details of the flows they had previously estimated at Aldington Road on 18/5. (Pre-development 1% AEP = 5.1 m^3/s at Aldington Rd) • AT&L prepared a brief summary letter outlining key hydrologic modelling parameters applied to the DRAINS modelling for Westlink and the stage 1 channel. GM issued this to SW on 15/5. • JWP confirmed the adoption of AT&L's pre-development 1% AEP flow estimates of 7.2 m^3/s at the western boundary for the design of the entire trunk drainage channel. • SW (JM) responded with initial comments by email on 25/5 to specific questions raised by AT&L relating to broader precinct scale hydrology for the Mamre Road Precinct. SW advised AT&L there would be further advice forthcoming on losses to be applied in the hydrological modelling. • JWP (DG) presented two alternate channel sections by email 5/6 that achieved a 20 m TD corridor width while complying with design arrangements agreed in principle (Option 8). Indicative cross sections of each option are provided in Attachment C. • SW to review and confirm the preferred Option. • SWC requested additional information on the 20m wide channel options, including overbank velocities for the establishment phase, channel profiles with additional profiles overlaid (Abbotts Road CL, boundary, maintenance track and channel banks) and preliminary hydraulic results. • JWP provided the additional information above along with 3D images of the channel profile. SWC to review and confirm the preferred option. • SWC agreed to the Option 1 20 m wide cross section at the meeting of 14/6/23.	JWP (Integrate into Design)	
6.	**Sydney Waters Role in Approvals**		
6.1.	Seeking more clarity on SWC's role in approvals of the drainage works at both DA and CC stages? Is there a different approach for TD /regional infrastructure (>15Ha) compared with works in the public road or on private allotments? It is noted that Sydney Waters Draft guidelines- *Drainage Management for Aerotropolis and Mamre Road Precincts (June 2022),* indicates that SWC will approve, inspect, and accept assets that are part of the Trunk Drainage scheme. (The previous diagrams presented in earlier issues of the minutes indicating a "Masterplanning Process" was confirmed by SW as not relevant to Mamre Rd Precinct) On 1/6/23 SW (email from AT to all stakeholders) advised: **DA stage** Consent authorities in the Aerotropolis initial precincts and Mamre Rd precinct are referring development applications to Sydney Water as the Regional Stormwater Authority for advice as to the adequacy of the application on any matters that impact on Sydney Water's regional scheme infrastructure or the ability for the Regional Scheme to achieve the Wianamatta Waterway health targets. This typically includes review of: - Stormwater catchment and drainage - Hydrologic and hydraulic modelling and reporting		

	- MUSIC modelling and reporting - On-lot non-potable water harvesting and re-use - On-lot facility for connection to the regional scheme - Street trees - GPTs - Any trunk drainage corridors including all connections and interfaces with the corridor - Any regional scheme wetland/pond basins including all connections and interfaces with the basins. **Post Consent** As per ESR's conditions of consent, design of stormwater management system including trunk drainage must be designed in consultation with Sydney Water (and other agencies listed). As per at DA stage, Sydney Water will provide advice as to the adequacy of the application on any matters that impact on Sydney Water's regional scheme infrastructure or the ability for the Regional Scheme to achieve the Wianamatta Waterway Health Targets. **Detailed Design/CC** – Sydney Water's involvement will be subject to the Works in Kind (WIK) procedure which is currently under development. As the ultimate manager of the trunk drainage asset Sydney Water approval will be required at key design development stages and throughout construction, completion and end of establishment. Sydney Water will continue to work with the proponent to develop the trunk drainage designs to Sydney Water's standards. Note that the developer will also need to apply for a Notice of Requirements for a S73 certificate which is a requirement of obtaining an occupation certificate. All Sydney Water requirements (which include requirements for wastewater, water, recycled water and stormwater) will need to be met before a S73 will be issued. It is also noted that the below diagram is the correct approvals process diagram for Mamre Rd Precinct	Noted	
			

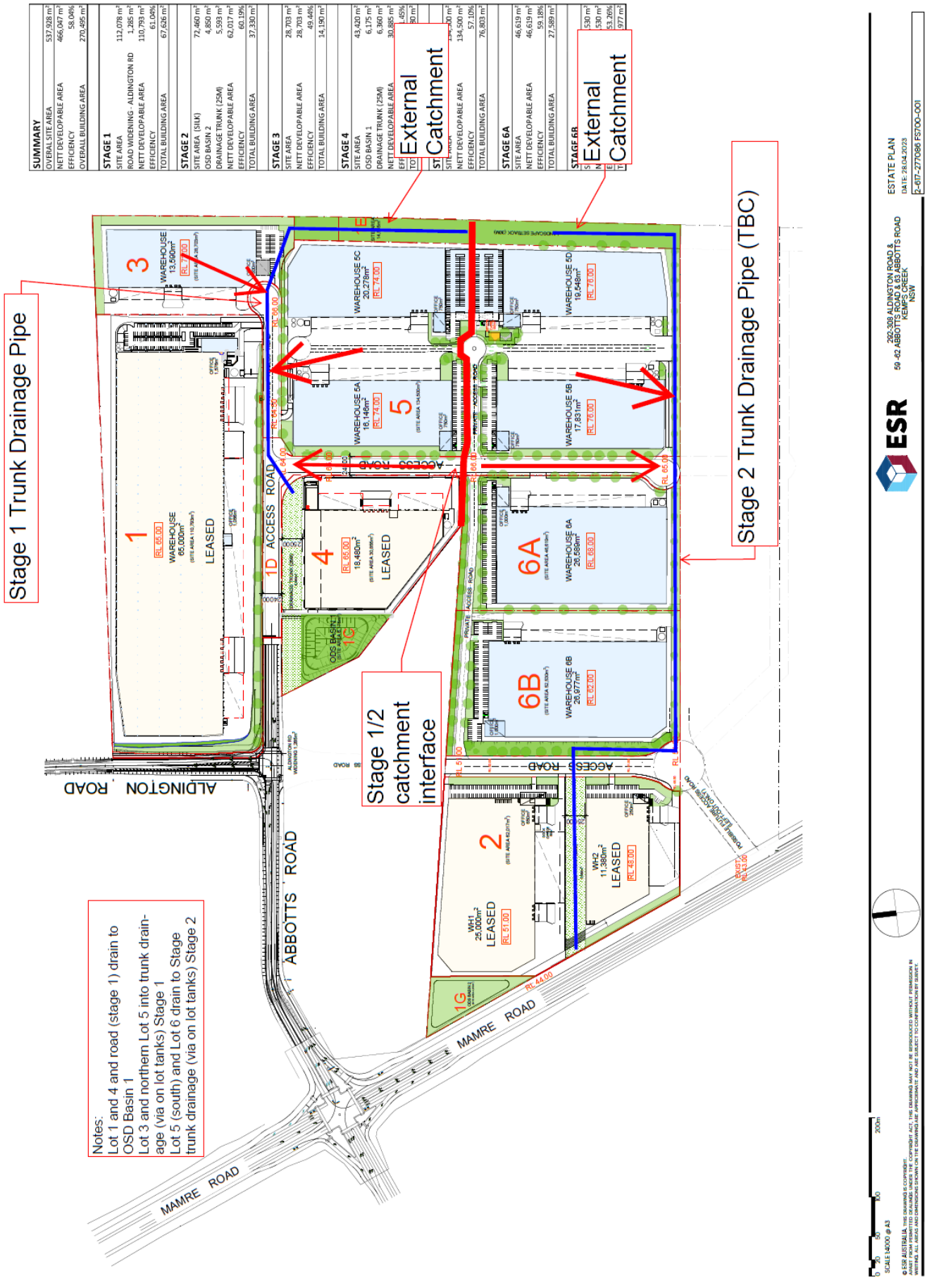
7.	**Westlink Broader Drainage Strategy**		
	JWP/ESR to outline the modified intent of the Stormwater management arrangements intended during subsequent development stages (i.e. 3 and 5) likely to drain into the Stage 1 drainage channel (OSD approach, external catchment management, pipe connections etc) On 24/5 JWP presented a sketch plan showing the current general arrangement for the remaining stages at Westlink. A copy of his sketch plan is provided in Attachment A. It should be noted that this plan is indicative only and may be adjusted to suit future specific development requirements.	Noted	
8.	**Catchment Redistribution**		
	Consistent with Sydney Waters verbal advice at the meeting of 17/4/23 ESR is proposing to redirect a maximum of 10% of the catchment areas discharging to each channel when compared to the post-development catchments detailed in the IWCM strategy. JWP issued an email and plan outlining intended catchment diversions on 18/5. On 24/5 SWC requested further details clarifying the treatment of the catchment in the NW corner of the Westlink site. JWP updated and reissued the plan to Sydney Water on 26/5. A copy of his sketch plan is provided in Attachment B. SW noted (AT email 30/5) that the proposed catchment redistribution exceeded the agreed 10% permissible limit but nevertheless confirmed that in this instance SW could facilitate the proposed change to catchments	Noted	

9.	**DA Stage Documentation/Deliverables**		
	The following DA stage Engineering documentation is proposed for the trunk drainage channel: On 1/6/23 AT advised a number of additional items that have been added to the list below in red text 1. Concept Engineering Design Drawings that provide details of the general arrangements of the channel including: a) Plans showing channel alignments, pipe drainage connections and /or discharge details, location of maintenance access paths and ramps, and adjacent existing and proposed infrastructure (including utility services) for the Channel from the eastern (upstream) end to a location that is 50 m downstream of the future Aldington Road extension. Provides details of the interim channel works needed to ensure a smooth transition onto the existing levels at the site's western boundary with Lot 2 in DP 25002. b) Channel profile(s) indicating pipe inlet, outlet and drop structure locations and confirming 12EY, 1 EY and 1% AEP flood/flow levels. c) Channel typical cross sections at key locations along the channel length that include indicative 12EY, 1 EY and 1% AEP flood/flow levels, proposed channel vegetation details (or reference to separate landscape plans) d) 3x cross sections as well showing relationship with any service crossings within the reserve. include retaining wall heights in cross sections etc. ensuring capture of maximum heights and extents of wall/height in plans e) General arrangements and sections for proposed culverts for any channel crossings, including maintenance access connections. f) Channel catchment plans. g) Pipe long sections for any pipe works within the trunk drainage reserve showing interface with street and lot drainage networks h) Typical rock drop structure details, and inlet and outlet structure general arrangements.		

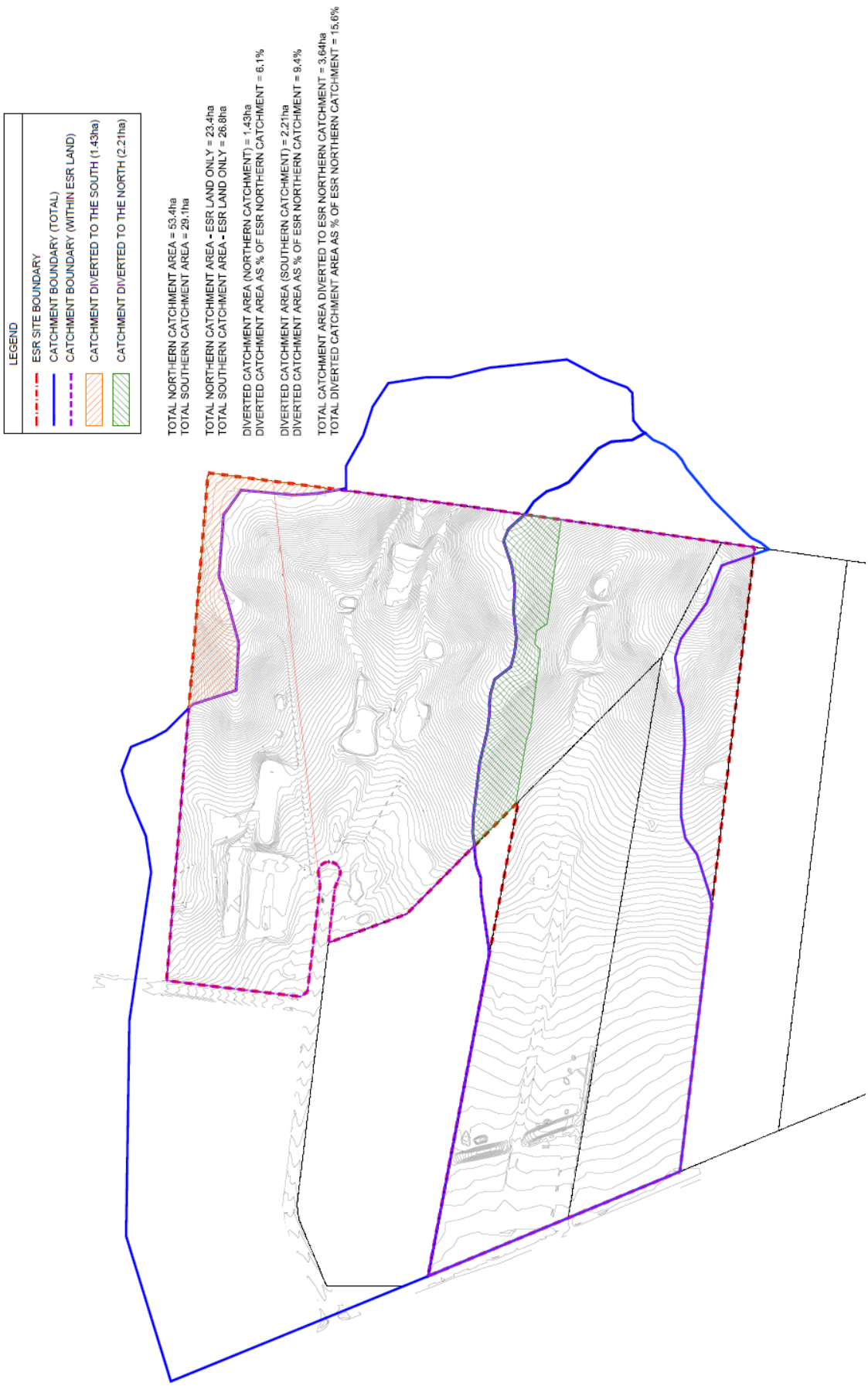
	i) Indicative sediment and erosion control plans for the channel works. j) adequate documentation of the ultimate scenario showing smooth connection to downstream future trunk drainage channel k) Note estimated required rock sizing in channel to handle the flows 2. A concept design report for the Stage 1 Trunk Drainage channel that: a) Provides details of the hydrologic and hydraulic modelling undertaken to support the design. (Note Page 43 of Sydney Water Design Guidelines for hydrograph and results documentation requirements). b) Provides a range of mapping from the 1D/2D hydraulic (Tuflow) modelling undertaken in support of the channel design that demonstrates flood depths, levels, velocities and shear stresses for the key design events (1%, 0.2% AEP and PMF events). c) Provide details of climate change and model roughness sensitivity assessments. d) Demonstrates consistency with Sydney Waters Stormwater Scheme Infrastructure Design Guidelines (DRAFT) and discusses any deviations from the guidelines and provides suitable justification for these. e) Discusses Safety in Design related risk assessments undertaken in support of the design. 3. Copies of the Hydrologic (DRAINS) and hydraulic (TUFLOW) modelling and results files developed to support the design. The design report, including the associated TUFLOW flood modelling will be progressed in support of the detailed design phase of the project. For concept design purposes JWP developed a generic HEC-RAS hydraulic model to help identify channel velocities and shear stresses and the key hydraulic parameters derived from this modelling was documented on the concept engineering plans.	JWP (detailed design Stage)	
10.	**Channel Design**		
	JWP presented an outline of the current design development and design options for the naturalistic drainage channel proposed for Stage 1 Application of the current SWC standard design template and adopting the approach of applying 0.9 m drop structures as previously discussed has led to the need for significant side retaining structures in lieu of batters. As this solution is not considered to be ideal, a range of additional channel solutions have been conceptualised for presentation and further discussion. Channel options presented included: (Concept profile, section and indicative hydraulic performance for each are attached to Minutes No 2)		

Option 1	SWC Standard Template and 0.9 regularly spaced drop structures – noting that substantial (up to 5 m high) retaining walls are required in lieu of batters.
Option 2	SWC template channel with vegetated batters on grade with Abbots Road (approx. 6.8%). Daylighting of inlet pipe further down the channel to avoid a deep rockwork trench. Full length rockwork lined base flow channel and vegetation only where velocities < 1.4 m/s. Vegetated batters on the Abbotts Road interface.
Options 3, 4 and 5	presented by JWP at the meeting but required extensive retaining walls in lieu of side batters, or a pipe to manage excess flows so were not progressed further.
Option 6	As for Option 2 but limiting maximum channel gradients to 5% and introducing five 0.5 m drops.

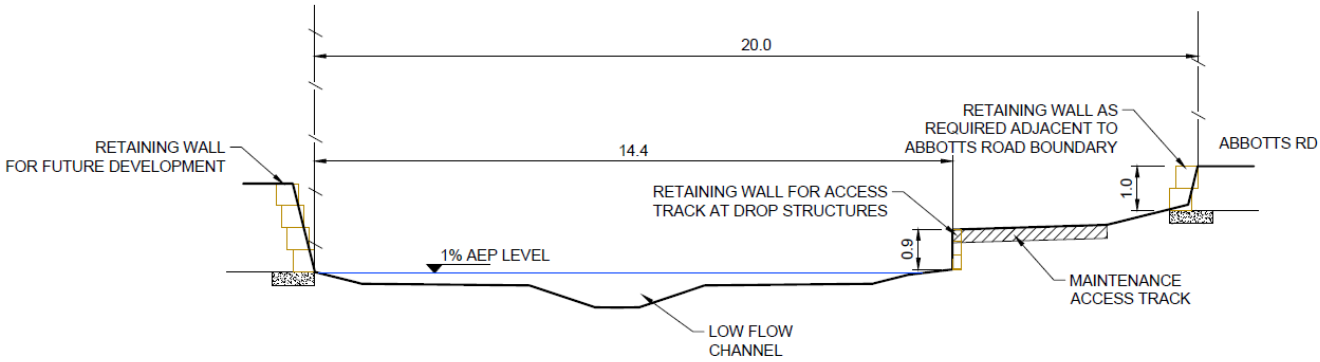
	It is noted that the options canvassed are site-specific solutions only and would not be applied to locations further downstream on this channel (nor on channels in future stages) where more reasonable channel gradients are possible. JWP discussed two refined variations of the Options based on Option 2 and a new Option 7 (as for Option 6 but with 2% max grades and 0.9 drops) at the meeting on 18/5. JWP refined these further based on Sydney Water feedback and assessed compliance against SW design parameters for the ultimate and establishment phases of the channel. Updated details were issued by email by PM on 22/5. (a copy is also attached to minutes No 3) SW (PG) raised concerns regarding Option 2 and the risks of erosion of the soil/rock interface associated with longitudinal grades of 6.8% on dispersive clays. SW confirmed maximum longitudinal grades of 2.0% would be acceptable. On 24/5 JWP issued an email to SW with updated details for "Option 8" which is a hybrid of Option 2 and Option 7 having max grades of 2.0%. A copy of his sketch plan is provided in Attachment C. SW confirmed acceptance of Option 8 in principle (AT email 30/5) and advised that at detailed & construction design stages, the channel must be designed to Sydney Water's specs which is currently under development. JWP (DG) issued Channel concept design plans to Sydney Water on 26/6/23. This was followed with a high-level concept design for the extension of the channel to Mulgoa Road on 27/6/23. SW (AT) provided minor comments back to JWP on 5/7/23 and after consultation with AT&L on the OSD basin channel interface updated designs were prepared and issued by JWP (DG) on 7/7/23. [JWP Ref: 110965-03-DD001-DD072] SW confirmed acceptance of the JWP concept plans for the naturalised trunk drainage channel at the project meeting of 12/7/23	Noted	
11.	**Final Outcome (Concept Stage)**		
	At the meeting of 12/7/23 Sydney Water confirmed: • Acceptance of the engineering concept design for the naturalised trunk drainage channel as depicted in JWP Plan Numbers 110965-03-DD001 to DD070. • Sufficient detail had been provided to allow progression of the bulk earthworks for Stage 1 (including the channel). • The concept design stage for the channel was complete. SW also advised that they were prepared to issue a letter to ESR confirming this position.	Noted SW by 17/7/23	



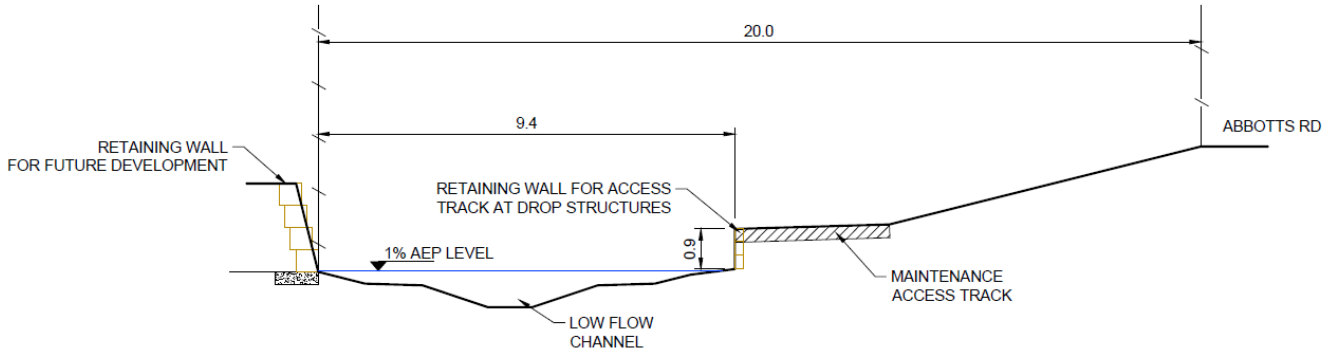
ATTACHMENT A - WESTLINK – INDICATIVE ESTATE PLAN



ATTACHMENT B - WESTLINK – CATCHMENT REDISTRIBUTION



20m WIDE CHANNEL CROSS SECTION - OPTION 1



20m WIDE CHANNEL CROSS SECTION - OPTION 2

ATTACHMENT C - WESTLINK – 20 m CHANNEL OPTIONS