

SJ58NE1448

PROJECT: WARRINGTON NEW TOWN

LOCATION: Acton Grange

GROUND LEVEL: 11.2 m

INCLINATION: Vertical

SCALE OF LOG 1 : 50

British Geological Survey

DIA. OF CASING: 154 mm. to metres

mm. to metres

DATE DRILLED: 31.3.71.

TYPE OF BORING: Shell and Auger

Reduced Level	Depth m	Legend	Sampling		Soil Description	Key to Laboratory Tests	Moisture Content and plot of Atterberg Limits			
			Type	Depth m			Percent			
							10	20	30	40
10.7	0.5	[Pattern]	D	0.5	TOPSOIL	Tx				
		[Pattern]	U4		CLAY - firm, brown, sandy					
		[Pattern]	D	1.0						
		[Pattern]	D	1.5						
9.2	2.0	[Pattern]	D	2.0		Tx				
		[Pattern]	U4		firm, brown, sandy, stoney					
		[Pattern]	D	2.5						
8.2	3.0	[Pattern]	S(30)	3.0						
		[Pattern]	D	3.5	SAND - red, fine/medium grained, dense					
		[Pattern]	D	4.0						
		[Pattern]			VGWL 4.15m					
		[Pattern]	S(30)	4.5						
		[Pattern]	D	5.0						
		[Pattern]	D	5.5						
		[Pattern]	D	6.0						
4.7	6.5	[Pattern]	S(4.5)*	6.5						
4.2	7.0	[Pattern]			SANDSTONE - hard, unweathered					
		[Pattern]			BOTTOM OF BOREHOLE					

Ground water encountered at 4.15m
Quantity

SHEET 1 OF 1

Borehole No. 369

Status
Draft 1



Norwest Holst Soil Engineering Ltd.

Borehole No.
2

Date 09/02/93

BOREHOLE LOG - CABLE PERCUSSION

Sheet 1 of 1

Contract No.	F9715	Method	Cable Percussion	Coords.	E 8,643.0
Project	River Mersey, Warrington	Drilling Rig	Mini Soils Probe		N 6,008.0
		Diameter	65mm	Ground Level	6.87
Client	NRA North West Region			Orientation	Vertical
Consultant	Manstock			Date Started	04/02/93
				Date Completed	04/02/93

SJ 68NW 894

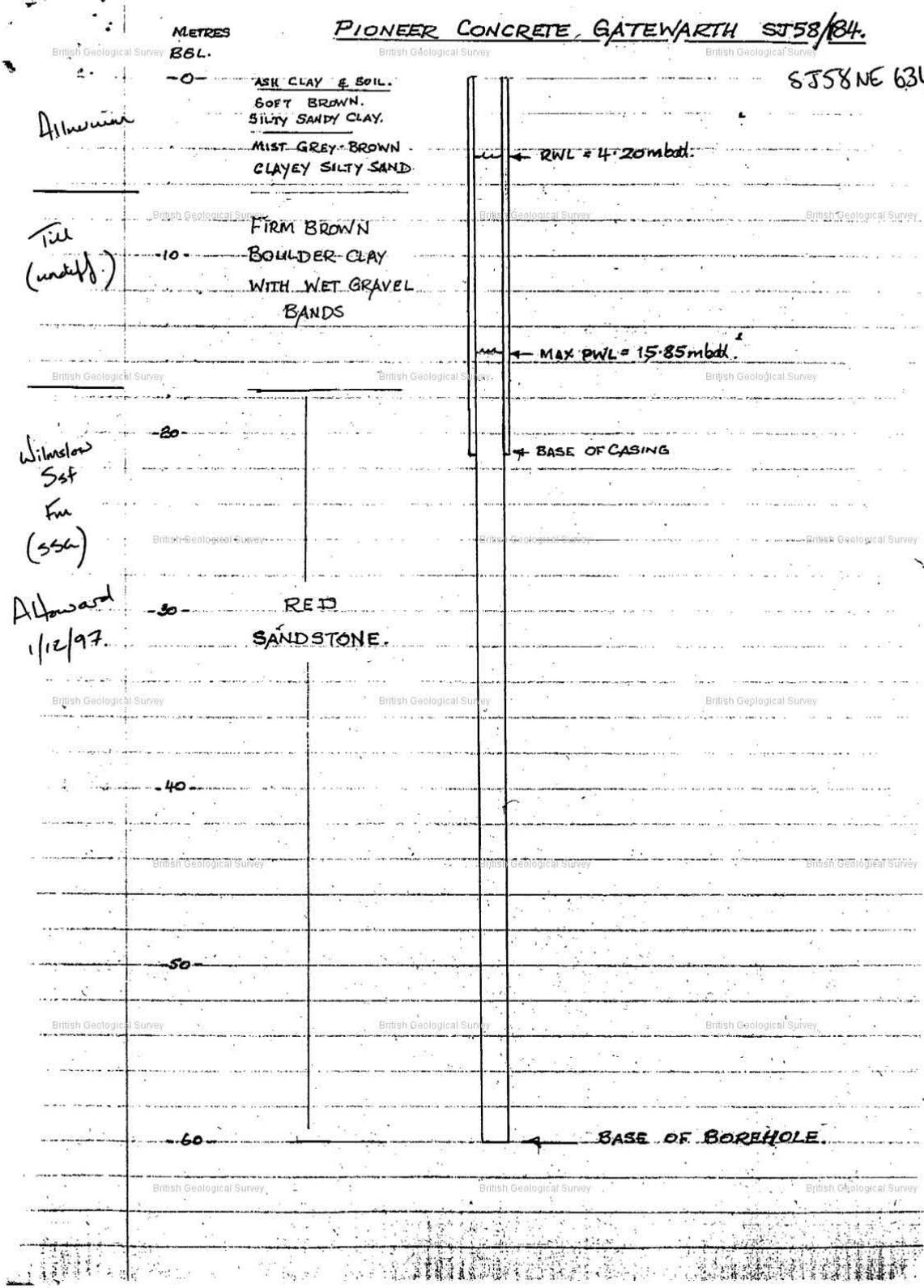
Description of Strata	Legend	Depth below G.L.	O.D. Level	Sampling	Casing Depth	() & "N"	Installation
Dark brown slightly clayey silty very sandy TOPSOIL with occasional fine gravel and many rootlets.		0.15	6.72	D 0.00 0.10			
MADE GROUND: Firm reddish brown silty clay mixed with brown medium sand with occasional ash.		0.60	6.27	D 0.40 0.50 DS 0.60 1.00		"3"	
MADE GROUND: Soft brown silty very sandy clay with occasional fine gravel and coal fragments.							
Soft light brown very silty sandy CLAY with occasional rootlets (damp).		1.60	5.27	D 1.60 2.20 S 1.80		"4"	
Soft grey very silty slightly sandy CLAY with organic odour and some fine gravel sized irregular pockets of black amorphous organic material		2.70	4.17	D 2.80 3.40 S 3.00		"3"	
— becoming very soft and wet with occasional thin lenses of amorphous organic material at 3.40m				D 3.40 4.00			
Borehole complete at 4.00m.		4.00	2.87				

REMARKS - See Header Sheet for:
Key to Symbols and abbreviations
Drilling Details, Progress and Water Strikes
General Notes

Form G112
Version 1.04
Revised 24.09.92

PIONEER CONCRETE, GATEWARTH SJ58/84.

SJ58 NE 634



SJ58NE1141

CABLE PERCUSSION RECORD SHEET		Borehole No. BHR5							
Location Warrington WwTW		Sheet 1 of 2.							
Job No. 7628/40		Project Ref: 3-21-48-188							
Equipment and methods light cable percussion		Drilled by GB							
Casing Diameter (mm) 150		Ground level 5.481 m AOD							
Casing Depth (m) 10.00		Co-ordinates E 1403.71 N 1059.60							
		Date 15/11/94							
STRATA SURVEYS LIMITED		558NE 5850 8691							
CASING DEPTH (m)	WATER DEPTH (m)	Field Records	SAMPLES / TESTS			Description	Depth & Thickness (m)	Reduced Level (m AOD)	Strata Legend
			Depth (m) from	to	SAMPLE Type & No				
		British Geological Survey	0.50	0.50	D 1	TOPSOIL	0.40		
1.20	dry	20 mins 1.15 15/11	1.20	1.65	U 1	Soft brown very silty CLAY	0.40	5.081	
1.70	dry	21	1.80	1.80	D 2		(2.20)		
			2.20	2.65	U 2				
		M1 2.60 15/11	2.60	2.60	V 1		2.60	2.881	
3.00	0.00	1.0-1.0,0.1	3.00	3.30	S 1	Loose medium dense below 6.00m grey brown silty fine to coarse SAND with a little fine to medium gravel	3.00		
			3.00	3.45	S 1				
4.00	0.00	1.2-2.1,1.1	4.00	4.50	U 2				
			4.00	4.45	U 2				
5.00	0.00	1.2-2.2,2.2	5.00	5.45	S 3				
							(5.40)		
6.00	0.00	2.3-3.2,2.3	6.00	6.45	S 4				
7.00	0.00	3.3-3.2,3.3	7.00	7.50	S 5				
			7.00	7.45	S 5				
8.00	0.00	3.4-5.5,4.4	8.00	8.50	S 6	Medium dense to dense brown slightly silty fine to coarse SAND with some to much fine to coarse gravel	8.00	-2.519	
			8.00	8.45	S 6				
9.00	0.26	4.6-6.7,8.10	9.00	9.50	S 7		(1.90)		
			9.00	9.45	S 7				
10.00	1.05	25/105-100/80	10.00	10.20	S 8	(Continued.....)	9.90	-4.419	
Remarks 1) Inspection pit 1.00m x 1.00m x 1.20m (1.25hrs) 2) Water strike at 2.60m rose to 1.15m in 20 minutes 3) Water added to borehole in granular strata to maintain head							Logged by MSW	Date 17/11	
British Geological Survey							Checked by		
British Geological Survey							Approved by British Geological Survey		
Scale 1:50							FIG No.		

BS 5400-Part 1: 1990, Table 10, -10/93, Rev 1

		CABLE PERCUSSION RECORD SHEET Location Warrington WWTW Job No. 7628/40				Borehole No. BHR5 Sheet 2 of 2.			
STRATA SURVEYS LIMITED		Equipment and methods light cable percussion Casing Diameter (mm) 150 Casing Depth (m) 10.00				Drilled by GB Ground level 5.481 m AOD Co-ordinates E 1403.71 M 1059.60 Date 15/11/94			
CASING DEPTH (m)	WATER DEPTH (m)	Field Records	SAMPLES / TESTS			Description	Depth Thickness (m)	Reduced Level (m AOD)	Strata Legend
			Depth (m) from	to	SAMPLE Type & No				
10.00	1.05	25/09/94-100/90 -(15711)-	10.00	10.20	S 8	975	10.20	-4.719	
						(...cont.) Red brown moderately weathered fine to medium grained SANDSTONE weak borehole continued by rotary coring			
Remarks							Logged by	Date	
							Checked by		
							Approved by		
Scale 1:50							FIG No.		

BS 1988-1994 part 1-10/93 88 8

SUB SOIL SURVEYS LTD.
MANCHESTER.

BOREHOLE No. 27

British Geological Survey

EXPLORATORY BORING RECORD

SSS&F 724
S957 8802

SITE Warrington

Ref.: 68/115

Boring Method Shell

Ground Level 23.50 O.D.

DATE	DIA. OF CASING & DEPTH BELOW G.L.	WATER LEVEL MORNING & EVENING	DEPTH OF STRATA BELOW G.L.	STRATA APPROX. SCALE 10 FT. TO ONE INCH	NO. OF SAMP.	TYPE OF SAMP.	PENETRATION OF SAMPLER OR CORE BARREL		NO. OF BLOWS	CORE RECOVERY
							FROM	TO		
2 12.68	8"	Nil	2'0"	Backfill						
			6'0"	Grey sand and gravel	1	O	5'0"			
					2	O	6'0"			
					3	O	11'0"			
					4	O	16'0"			
					5	O	17'0"			
					6	O	22'0"			
				Stiff brown sandy clay with stone inclusions	7	O	24'0"			
					8	O	29'0"			
					9	W	9'0"			
					10	O	34'0"			
			17'0"		11	X	37'0"	37'6"	100	
					12	O	41'0"			
			24'0"	Red silty fine sand becoming red fine-grained sandstone						
				Red and grey fine-grained sandstone						
2 12.68		29'	29'0"							
3 12.68		7'								
				Red fine-grained sandstone						
3 12.68	30'		41'0"							

Samples shown thus: Disturbed O. Undisturbed U. Standard Pen. Test X. Water W. Bulk B.

WATER STRUCK AT THE FOLLOWING DEPTHS	DEPTH OF CASING WHEN SEALED (N.S.—NOT SEALED)	ESTIMATED SEEPAGE	WATER ADDED AT FOLLOWING DEPTHS TO ASSIST BORING	WATER LEVEL IN CASED/UNCASED BOREHOLE ON COMPLETION		
				DATE	WATER LEVEL	DEPTH OF CASING
1. 20'0"	N.S.			7.12.68	7'0"	
2.						
3.						
4.						
5.						
6.						

REMARKS:
1) No initial 6" penetration for S.F.T. No: 11
11) Chiselling required in sandstone (7½ hours)

EXPLORATORY BORING RECORD SS88NE 725
S969 8799

SITE Warrington Ref.: 63/115
Boring Method Shell Ground Level 21.50 O.D.

DATE	DIA. OF CASING & DEPTH BELOW G.L.	WATER LEVEL MORNING & EVENING	DEPTH OF STRATA BELOW G.L.	STRATA APPROX. SCALE 10 FT. TO ONE INCH	NO. OF S-NP.	TYPE OF SAMP.	PENETRATION OF SAMPLER OR CORE BARREL		NO. OF BLOWS	CORE RECOVERY
							FROM	TO		
4.12.68	8"	N11		Brown and black silt and clay with ashes, etc FILL	1	O	5'0"			
			6'6"	Soft to firm grey sandy silt, clayey in parts	2	O	7'0"			
					3	O	11'0"			
					4	W	13'0"			
					5	O	13'0"			
					6	O	15'0"			
					7	O	20'0"			
			13'0"		8	O	25'0"			
				Grey silty sand and gravel	9	O	30'0"			
			14'6"		10	X	32'0"	32'6"	91	
				Red and grey fine sand becoming fine grained sandstone	11	O	37'0"			
			20'0"							
				Red fine-grained sandstone						
			31'0"							
				Red and grey fine-grained sandstone						
			37'0"							

Samples shown thus: Disturbed O. Undisturbed U. Standard Pen. Test X. Water W. Bulk B.

WATER STRUCK AT THE FOLLOWING DEPTHS	DEPTH OF CASING WHEN SEALED (N.S.—NOT SEALED)	ESTIMATED SEEPAGE	WATER ADDED AT FOLLOWING DEPTHS TO ASSIST BORING	WATER LEVEL IN CASED/UNCASED BOREHOLE ON COMPLETION		
				DATE	WATER LEVEL	DEPTH OF CASING
1. 13'0"	15'0"	slow		7.12.68	3'8"	
2. 12'0"	25'0"					
3. 27'0"	N.S.					
4.						
5.						
6.						

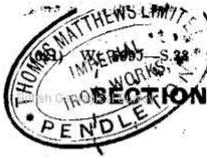
REMARKS:

1) No initial penetration for S.P.T. sample No: 10

11) Chiselling required in sandstone (4 1/2 hours)

SJ58NE1464

Sampling		Properties			Strata				
Depth	Type	Strength kN/m ²	w %	SPT N	Description	Depth	Level	Legend	
					TOPSOIL.	GL	11.4		
					MADE GROUND:- Dark grey silty sandy very sandy in places, clay with some fine grain- ed gravel.	0.10	11.3		
					MADE GROUND:- Loose brick and rubble with some sand and occasional wood.	0.45	10.9		
					End of Trial Pit.	1.20	10.2		
						Groundwater & Support			
						Ingress No Groundwater ingress during excavation.			
						Behaviour Sides stable during excavation.			
						Pumping Details NONE			
						Support Systems NONE			
						Excavation			
						Plant Hand Dug			
Area 0.6m x 1.2m									
Remarks Probe to 1.5m still in brick fill.						Date 21/5/86			
Trial Pit Record				Project Warrington & Runcorn D.C., Southern Expressway.			Contract E5600/7		
exploration associates							Trial Pit 9085 Sheet 1 of 1		



SJ 58 NE 11
 SECTION OF Borehole at

33 on pencil
115 NE 7
 Helen's Cable Works
 Warrington
 Lancs

Maps: One-inch ~~80 A~~ ⁹⁷ Six-inch *115 NE* County *Lancs*
 Height above O.D. *c. 300.0* Latitude *53° 23' 20"* Longitude *2° 36' 45"*
 Communicated by *Messrs Tho. Matthews Ltd* Date of sinking *1904*
 Made by *St. Helens Cable Works* Dip of Strata
From the site of British Aluminium Works
Water level 12 ft. **5984 8757**

	Thickness.		Depth from Surface.	
	ft	ins	ft	ins
Boring begun clay, sand & gravel		<i>3.66</i>	<i>12</i>	<i>3.66</i>
Bunter. Red sdst. (a little marl abt 125 ft)	<i>92</i>	<i>28.04</i>	<i>104</i>	<i>31.70</i>
	<i>96</i>	<i>29.26</i>	<i>200</i>	<i>60.96</i>

Tubed to 149' 0" 12" No. Co.

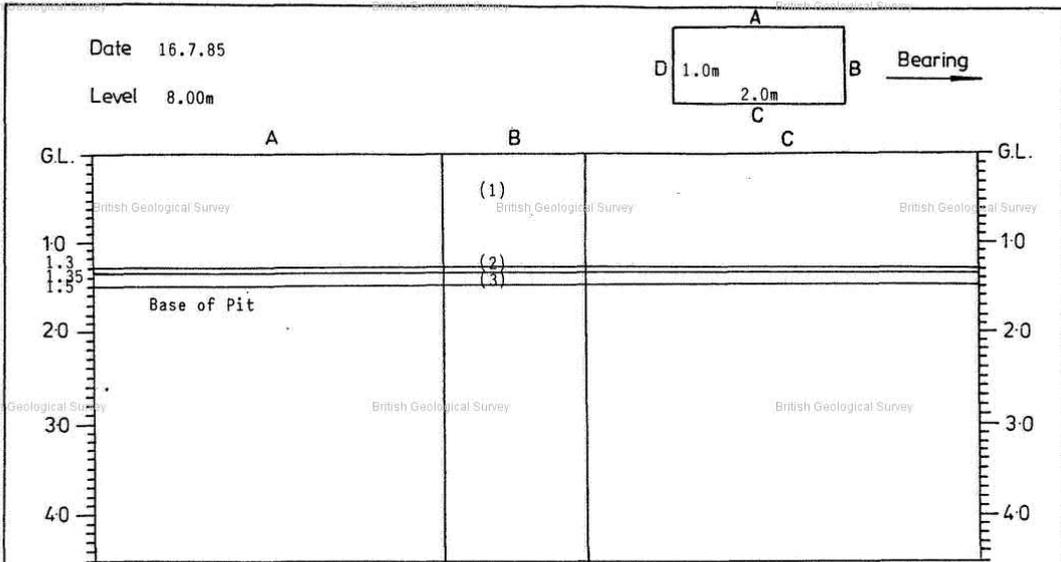
No. 1453 D.H. Lond.

From now British Aluminium Co Ltd
 the Borehole known - feasible filled in
 and abandoned.

SJ58N1514

Sampling		Properties			Strata						
Depth	Type	Strength kN/m ²	w %	SPT N	Description	Depth	Level	Legend			
0.10	B				MADE GROUND: Hardcore and gravel fill	G.L.	7.9				
0.50-0.85	CB			61/225	MADE GROUND: Dark grey friable silty sandy clay with rubble fill.	0.55	7.3				
1.00	B				MADE GROUND: Tarmac and hardcore	0.75	7.1				
						0.95	6.9				
1.50-1.95	SD			7	MADE GROUND: Domestic refuse with dark grey clayey ash fill, topsoil and gravel.						
2.00	B										
2.25	W										
2.50-2.95	SD										
3.00	B			4	MADE GROUND: Firm grey brown silty clay with gravel some rubble and bricks	2.65	5.2				
3.40-3.85	W										
3.40-4.00	B										
					End of Borehole	4.0	3.9				
Drilling					Ground Water						
Type	From	To	Size	Fluid	Struck	Behaviour	Sealed	Date	Hole	Cased	Water
Shell and Auger	G.L.	4.0	0.15	-	2.25	Seepage		26.7.85	Nil	Nil	Nil
					2.5	Rose to 2.25m	3.2	26.7.85	4.0	3.2	-
Remarks Chiselled between 0.75m and 0.95m (1/2 hour) Water added to assist drilling between G.L. and 2.0m below ground level.											
Borehole Record					Project Warrington and Runcorn DC Whittle Brook Rising Main				Contract \$4300/25		
exploration associates									Borehole 8914F Sheet 1 of 1		

SJ58NE1517



SAMPLES		STRATA		Test Depth	Cv	REMARKS
Depth	Type	No.	Description	m	kN/m ²	
		(1)	MADE GROUND: Bricks, stone rubble, dark brown fine to medium sand.			
		(2)	MADE GROUND: Soft dark grey brown silty slightly sandy clay.			
		(3)	MADE GROUND: Domestic refuse with odour			

PLANT	UCB-3C	WATER	Dry	Cv	Approximate value of undrained shear strength from hand vane Peak/residue
SHORED TO	-	STABILITY	Pit sides unstable		
Trial Pit Records			Project Warrington and Runcorn DC Whittle Brook Rising Main	Contract	S4300/25
exploration associates				Trial Pit	8915

SJ58NE **S8 NE/8** 27 On field slip.

WELL BORING at *Sunby Hill, Sunby, Lancs.* County *Lancs.* **115 NE 4.**

Geol. map 1 in. map New Series 47 6 in. map **115 NE**

Made by *Messrs E. Timmins & Sons.* Date _____

Sunk _____ feet. Bored **302** feet. **6** in. dia.

Communicated by *Major A. Timmins, Rumour Dec. 1926.*

Height above Ordnance Datum *about 20ft.* Rest level of water _____

Yield _____

Quality (with copy of analysis on separate sheet) **5803 8774**

GEOLOGICAL FORMATION.	NATURE OF STRATA.	THICKNESS.		DEPTH.	
		Feet.	Inches.	Feet.	Inches.
<i>Glacial. ls. Bunter</i>	<i>Griff Red sandstone</i>	(34.75m)		(34.75m)	
		114		114	
		188	6	302	6
		(57.45m)		(92.20m)	

SJ58NE1251

PROJECT: WARRINGTON NEW TOWN
LOCATION: Burtonwood Distributor
GROUND LEVEL: 10.00 **DIA. OF CASING:** 154 mm. to 3.00metres
INCLINATION: Vertical mm. to metres
SCALE OF LOG: 1:50 **DATE DRILLED:** 4.7.72.

TYPE OF BORING: Shell and Auger

Reduced Level	Depth	Legend	Sampling		Soil Description	Key to Laboratory Tests	Moisture Content and plot of Atterberg Limits			
			Type	Depth			Percent			
							10	20	30	40
9.5	0.50		D	0.50	TOPSOIL - black, sandy, organic	Tx				
			U(100)	0.50	CLAY - grey/brown, sandy, stony					
			D	1.00						
8.5	1.50		D	1.50						
			U(100)	1.50						
			D	2.00	grey/brown, firm, sandy, stony					
			D	2.00						
			U(100)	2.50						
7.0	3.00		D	3.00	▼ GWL 3.0m. SAND - brown, fine grained					
					BOTTOM OF BOREHOLE					

Ground water encountered at 3.00m. Trace Quantity

SHEET 1 OF 1

SJ58NE1370

British Geological Survey

British Geological Survey

British Geological Survey

RECORD OF BOREHOLE 174D

Ground level:.....8.05m above O.D.....

Dia. of boring:..0.15m.....

Method of boring: Shell and Auger.....

Lining tubes:.....0.15m to 3.00m.....

Daily Progress	Samples		Change of Strata			Description of Strata
	Depth	Type	Legend	Depth	O.D. Level	
18/9/73	0.50 - 0.95	U(4)		0.45	7.60	TOPSOIL
	0.95 - 1.25	D			1.25	6.80
	2.00 - 2.45	U(4)		2.20	5.85	Stiff mottled light and dark brown sandy CLAY with some fine gravel
	2.45 - 2.75	D				
	3.55 - 4.00	U(4)		4.00	4.05	
	4.00	D				
Key to type of sample: U(4) — 102mm (4in.) dia. undisturbed sample D — disturbed sample BD — bulk disturbed sample V — vane test S () — standard penetration test C () — dynamic cone penetration test Figure in brackets is No. of blows for penetration given in depth column (see Notes, page 1).			Remarks: (Observations on ground-water, etc.) Ground-water was encountered at 4.00m below ground level and rose to 3.40m below ground level in 3h. A water sample was taken. A standpipe was installed to a depth of 4.00m.			
Lab. Ref. No. S/ 10185		WARRINGTON, OLDHALL 4 DRAINAGE				FIG 33

SJ58NE1371

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British Geological Survey

RECORD OF BOREHOLE 1749

Ground level:.....8.45m above O.D.....

Dia. of boring: 0.15m.....

Method of boring: Shell and Auger.....

Lining tubes:.....0.15m to 3.00m.....

British Geological Survey Daily Progress	Samples		Change of Strata		Description of Strata	
	Depth	Type	Legend	O.D. Level		
19/7/73	0.50 - 0.80	U(4) ↓		0.45	8.00	TOPSOIL
	0.95	D		0.70	7.75	Stiff brown sandy CLAY
	1.25	D		1.00	7.45	Brown silty fine SAND with layers of clay
	2.00 - 2.45	U(4)				Firm mottled light and dark brown sandy CLAY with occasionally gravel
	2.45	D				
	2.75	D				
	3.55 - 4.00	U(4)				Stiff brown sandy CLAY with fine to medium gravel and occasionally pockets of organic sandy CLAY
	4.00	D		4.00	4.45	

Key to type of sample:
U(4) — 102mm (4in.) dia. undisturbed sample
D — disturbed sample
BD — bulk disturbed sample
V — vane test
S () — standard penetration test
C () — dynamic cone penetration test
 Figure in brackets is No. of blows for penetration given in depth column (see Notes, page 1).

Remarks: (Observations on ground-water, etc.)
 Ground-water was encountered at 3.00m below ground level and rose to 2.00m below ground level in 3h.
 ↓ Full penetration of sampler attained but limited sample recovered.

Lab. Ref. No. S/ 10185

WARRINGTON, OLDHALL 4 DRAINAGE

FIG 15

British Geological Survey

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SJ58NE1372

British Geological Survey

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British Geological Survey

RECORD OF BOREHOLE 1750

Ground level:.....7.90m above O.D.....

Dia. of boring:..0.15m.....

Method of boring:Shell and Auger.....

Lining tubes:.....0.15m to 4.50m.....

Daily Progress	Samples		Change of Strata			Description of Strata	
	Depth	Type	Legend	Depth	O.D. Level		
2/10/73	0.50 - 0.95	U(4)	[Pattern]	0.15	7.75	FILL (Concrete)	
	0.95 - 1.25	D		0.50	7.40	FILL (Cinders)	
	2.00 - 2.45	U(4)	[Pattern]	2.75	5.15	Black silty clayey fine to medium SAND with pockets of soft sandy silty clay and traces of fine gravel.	
	2.45 - 2.75	D					
	3.50 - 3.95	U(4)	[Pattern]	4.20	3.70	Soft to firm brown very sandy CLAY	
	3.95 - 4.25	D					
	4.55 - 5.00	U(4)	[Pattern]	5.00	2.90	Very stiff brown sandy CLAY with fine gravel	
	5.00	D					
	Key to type of sample: U(4) — 102mm (4in.) dia. undisturbed sample D — disturbed sample BD — bulk disturbed sample V — vane test S () — standard penetration test C () — dynamic cone penetration test Figure in brackets is No. of blows for penetration given in depth column (see Notes, page 1).			Remarks: (Observations on ground-water, etc.) Seepages of ground-water were encountered between 2.75m and 4.20m below ground level and were sealed off by the lining tubes at a depth of 4.20m. A water sample was taken.			
	Lab. Ref. No.	WARRINGTON, OLDHALL 4 DRAINAGE				FIG 17	
S/ 10185							

SJ58NE1373

British Geological Survey

British Geological Survey

British Geological Survey

RECORD OF BOREHOLE 1751

Ground level:.....8.10m above O.D.....

Dia. of boring:..0.15m.....

Method of boring:..Shell and Auger.....

Lining tubes:.....0.15m to 3.50m.....

Daily Progress	Samples		Change of Strata			Description of Strata
	Depth	Type	Legend	Depth	O.D. Level	
2/10/73	1.65 - 1.95	C(17)		1.50	6.60	FILL (Bricks, clay, gravel).
	2.65 - 2.95	C(18)		3.25	4.85	Medium dense brown fine to coarse SAND and fine to medium GRAVEL
	3.25	D		5.00	3.10	Firm brown sandy CLAY with occasionally fine gravel
	3.50 - 3.95	U(4)				
	3.95	D				
4.25	D					
4.55 - 5.00	U(4)					
	5.00	D				
Key to type of sample: U(4) — 102mm (4in.) dia. undisturbed sample D — disturbed sample BD — bulk disturbed sample V — vane test S () — standard penetration test C () — dynamic cone penetration test Figure in brackets is No. of blows for penetration given in depth column (see Notes, page 1).			Remarks: (Observations on ground-water, etc.) Ground-water was first encountered 2.00m below ground level and rose to 1.75m below ground level in 1/2h. The water was sealed off by the lining tubes below 3.50m. Water was again encountered at a depth of 4.55m and rose to 3.00m in 1/2h. On the completion of boring, water stood at 1.60m below ground level.			
Lab. Ref. No. S/ 10185		WARRINGTON - OLDHALL 4 DRAINAGE				FIG 18

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SJ58NE1514

Sampling		Properties			Strata						
Depth	Type	Strength kN/m ²	w %	SPT N	Description	Depth	Level	Legend			
0.10	B				MADE GROUND: Hardcore and gravel fill	G.L.	7.9				
0.50-0.85	CB			61/225	MADE GROUND: Dark grey friable silty sandy clay with rubble fill.	0.55	7.3				
1.00	B				MADE GROUND: Tarmac and hardcore	0.75	7.1				
						0.95	6.9				
1.50-1.95	SD			7							
2.00	B				MADE GROUND: Domestic refuse with dark grey clayey ash fill, topsoil and gravel.						
2.25	W										
2.50-2.95	SD										
3.00	B			4	MADE GROUND: Firm grey brown silty clay with gravel some rubble and bricks	2.65	5.2				
3.40-3.85	W										
3.40-4.00	B										
					End of Borehole	4.0	3.9				
Drilling					Ground Water						
Type	From	To	Size	Fluid	Struck	Behaviour	Sealed	Date	Hole	Cased	Water
Shell and Auger	G.L.	4.0	0.15	-	2.25	Seepage		26.7.85	Nil	Nil	Nil
					2.5	Rose to 2.25m	3.2	26.7.85	4.0	3.2	-
Remarks Chiselled between 0.75m and 0.95m (½ hour) Water added to assist drilling between G.L. and 2.0m below ground level.											
Borehole Record					Project Warrington and Runcorn DC Whittle Brook Rising Main			Contract \$4300/25			
exploration associates								Borehole 8914F Sheet 1 of 1			

SJ58NE10A

8/0384 10x 7/45 (51) F.&S.

58 NE 32 107

(For Survey use only)
6-inch Map Registered No.

RECORD OF SHAFT OR BORE FOR MINERALS

SJ58 NE 32

Name and Number of Shaft or Bore

For Messrs. Laporte Ltd.

Town or Village Mosley Common

County Lancs Six-inch quarter sheet

Exact site See attached tracing - Where

6-inch Map Registered No.

5983 8609.

Attach a tracing from a map, or a sketch-map, if possible.

Purpose for which made trial bores for foundations of new factory

Level at which ^{shaft}bore commenced relative to O.D. separately stated State if ^{shaft}bore is up, down, horizontal or inclined; in latter cases give angle of inclination and direction down from surface

Made by Messrs. T. Matthews

Information from R. Matthews Esq.

Date of Sinking Jan 1946

Specimens None

Additional Notes in Space Overleaf

(For Survey use only) GEOLOGICAL CLASSIFICATION	NATURE OF STRATA	THICKNESS			DEPTH		
		Meters			Meters		
A	No. A.1 o.D. 30.75' w.l. 8'6"						
	Turf	0.08	0	3	0.08	0	3
	Sandy silt	0.28	0	11	0.36	1	2
	Sand	2.01	6	7	2.37	7	9
	Sand & gravel	1.52	5	-	3.89	12	9
	Stiff clay & silt	1.52	5	-	5.41	17	9
	Soft red sandstone	0.38	1	3	5.79	19	0
B	No. A.2 o.D. 30.72' w.l. 9'0"						
	Turf	0.08	0	3	0.08	0	3
	Sandy silt	0.31	1	0	0.39	1	3
	Sand	2.36	7	9	2.75	9	6
	Sand & gravel	2.13	7	0	4.88	16	6
	Stiff clay & stones	0.84	2	9	5.72	19	3
	Soft red sandstone	0.23	0	9	5.95	20	0
C	No. A.3 o.D. 30.57' o. w.l. 9'0"						
	Turf	0.08	0	3	0.08	0	3
	Sandy silt	0.16	1	6	0.54	1	9
	Sand	2.74	9	0	3.28	10	9
	Brown sand & gravel	5.49	18	0	8.77	28	9
	Brown sand	6.78	22	3	15.55	51	-
	Soft red sandstone	6.86	22	6	22.41	73	6
					Continued	Overleaf	

GEOLOGICAL SURVEY AND MUSEUM, SOUTH KENSINGTON, LONDON, S.W.7.	Date received	Correspondence File No.	1" N.S. Map No.	1" O.S. Map No.	Site marked (use symbol) on 1" Map	on 6" Map
	Jan 1946	None.	97.			

SUB SOIL SURVEYS LTD.
MANCHESTER.

BOREHOLE No. 30

British Geological Survey

EXPLORATORY BORING RECORD

SJ 88 NE 726
S 982 8776

SITE Warrington Ref.: 68/115
Boring Method Shell Ground Level 22.80 O.D.

DATE	DIA. OF CASING & DEPTH BELOW G.L.	WATER LEVEL MORNING & EVENING	DEPTH OF STRATA BELOW G.L.	STRATA APPROX. SCALE 10 FT. TO ONE INCH	NO. OF SAMP.	TYPE OF SAMP.	PENETRATION OF SAMPLER OR CORE BARREL		NO. OF BLOWS	CORE RECOVERY
							FROM	TO		
6.12.68	3"	N11	5'0"	Backfill						
				Soft to firm grey sandy silt, clayey in parts	1	O	5'0"			
6.12.68	18'	N11			2	O	10'0"			
7.12.68		N11			3	O	15'0"			
			19'0"		4	O	19'0"			
					5	O	24'0"			
					6	O	25'0"			
				Grey sand and gravel	7	O	30'0"			
			24'6"		8	U	32'0"	33'0"	41	
					9	O	35'0"			
					10	W	20'0"			
					11	O	37'0"			
7.12.68	27'6"	N11								
9.12.68		N11		Stiff brown sandy clay with stone inclusions and thin bands of sand						
9.12.68	32'6"	N11	37'0"							

Samples shown thus: Disturbed O. Undisturbed U. Standard Pen. Test X. Water W. Bulk B.

WATER STRUCK AT THE FOLLOWING DEPTHS	DEPTH OF CASING WHEN SEALED (N.S.—NOT SEALED)	ESTIMATED SEEPAGE	WATER ADDED AT FOLLOWING DEPTHS TO ASSIST BORING	WATER LEVEL IN CASED/UNCASED BOREHOLE ON COMPLETION		
				DATE	WATER LEVEL	DEPTH OF CASING
1. 19'0"	25'0"			16.12.68	5'10"	
2.						
3.						
4.						
5.						
6.						

REMARKS:

British Geological Survey

British Geological Survey

British Geological Survey

E. Segment summaries

SEGMENT NAME		ROUTE OPTIONS ADOPTING SEGMENT	
A1		Route 25: D, P (I); Route 26: D, P (II); Route 51: G, P (I); Route 52: G, P (II); Route 57: H, P (I); Route 58: H, P (II); Route 63: I, P (I); Route 64: I, P (II)	
SEGMENT DESCRIPTION		STRUCTURES REQUIRED	
The segment starts at proposed Bridge 11 (or tunnel) crossing the Manchester Ship Canal and the West Coast Main Line and Chester Line. It travels to the south, crossing over Bridgewater Canal at proposed Bridge 12 and veering to the east of Hollyhedge Farm before terminating at Cheshire Road (A56) after 1200m.		Bridge 11: Acton Grange/ tunnel Bridge 12: Bridgewater.	
GROUND GEOLOGY/ MODEL		RELEVANT BOREHOLE LOGS	
The BGS 1:50,000 map shows the geology to comprise coastal blown sand deposits of the Shirdley Hill Sand Formation. This is underlain by gravelly sandstone of the Helsby Sandstone Formation at the northern half of the segment and sandstone of the Wilmslow Sandstone Formation at the southern half of the segment. Superficial deposits are absent at the final 120m of the segment where the Wilmslow Sandstone Formation outcrops at the surface.		SJ58NE1407 SJ58NE1408 SJ58NE1409 SJ58NE1435 SJ58NE1436	
Boreholes show that up to 1m topsoil and sandy clay, interpreted as Tidal Flat Deposits (TFD), are underlain by up to 5m of loose to medium dense sand which is interpreted as Shirdley Hill Sand Formation. Underlying the sand is hard sandstone which is as shallow as 3mbgl at SJ58E1207 near the Manchester Ship Canal. TFD appears to be localised around the northern part of the segment and may be absent towards the south where elevation increases.		Historical borehole logs which inform the ground model below are only available at the northern edge of the segment to the immediate south of Manchester Ship Canal and West Coast Main Line and Chester Line.	
		Strata	Typical Base Level (mAOD)
		Tidal Flat Deposits	13.7 – 11.2
		Coastal Blown Sand	12.7 – 8.2
		Weathered Sandstone	11 – 6.7
		Sandstone	Proven to 10.7
		Groundwater level: No groundwater encountered	
TOPOGRAPHY/ EARTHWORKS			
Starting at 14mAOD near the dismantled railway, the segment gently rises to 19mAOD at Mill Lane Cottages (150m) and 25mAOD at 600m. The increase in elevation continues towards the south as topography rapidly steepens, reaching 30mAOD at 900m and 37mAOD at Chester Road where the segment terminates. Topographic gradient exceeds 6% near Hollyhedge Farm and Chester Road and a cutting may be required in order to achieve acceptable highway gradients. An approach embankment is required for the proposed bridge crossing at the segment start.			
HISTORICAL LAND USE			
West Coast Main Line and Chester Line built by 1849; Manchester Ship Canal built by 1893; Arpley Landfill licensed from 1997.			
HYDROLOGY/ FLOOD RISK			
The segment passes through a small body of water next to Hollyhedge Farm and a stream which intersects Mill Lane to the north of Cockfight Cottages, as well as over Cheshire Ring Canal. All of these on-line areas have the potential to experience surface water flooding for a 1 in 30 year flood event., with progressively larger impact areas for 1 in 100 and 1 in 1000 year flood events. There is no risk of flooding from rivers or seas.			
LICENSED INDUSTRIAL ACTIVITY			
None recorded			
DISCHARGE CONSENTS			
None recorded			
SENSITIVE LAND USE		MINERAL SITES	
None recorded		Moore Sand Pit (inactive) recorded 150m to the SW of the segment end at 358892, 384281.	
HYDROGEOLOGY/ GROUNDWATER SOURCE PROTECTION ZONES			
The Shirdley Hill Sand Formation is classified as a Secondary Aquifer A. The Wilmslow Sandstone Formation is classified as a Principal Aquifer and the Helsby Sandstone Formation is classified as a Principal Aquifer.			
The segment is within Groundwater Source Protection Zone 3 of an abstraction point located to the SE of the study area near Appleton Reservoir.			
LANDFILLS AND WASTE MANAGEMENT			

The active Arpley Landfill is located 300m to the north of Bridge 11 at the start of the segment. The landfill currently has no restrictions on the type of waste and material that can be deposited and is licensed as a co-disposal site, meaning that non-hazardous and hazardous waste has been buried together.

POLLUTION INCIDENTS

1No. minor pollution incident is recorded within 200m of the segment start at 359000, 385500. Recorded in 1994, the catchment is the River Mersey (non-tidal) and the pollutant is classified as miscellaneous – inert suspended solids.

POTENTIAL FOR CONTAMINATION

Considered to be low due to the lack of significant recorded pollution incidents and absence of industrial land uses.

GEOTECHNICAL RISKS

- Compressible/weak ground comprising unconsolidated TFD in the vicinity of the Manchester Ship Canal, posing a risk to bridge construction, embankment construction and highway construction.
- Tunnelling in soft ground deposits resulting in volume loss and settlement of existing structures.
- Tunnelling/excavating below the water table risks water ingress.
- Settlement may occur if water is lowered during tunnelling works, potentially impacting existing structures.
- TFD has low potential for re-use as suitable embankment fill, contributing towards a material deficit.

SEGMENT NAME	ROUTE OPTIONS ADOPTING SEGMENT		
A2	Route 28: D, R (I); Route 39: E, R; Route 41: E, R (III); Route 47: F, R (I); Route 49: F, R (III); Route 55: G, R (II)		
SEGMENT DESCRIPTION	STRUCTURES REQUIRED		
The segment starts at proposed Bridge 11 (or tunnel) crossing the Manchester Ship Canal and the West Coast Main Line and Chester Line. It turns eastwards and travels to the NE through agricultural fields, terminating at Chester road after 1200m. At 370m the segment intersects a tributary of the River Mersey which now feeds the Manchester Ship Canal.	Bridge 11: Acton Grange/ tunnel		
GROUND GEOLOGY/ MODEL	RELEVANT BOREHOLE LOGS		
<p>The BGS 1:50,000 map shows the geology to comprise deposits of the Shirdley Hill Sand Formation and Glaciofluvial Deposits. Superficial deposits are underlain by the Helsby Sandstone Formation and the Tarporley Siltstone Formation at the eastern edge of the segment.</p> <p>Boreholes show that a surface layer of up to 4m of firm sandy clay, interpreted as TFD, is underlain by up to 3.5m of medium dense sand, interpreted as Shirdley Hill Sand Formation. Underlying superficial deposits is hard sandstone which is 3mbgl at the west and 7mbgl at the east.</p>	SJ58NE1408 SJ58NE1416 SJ58NE1417 SJ58NE1418 SJ58NE1419 SJ58NE1420	Lack of historical borehole logs informing the ground conditions along the mid-western section of the segment.	
	Strata	Typical Base Level (mAOD)	
		E	W
	Tidal Flat Deposits	6	14
	Coastal Blown Sand Sandstone	4.5 Proven to 6.5	13 Proven to 11
Groundwater level: Recorded as high as 3.7mbgl near the tributary of the River Mersey.			
TOPOGRAPHY/ EARTHWORKS			
<p>Elevation is 14mAOD at the start of the segment. It rises to 16mAOD before dropping to 12mAOD where River Mersey Tributary is flowing. Elevation is then fairly consistent as the segment continues eastwards, ranging from 11mAOD to 13mAOD before climbing to 19mAOD over the last 100m of the segment.</p> <p>Topographic gradient exceeds 6% where the proposed segment crosses the tributary of the River Mersey. Embankment construction with drainage (or structural equivalent) may be required in order to meet acceptable highway gradients.</p> <p>Approach embankment required for the proposed bridge crossing.</p>			
HISTORICAL LAND USE			
<ul style="list-style-type: none"> The eastern half of the segment is within 200m of Baronet Works along the Manchester Ship Canal. Baronet Works includes the chemical works of Solvay Interlox Ltd which was present by 1993 and sawmilling and timber treatment works which was present until 1954. West Coast Main Line and Chester Line built by 1849; Manchester Ship Canal built by 1893; Arpley Landfill licensed from 1997. 			
HYDROLOGY/ FLOOD RISK			
<ul style="list-style-type: none"> The segment lies to the south of the similarly orientated E-W Manchester Ship Canal, which is within 200m of the segment at its closest point. A tributary of the River Mersey which now feeds the Manchester Ship Canal is intersected near Grange Mill House at 359344, 385544. The section of the segment which crosses the tributary of the River Mersey is shown to be at risk from surface flooding from a 1 in 30 year flood event. The affected area at risk increases insignificantly from a 1 in 100 year flood event but two additional sections are at risk from a 1 in 1000 year flood event at the western (359064, 385568) and eastern (359944, 385880) sections of the segment. The risk of flooding from rivers and seas is shown to be high along the river Mersey Tributary and medium for the 185m section of the segment to the east of the tributary. 			
LICENSED INDUSTRIAL ACTIVITY			
At Baronet Works there are trade directories for Solvay Interlox Ltd, chemical manufacturers, and Solvay, chemical distributors and wholesalers.			
DISCHARGE CONSENTS			
1No. discharge consent of chemical products into the Manchester Ship Canal at 359810, 385970, 150m from the segment.			
SENSITIVE LAND USE	MINERAL SITES		
None recorded	Stockton Heath Sand Pit (inactive) and an adjacent sand and gravel quarry (inactive) recorded 175m to the NE of the segment end at 360270, 385918 and 360270, 385908.		

HYDROGEOLOGY AND GROUNDWATER SOURCE PROTECTION ZONES

The Shirdley Hill Sand Formation and Glaciofluvial Deposits are classified as a Secondary Aquifer A. The Helsby Sandstone Formation is classified as a Principal Aquifer and the Tarporley Siltstone Formation is classified as a Secondary B Aquifer.

The segment is within a Groundwater Source Protection Zone 3 of an abstraction point located to the SE of the study area at 360180, 384562.

LANDFILLS AND WASTE MANAGEMENT

The active Arpley Landfill is located 300m to the north of proposed Bridge 11 crossing the Manchester Ship Canal and West Coast and Chester Main Line at the start of the segment. The landfill currently has no restrictions on the type of waste and material that can be deposited and is licensed as a co-disposal site, meaning that non-hazardous and hazardous waste has been buried together.

POLLUTION INCIDENTS

- 1No. minor pollution incident is recorded within 100m of the segment at 359800, 385900. Occurring in 1998, the pollutant is recorded as fire water/foam affecting the Manchester Ship Canal catchment.
- 2No. minor pollution incidents are recorded within 200m of the segment. The first incident occurred in 1996 at 360299, 385900 involving miscellaneous pollutants affecting Manchester Ship Canal. The second incident occurred in 1994 at 359000, 385500 and affects the catchment of the River Mersey (non-tidal) with a pollutant classified as miscellaneous – inert suspended solids.
- Integrated Pollution Control (IPC) and Integrated Pollution Prevention Control (IPPC) points are present for Solvay Interlox Ltd at Baronet Works from 1992 to present day, given for organic chemicals (manufacture and use) and combustion processes.
- Solvay Interlox Ltd is a Control of Major Accident Hazards (COMAH) and Notification of Installations Handling Hazardous Substances (NIHHS) site.

POTENTIAL FOR CONTAMINATION

- A potential source of contamination is the chemical works at Baronet Works on the northern side of Manchester Ship Canal. The most likely contaminants are inorganic non-metals which can be toxic, providing a risk to human health, as well as having the potential to cause deterioration to construction materials.
- A potential source of contamination is the historical saw mill and timber treatment works at Baronet Works, which typically uses a variety of organic and inorganic chemicals and metals. Such substances can be considered as flammable and toxic, providing a risk to human health, with the potential to deteriorate construction materials.

GEOTECHNICAL RISKS

- Compressible/weak ground comprising unconsolidated TFD in the vicinity of the Manchester Ship Canal, posing the risk of weak foundation strata to bridge and embankment construction, as well as highway construction along the rest of the segment due to potentially unsuitable subgrade.
- Risks associated with the tunnel are the same as those mentioned for Segment A1.
- There is likely to be a material deficit if two embankments are required as TFD is likely to be unsuitable for re-use as embankment fill.

SEGMENT NAME	ROUTE OPTIONS ADOPTING SEGMENT	
A3	Route 41: E, R (III); Route 43: F, P (I); Route 44: F, P (II); Route 47: F, R (I); Route 49: F, R (III); Route 51: G, P (I); Route 52: G, P (II); Route 55: G, R (II); Route 57: H, P (I); Route 58: H, P (II); Route 61: H, R (II); Route 63: I, P (I); Route 64: I, P (II); Route 67: I, R (II)	
SEGMENT DESCRIPTION	STRUCTURES REQUIRED	
The segment commences at a body of water within Arpley Landfill Site. It travels along Forrest Way to the south before passing along an unnamed road by the western edge of Moss Wood and the disused Runcorn and Latchford Canal at 360m. It then veers to the SW where it passes through a body of water and joins to proposed Bridge 11 (or tunnel) which crosses the Manchester Ship Canal and West Coast Main Line and Chester Line at approximately 700m.	Bridge 11: Acton Grange/ tunnel	
GROUND GEOLOGY/ MODEL	RELEVANT BOREHOLE LOGS	
<p>The BGS 1:50,000 map shows the geology to comprise coastal blown sand deposits of the Shirdley Hill Sand Formation. This is underlain by sandstone of the Wilmslow Sandstone Formation and gravelly sandstone of the Helsby Sandstone Formation at the southern tip of the segment.</p> <p>The historical borehole shows sand and gravel with a layer of boulders, interpreted as Glaciofluvial Deposits (GFD) to a depth of 7mbgl. This is underlain by 3m of red sandy clay, interpreted as weathered sandstone, overlying red sandstone.</p> <p>Landfill material composition is unknown but is presumed to comprise an uncompacted, layer of dredged material overlain by a variety of hazardous and non-hazardous landfill waste. Thickness has been estimated based on current elevation relative to surrounding land.</p>	SJ58NE22	1No. historical borehole log is present at the southern end of the segment.
	Strata	Typical Base Level (mAOD)
	Landfill (estimated) Glaciofluvial Deposits Weathered Sandstone Sandstone	7 0 -3 Proven to -3
	Groundwater level: 4mAOD	
TOPOGRAPHY/ EARTHWORKS	<p>Elevation starts at 9mAOD to the immediate north of the Manchester Ship Canal and West Coast Main Line and Chester Line. It drops to 5mAOD over the body of water at Moss Wood and returns to 8mAOD as the segment progresses northwards. Continuing through the landfill site, elevation rises quickly to 12mAOD past the disused Runcorn and Latchford Canal, reflecting a steepening in topography, and then plateaus for the remainder of the segment.</p> <p>The rise in elevation past the disused canal exceeds 6%. The segment is proposed to follow an existing unpaved road along this section and therefore it is possible to build up the road via suitable granular fill in order to reduce the slope to an acceptable highway gradient.</p>	
HISTORICAL LAND USE	<ul style="list-style-type: none"> • There is on-line refuse disposal from 300m to 600m at Arpley Landfill, dated 1993. • Potential partial infilling of Acton Grange Sand Pit at Moss Wood with unknown material. • West Coast Main Line and Chester Line built by 1849; Manchester Ship Canal built by 1893; Arpley Landfill licensed from 1997. 	
HYDROLOGY/ FLOOD RISK	<ul style="list-style-type: none"> • The segment directly passes through two bodies of water within the area of Arpley Landfill and is within 25m of a number of small streams and pools, including the disused Runcorn and Latchford Canal. • There is a small area of the segment at risk from surface water flooding from a 1 in 100 year flood event and an additional four areas at risk of flooding from a 1 in 1000 year flood event. The affected areas include a 200m long section along Forrest Way. This excludes existing bodies of water that the segment is proposed to pass through. • The majority of the segment to south of the canal is at a high risk of flooding from rivers and seas. 	
LICENSED INDUSTRIAL ACTIVITY	None recorded	
DISCHARGE CONSENTS		

Sewage discharge point at 358842, 386700, 100m to the NE of the segment start. The recorded catchment is the River Mersey.

SENSITIVE LAND USE

None recorded

MINERAL SITES

Acton Grange Sand Pit (inactive) present at the southern end of the segment; now infilled with water.
 Arpley Landfill Site Gas Extraction (active) present within 20m of the northern end of the segment at 358837, 386594.
 Birchwood Lane Sand Pit (inactive) present 200m to the SW of the segment end at 358815, 385740.

HYDROGEOLOGY/ GROUNDWATER SOURCE PROTECTION ZONES

The Shirdley Hill Sand Formation is classified as a Secondary Aquifer A.
 The Wilmslow Sandstone Formation is classified as a Principal Aquifer and the Helsby Sandstone Formation is classified as a Principal Aquifer.

LANDFILLS AND WASTE MANAGEMENT

The entire segment down to the water body at Birch Wood/Moss Wood is within the Arpley Landfill Site. The landfill license has no restrictions on material and waste being deposited and is licensed as a co-disposal site, meaning that non-hazardous and hazardous waste has been buried together.

POLLUTION INCIDENTS

- Arpley Landfill, operated by 3C Water Ltd, is an IPPC site since 2008.
- The landfill was reportedly fined at an unknown date for 'failure to control and minimise the escape of landfill gas, prevent escaping leachate and maintain effective measures to prevent disruption of waste material.'

POTENTIAL FOR CONTAMINATION

The entirety of the segment north of the water-infilled Acton Grange Sand Pit is within the Arpley Landfill Site. The landfill is unrestricted in regards to material disposal and hence it is unknown as to the types of contaminants within the ground and how highway works may be affected. Similarly, Acton Grange Sand Pit may be partially infilled with unknown material. There is also a record of uncontrolled gas escape and leachate migration. Therefore, the presence of contamination with the potential to affect human health and highway construction is considered to be high.

GEOTECHNICAL RISKS

- Moderate hazard of running sand and shrink-swell (BGS).
- Potentially compressible, weak and variable landfill deposits; unsuitable for use as bridge and embankment foundation strata as well as subgrade for highway construction.
- There is a risk of ground settlement if the water table is lowered during the infilling of existing water bodies. Landfill leachate will also need managing.
- There is a large material deficit if the two intersected water bodies are to be infilled with suitable granular material.
- Potential risk of explosion during highway construction and works due to methane gas.

SEGMENT NAME	ROUTE OPTIONS ADOPTING SEGMENT	
A4	Route 25: D, P (I); Route 26: D, P (II); Route 28: D, R (I); Route 29: D, R (II); Route 30: D, R (III); Route 36: E, P (I); Route 37: E, P (II); Route 39: E, R (I)	
SEGMENT DESCRIPTION	STRUCTURES REQUIRED	
The 1900m long segment starts with proposed Bridge 9 which crosses over the River Mersey and Fiddler's Ferry railway/disused St Helens Canal. The segment travels to the SE along the northern edge of Arpley Landfill – alongside the River Mersey – and veers to the south after 1000m where it passes through a body of water, intersects Forrest Way and terminates at a body of water where there is proposed Bridge 11 (or tunnel) which crosses the Manchester Ship Canal and West Coast Main Line and Chester Line.	Bridge 9: West Mersey Bridge 11: Acton Grange/ tunnel	
GROUND GEOLOGY/ MODEL	RELEVANT BOREHOLE LOGS	
<p>The BGS 1:50,000 map shows the geology to comprise Tidal Flat Deposits underlain by Shirdley Hill Sand Formation. Shirdley Hill Sand Formation is mapped at the surface at the start and end of the segment. Beneath superficial deposits is sandstone of the Wilmslow Sandstone Formation.</p> <p>Historical boreholes show up to 4m of soft to very soft silty clay with organic zones, interpreted as TFD, underlain by 2m of loose to dense sand and gravel, interpreted as GFD. Superficial deposits are underlain by 2m of mixed red sand and medium hard red sandstone. TFD appears to be absent from SJ58NE22 at the southern end of the segment.</p> <p>Landfill material composition is unknown but is presumed to comprise an uncompacted layer of dredged material overlain by a variety of hazardous and non-hazardous landfill waste Landfill thickness has been estimated based on current elevation relative to surrounding land. A thickness of 15m is suggested as the maximum landfill thickness along the segment.</p>	SJ58NE22 SJ58NE1 SJ58NE716 SJ58NE1116	Historical borehole logs are sparse across the 1900m long segment. SJ58NE1 is the only borehole within the Arpley landfill area and was drilled before landfill construction.
	Strata	Typical Base Level (mAOD)
	Landfill	6
	Tidal Flat Deposits	2
	Glaciofluvial Deposits	-4
Weathered Sandstone	-6	
Sandstone	Proven to -6	
	Groundwater level: 5mAOD	
TOPOGRAPHY/ EARTHWORKS		
<p>Elevation starts at 9mAOD to the immediate north of the Manchester Ship Canal and West Coast Main Line and Chester Line. It drops to 5mAOD over the body of water at Moss Wood and quickly rises to 16mAOD as topography steepens over the landfill before dropping to 1mAOD where another body of water is present. Elevation rises again to a maximum of 21mAOD 200m to the NW of the water body before falling to 11 – 14mAOD for the remainder of the landfill and then down to 3mAOD over the River Mersey. Elevation then rises to 10mAOD on the opposite site of the river.</p> <p>A topographic gradient in excess of 6% is observed at both sides of the water-filled pit that the NE part of the segment is proposed to run through, as well as at the landfill edge where the proposed Bridge 9 crosses the River Mersey.</p> <p>An approach embankment will be required for the bridge crossing and the ground will need levelling to a highway accepted gradient at the water-filled pit.</p>		
HISTORICAL LAND USE		
<ul style="list-style-type: none"> • There is an on-line 'heap of unknown constituents' at the segment start, dated 1993 on the northern side of the River Mersey, and an on-line refuse disposal from 1700m to 2000m at Arpley Landfill, dated 1993. • Two discrete areas of off-line sewage disposal are shown at historic Gatewarth Farm Landfill centred at 358273, 387100 and 357781, 387190, approximately 300m to the north of the segment. • There is an off-line saw mill and timber treatment works at the segment end along the Manchester Ship Canal, dated from 1928 to 1954. In the same area there are also railways from 1899 to 1954. • West Coast Main Line and Chester Line built by 1849; Manchester Ship Canal built by 1893; Arpley Landfill licensed from 1997. 		
HYDROLOGY/ FLOOD RISK		
<ul style="list-style-type: none"> • The segment directly passes through the two aforementioned bodies of water as well as through/alongside several small streams and pools within the landfill site and at Sankey Valley Park. • There is shown to be a risk of surface water flooding along the segment from a 1 in 30 year flood event at Sankey Valley Park and near Bank Quay Reach next to the River Mersey, as well as the at the water-filled 		

<p>sand pit at the segment end. Two additional sections are shown to be at risk from a 1 in 100 year flood event and several more sections at risk from a 1 in 1000 year flood event, focussed around Sankey Valley Park, the northern tip of Arpley Landfill and the NE area of the segment.</p> <ul style="list-style-type: none"> • Large areas of the segment around Moss Wood, Sankey Valley Park and through the landfill site are at high to medium risk of flooding from rivers and seas. 	
LICENSED INDUSTRIAL ACTIVITY	
None recorded	
DISCHARGE CONSENTS	
<ul style="list-style-type: none"> • Treated effluent sewage discharge point into the River Mersey from 1980 to 1991 at 358110, 386860, 200m to the north of the middle segment section. • Storm overflow sewage discharge point into the River Mersey from 1980 to 1991 at 358040, 386890, 200m to the north of the middle segment section. • Waste site discharge point into the River Mersey from 1996 – 2005 at 358350, 386750, 200m to the north of the middle segment section. 	
SENSITIVE LAND USE	MINERAL SITES
None recorded	<p>Acton Grange Sand Pit (inactive) present at the southern end of the segment; now infilled with water.</p> <p>Birchwood Lane Sand Pit (inactive) present 200m to the SW of the segment end at 358815, 385740.</p> <p>Arpley Sand Pit (inactive) present beneath the centre of Arpley Landfill at 358167, 386907.</p>
HYDROGEOLOGY/ GROUNDWATER SOURCE PROTECTION ZONES	
<p>Tidal Flat Deposits across the site are classified as a Secondary Undifferentiated Aquifer. Glaciofluvial Deposits and coastal blown sand of the Shirdley Hill Sand Formation are classified as a Secondary A Aquifer. The Wilmslow Sandstone Formation is classified as a Principal Aquifer and the Helsby Sandstone Formation is classified as a Principal Aquifer.</p>	
LANDFILLS AND WASTE MANAGEMENT	
<p>The entire segment from the River Mersey down to the water body at Birch Wood/Moss Wood is within the Arpley Landfill Site. The landfill license has no restrictions on material and waste being deposited there and is licensed as a co-disposal site, meaning that non-hazardous and hazardous waste has been buried together. Proposed Bridge 9 crosses over the River Mersey and Fiddler's Ferry Railway/St Helen's Canal passes through the Gatewarth Farm Landfill - an historic landfill which reportedly holds inert, industrial commercial, household and special waste from between 1968 and 1989. There was no restriction on the type of waste that could be deposited.</p>	
POLLUTION INCIDENTS	
<ul style="list-style-type: none"> • Arpley Landfill, owned by Warrington Borough Council, is an IPPC site since 2008. • The landfill was fined at an unknown date for 'failure to control and minimise the escape of landfill gas, prevent escaping leachate and maintain effective measures to prevent disruption of waste material.' • A pollution incident occurred at the western side of the landfill at 357895, 386527 in 2006. There was a significant impact to land recorded. 	
POTENTIAL FOR CONTAMINATION	
<p>The entirety of the segment north of the water-infilled Acton Grange Sand Pit is within the Arpley Landfill Site. The landfill is unrestricted in regards to material disposal and hence it is unknown as to the types of contaminants within the ground and how highway works may be affected. Similarly, Acton Grange Sand Pit may be partially infilled with unknown material. There is also a record of uncontrolled gas escape and leachate migration. Therefore, the presence of contamination at Arpley Landfill with the potential to affect human health and highway construction is considered to be high. The same risks are also applied to Gatewarth Farm Landfill which the proposed segment at the start of the bridge crosses over.</p>	
GEOTECHNICAL RISKS	
<ul style="list-style-type: none"> • There is a moderate risk of running sand (BGS). • There is the risk of cutting into unknown landfill material where earthworks are required due to gradient exceedance. • Potentially compressible, weak and variable landfill deposits; unsuitable for use as bridge and embankment foundation strata as well as subgrade for highway construction. • There is a risk of ground settlement if the water table is lowered during the infilling of existing water bodies. • There is a large material deficit if intersected water bodies are to be infilled with suitable granular material. 	

SEGMENT NAME	ROUTE OPTIONS ADOPTING SEGMENT			
A5	Route 51: G, P (I); Route 52: G, P (II); Route 54: G, R (I); Route 55: G, R (II); Route 56: G, S			
SEGMENT DESCRIPTION	STRUCTURES REQUIRED			
The segment commences at Liverpool Road (A57) and travels to the south through Sankey Recreation Ground before turning SE and crossing over Fiddler's Ferry Railway and the River Mersey on a proposed bridge. To the south of Bank Quay Soap Works then segment then turns to the SW and travels parallel to the River Mersey where it terminates at Forrest Way roundabout where proposed Bridge 3 crosses the River Mersey to the west. The length of the route is 1200m.	Bridge 3: Forrest Way Proposed bridge over the River Mersey and Fiddler's Ferry Railway			
GROUND GEOLOGY/ MODEL	RELEVANT BOREHOLE LOGS			
The BGS 1:50,000 map shows the geology to comprise Glaciofluvial Deposits on the northern side of the River Mersey and Tidal Flat Deposits to the south. Superficial deposits are underlain by sandstone of the Wilmslow Sandstone Formation. Historical borehole logs suggest there to be 3m of silt and sand to the south of the River Mersey, interpreted as TFD, which is underlain by 6m of sands and gravels, interpreted as GFD, and at least 20m of gravelly clay, interpreted as GT. TFD is absent to the north of the river where ground comprises of 3m of GFD underlain by GT to at least 16mbgl.	SJ58NE3 SJ58NE721 SJ58NE722 SJ58NE723			
	Strata	Typical Base Level (mAOD)		
		N	S	
	Tidal Flat Deposits	9 – 6	8 – 5	
	Glaciofluvial Deposits		5 - -1	
Glacial Till	Proven to 6	Proven to -1		
	Groundwater level: 3mAOD			
TOPOGRAPHY/ EARTHWORKS				
Elevation drops from 11mAOD at Sankey Way (A57) to 7mAOD as the segment passes south through Sankey Recreation Ground to Fiddler's Ferry Railway at 300m. Elevation then quickly rises to 13mAOD over the next 80m before dropping to 3mAOD over the River Mersey and then rising again to 8mAOD as the segment curves to the SW at 800m. Elevation then gently rises to 11mAOD where it stays roughly level for the remainder of the segment. An approach embankment is required for Bridge 3 and either side of Bridge 4				
HISTORICAL LAND USE				
There are many on-line historical heavy industry land uses around Atherton's Quay through which the segment directly passes. These are as follows: <ul style="list-style-type: none"> • Transport support and cargo handling, dated 1849-1993. • Heavy product manufacture – rolling and drawing of iron, steel and ferroalloys, dated at 1908-1954. • Metal casting and foundries, dated 1908-1954. • Machinery – engines, building and general industrial manufacturing, dated at 1928. • Unspecified works, dated at 1993. There are also a large number of off-line historical industrial activity around Bank Quay, upstream of the proposed segment. These are as follows: <ul style="list-style-type: none"> • Cement, lime and plaster products, dated at 1849 • Food processing, dated at 1849. • Metal casting and foundries, dated 1849-1954. • Insulated wire and cable, dated at 1910. • Chemical manufacturing, dated at 1910. • Heavy product manufacture – rolling and drawing of iron, steel and ferroalloys, dated at 1928-1954 • Animal by-products – soap, gelatine, glue, dated 1928-1954. • Unspecified works from 1896 to 1993 around Bank Quay. <ul style="list-style-type: none"> • An on-line historic tank is marked at the segment start at 359197, 388042 from 1972 to 1986. 				
HYDROLOGY/ FLOOD RISK				
<ul style="list-style-type: none"> • The segment crosses onto a peninsula of the River Mersey – an EA Main River - which flows from the south, around Bank Quay and to the SW towards Arpley Landfill Site. • There are a large number of drainage channels that have been installed at the southern end of the peninsula. • There is a small section of the segment along Fiddler's Ferry Railway at risk of surface flooding from a 1 in 30 year flood event. The area at risk is progressively larger for a 1 in 100 year event, which includes a section to the north at Samuel Street, and a 1 in 1000 year event, which also includes at-risk sections at Sankey Recreation Ground, and to the south on the peninsula and near Forrest Way roundabout. 				

- There is a high risk of flooding from rivers and seas where the segment crosses the River Mersey and a high to low risk from Sankey Recreation Ground down to Old Liverpool Road.

LICENSED INDUSTRIAL ACTIVITY

There are 3No. on-line trade directory points at Atherton's Quay. These are:

- Disability equipment, manufacturers and suppliers (active), 359208, 387839.
- Furniture repair/polishers (inactive)/wrought ironwork (inactive), 359220, 387806.
- Joinery manufacturers (active), 359197, 387841.

There are also a number of off-line trade directory points, all of which are inactive and located along Old Liverpool Road., including 8No. for car sales/auto-repair and a waste disposal can recycling centre,

DISCHARGE CONSENTS

There are in excess of 20No. off-line discharge points around Atherton's Quay and Bank Quay which discharged sewage and chemical products into the River Mersey upstream of the segment crossing and 4No. sewage discharge points 60-80m to the NW of the northern end of the segment, discharging into Sankey Brook.

SENSITIVE LAND USE

The northern end of the segment is within a Surface Water Nitrate Vulnerable Zone (NVZ) Area with NVZ number S639.

MINERAL SITES

None recorded.

HYDROGEOLOGY/ GROUNDWATER SOURCE PROTECTION ZONES

Tidal Flat Deposits to the south are classified as a Secondary Undifferentiated Aquifer and Glaciofluvial Deposits to the north are classified as a Secondary A Aquifer.

The Wilmslow Sandstone Formation is classified as a Principal Aquifer.

LANDFILLS AND WASTE MANAGEMENT

The southern end of the segment at Forrest Way roundabout is 150m to the north of the boundary of Arpley Landfill – an active landfill site which is not restricted on the type of waste which can be deposited there and is licensed as a co-disposal site, meaning that non-hazardous and hazardous waste has been buried together.

POLLUTION INCIDENTS

- An off-line IPC Point is present 10m from the middle of the segment at 359505, 387500 for the manufacture and use of organic chemicals by Vinamul Ltd/Celanese Emulsions Ltd from 1997 to 1999.
- There are 2No. off-line IPCC Points are around Bank Quay: Pq Silicas UK Ltd at 359885, 387808, 2006 to present and Celanese Emulsions Ltd at 359661, 387732, 2007 to present.
- There are 6No. off-line recorded pollution incidents around Bank Quay and upstream of the segment. 3No. of these occurred in 1995-1996 and involve the use of miscellaneous chemicals (359700, 387800), organic chemicals (359500, 387800) and polymer emulsion (359500, 387900). Incident severity is classified as minor. The remaining incidents occurred in 1995 and involve the use of oil pollutants, 2No. of which were minor (359700, 387900 and 359900, 387800) and 1No. of which was major (359700, 387700). All incidents occurred within the River Mersey catchment. A significant off-line pollution incident also occurred in 2004 at Forrest Way roundabout where there was a significant impact to land involving unknown contaminants.
- There is a recorded 'breach of conditions of authorisation by failure to prevent release of unauthorised substances and failure to ensure control of process during production', occurring in 1995 at the works on the peninsula edge.
- An inactive NIHHS Point is present at 359600, 387700 at the peninsula edge.
- Authorisation was issued for the disposal of radioactive waste at Bank Quay (359700, 388010) in 1991-1995.

POTENTIAL FOR CONTAMINATION

There is a high concentration of historical heavy industrial activity at Atherton's Quay through which the segment passes and at the surrounding area of Bank Quay. On-line land uses include foundries and iron works. This section of the segment is considered most at risk of contamination. Although the segment to the south of Atherton's Quay is less at risk from historical land use, there is the potential for contamination at the Celanese Emulsions Ltd IPC Point and Forrest Way roundabout where a significant pollution incident occurred.

GEOTECHNICAL RISKS

- Compressible/weak ground comprising unconsolidated TFD, posing a risk to bridge construction, embankment construction and highway construction.
- TFD has low potential for re-use as suitable embankment fill, contributing towards a material deficit.

SEGMENT NAME	ROUTE OPTIONS ADOPTING SEGMENT	
A6	Route 36: E, P (I); Route 37: E, P (II); Route 39: E, R (I)	
SEGMENT DESCRIPTION	STRUCTURES REQUIRED	
The segments starts at proposed Bridge 8 which crosses over the disused St Helen's Canal and Fiddlers Ferry Railway from Penketh Business Park. The segment travels 170m to the SW through Gatewarth Farm Landfill before turning westwards and continuing to Sankey Valley Park and meeting proposed Bridge 9 which crosses over the River Mersey to the south.	Bridge 8: Garston Bridge Bridge 9: West Mersey	
GROUND GEOLOGY/ MODEL	RELEVANT BOREHOLE LOGS	
The BGS 1:50,000 map shows the geology to comprise Glaciofluvial Deposit over the eastern half of the segment and Tidal Flat Deposits over the western half. Superficial deposits are underlain by Wilmslow Sandstone Formation.	SJ58NE152 SJ68NE1112 SJ58NE1512 SJ58NE1519	There is a distinct lack of available boreholes across the segment and within Gatewarth Farm Landfill. The ground model below has been informed by the closest boreholes that are believed to be representative of conditions along the segment.
Boreholes at the NE side of the landfill to the east of the segment record mixed made ground (including 'chemical fill') to depths of 2mbgl, underlain by medium dense sand and gravel, interpreted as GFD, to depths of 3.5mbgl and stiff to very stiff clay with gravel, interpreted as GT, to depths of 10mbgl.	Strata	Typical Base Level (mAOD)
		E W
	Landfill	7 – 6 11 – 8
	Tidal Flat Deposits	7 – 4
	Glaciofluvial Deposits	5.5 - 4.5
	Glacial Till	Proven to 5.5 Proven to 4
Boreholes within the TFD mapped zone record soft sandy clay and silt, interpreted as TFD, to depths of up to 4mbgl underlain by stiff to very stiff clay with gravel, interpreted as GT, to depths of 10mbgl. Given differences in elevation it is likely that this area of the segment also comprises at least 2-5m of made ground.	Groundwater level: 3mAOD	
TOPOGRAPHY/ EARTHWORKS	Starting at 7mAOD at St Helen's Canal, Elevation rises to 13mAOD at Gatewarth Farm Landfill. It quickly drops to 7mAOD and rises back to 13mAOD as the segment travels towards the west, remaining at this elevation over the landfill site. Elevation falls again to 6mAOD at the edge of the landfill where a tributary flows southwards into the River Mersey. Topographic gradient exceeds 6% as the segment passes an unnamed road at 340m. A cutting may need to be constructed in order to achieve highway acceptable gradients whilst maintaining the use of the unnamed road.	
HISTORICAL LAND USE	<ul style="list-style-type: none"> There is 1No. on-line area of land use - a 'heap of unknown constituents' to the immediate SW of the segment end where a bridge is proposed to cross the River Mersey, dated at 1993. There is 1No. off-line area of land use - a sewage disposal site 100m to the south of the segment, to the immediate east of Sankey Valley Park, dated at 1993. 	
HYDROLOGY/ FLOOD RISK	<ul style="list-style-type: none"> Proposed bridges Bridge 8 and 9 pass over the disused St Helens Canal and the River Mersey, both of which flow towards the SW. Sankey Brook – a tributary which flows into the River Mersey from the NE. – lies 10m away from the proposed segment at its closest point There are large bodies of water to the south of the segment next to Sankey Brook. The segment is shown to be at risk of surface water flooding from a 1 in 30 year flood event where it passes closest to Sankey Brook within the landfill site and at the end of the segment where it passes over a tributary of the River Mersey which flows from the north. Affected areas are progressively larger for a 1 in 100 year flood event and 1 in 1000 year flood event, with the addition of the section crossing over St Helen's Canal. The same areas as above are shown to be at risk of flooding from rivers and seas, where risk is classified as high around Sankey Brook, high to low at the tributary flowing through Sankey Valley Park and medium to low at St Helen's Canal. 	
LICENSED INDUSTRIAL ACTIVITY	None recorded	
DISCHARGE CONSENTS	3No. on-line sewage discharge consents are shown where the segment travels past Sankey Brook at its closest point. A date of 2010 is only provided for one point.	
SENSITIVE LAND USE	MINERAL SITES	

The western end of the segment is within a surface water NVZ Area – NVZ number S639.	None recorded.
HYDROGEOLOGY/ GROUNDWATER SOURCE PROTECTION ZONES	
Tidal Flat Deposits across the site are classified as a Secondary Undifferentiated Aquifer. Glaciofluvial Deposits are classified as a Secondary A Aquifer. The Wilmslow Sandstone Formation is classified as a Principal Aquifer.	
LANDFILLS AND WASTE MANAGEMENT	
The entire segment from St Helen's Canal to the River Mersey is within the Gatewarth Farm Landfill Site – an historic landfill which reportedly holds inert, industrial commercial, household and special waste from between 1968 and 1989. There was no restriction on the type of waste that could be deposited.	
POLLUTION INCIDENTS	
There is 1No. pollution incident recorded 40m to the south of segment near where Sankey Brook flows closest to the segment. Occurring in 1993 and affecting the Sankey Brook catchment, it is classified as a minor incident involving miscellaneous pollutants	
POTENTIAL FOR CONTAMINATION	
The landfill was unrestricted in regards to material disposal and hence it is unknown as to the types of contaminants within the ground and how highway works may be affected. There is therefore a potential for contamination and a risk to human health.	
GEOTECHNICAL RISKS	
<ul style="list-style-type: none"> • Moderate risk of running sand (BGS). • Potentially compressible, weak and variable landfill deposits; unsuitable for use as bridge and embankment foundation strata as well as subgrade for highway construction. • Landfill deposits unsuitable for re-use as fill for approach embankments and hence a material deficit for the segment. • Where required to level out slopes to highway acceptable gradients, cuttings can expose contaminants within the landfill. 	

SEGMENT NAME	ROUTE OPTIONS ADOPTING SEGMENT		
A7	Route 25: D, P (I); Route 26: D, P (II); Route 28: D, R (I); Route 29: D, R (II); Route 30: D, R (III)		
SEGMENT DESCRIPTION	STRUCTURES REQUIRED		
The segment commences at Halton's Bridge at Penketh Road (A562) and travels 300m to the SE, alongside a tributary of the River Mersey and in between residential areas. Continuing to the SE, the segment crosses over the disused St Helen's Canal/Fiddler's Ferry Railway, Sankey Valley Park and the River Mersey on proposed Bridge 9.	Bridge 9: West Mersey		
GROUND GEOLOGY/ MODEL	RELEVANT BOREHOLE LOGS		
The BGS 1:50,000 map shows geology to comprise Tidal Flat Deposits (Alluvium) for the length of the segment overlying Glacial Till, Shirdley Hill Sand Formation and Glaciofluvial Deposits. Superficial deposits are underlain by the Wilmslow Sandstone Formation.	SJ58NE151 SJ58NE152 SJ58NE1300 SJ58NE1580 SJ58NE1581		
	Historical borehole records show up to 3m of Made Ground deposits comprising soil, clay, ash and brick fragments along the length of the segment. Underlying this to the south is up to 1.3m of soft silty clay and clayey silt, interpreted as TFD, underlain by stiff to very stiff sandy clay, interpreted as GT, to a depth of 10mbgl. Underlying Made Ground to the north is TFD and up to 3m of medium dense sand and gravel, interpreted as GFD, underlain by 0.5m of very dense sand, interpreted as weathered sandstone, and sandstone.	Strata	Typical Base Level (mAOD)
		N	S
	Made Ground	7.6 – 6	5.4 – 4.5
	Tidal Flat Deposits	4.5	4
	Glaciofluvial Deposits	5.3 – 4.4	
	Glacial Till		-2 - -2.5
	Weathered Sandstone	5.8 - 4	
	Groundwater level: 1.5mbgl		
TOPOGRAPHY/ EARTHWORKS			
Starting at 9mAOD, elevation remains constant for the first 150m of the segment where it then drops to 6mAOD and remains level until St Helen's Canal. Elevation rises slightly to 7mAOD as the segment passes onto Sankey Valley Park and terminates. An approach embankment is required for proposed Bridge 9			
HISTORICAL LAND USE			
<ul style="list-style-type: none"> There is an on-line 'heap of unknown constituents' at the segment end at Sankey Valley Park, dated at 1993 There is an off-line area of road haulage land use to the immediate east of the segment at present day Lytham Close, dated 1993. 			
HYDROLOGY/ FLOOD RISK			
<ul style="list-style-type: none"> A tributary of the River Mersey flows to the south alongside and through the proposed segment area St Helen's Canal flows to the SW through the segment near Sankey Valley Park The River Mersey flows to the SE to the south of the segment end. There are two areas of the segment at risk of surface flooding from a 1 in 30 year flood event at the middle of the segment and near the segment end at Sankey Valley Park. Areas are progressively larger for a 1 in 100 year event and a 1 in 1000 year event, covering the southern half of the segment and a section at Penketh Road (A562). The entire southern half of the segment is shown to be at high risk of flooding from rivers and seas 			
LICENSED INDUSTRIAL ACTIVITY			
None recorded			
DISCHARGE CONSENTS			
2No. on-line discharge points are shown: <ul style="list-style-type: none"> At the segment start (357270, 387730) discharging into the River Mersey tributary. The discharge consent was issued in 2002 for public sewage – storm sewage overflow. Near St Helen's Canal (357369, 387332) discharging into the River Mersey Tributary. The discharge consent was issues in 2010 for public sewage – storm sewage overflow. 			
SENSITIVE LAND USE	MINERAL SITES		
The full length of the segment is within a surface water NVZ Area – NVZ number S639.	None recorded.		
HYDROGEOLOGY/ GROUNDWATER SOURCE PROTECTION ZONES			
Tidal Flat Deposits across the site are classified as a Secondary Undifferentiated Aquifer. Glaciofluvial Deposits and deposits of the Shirdley Hill Sand Formation are classified as a Secondary A Aquifer. The Wilmslow Sandstone Formation is classified as a Principal Aquifer.			
LANDFILLS AND WASTE MANAGEMENT			

To the south of St Helen's canal the segment crosses onto the Gatewarth Farm Landfill Site – an historic landfill which reportedly holds inert, industrial commercial, household and special waste from between 1968 and 1989. There was no restriction on the type of waste that could be deposited.

POLLUTION INCIDENTS

- 1No. on-line pollution incident is recorded where the River Mersey tributary crosses St Helen's Canal. The incident occurred in 1993 and is classified as significant, involving tip leachate within the River Mersey catchment.
- 2No. off-line pollution incidents are recorded within 50m of the segment start. One incident (357800, 387300) occurred in 1991 and is classified as minor, involving miscellaneous pollutants within the Sankey Brook catchment. The other incident (357200, 387700) occurred in 1991 and is classified as minor, involving oil pollutants within the Sankey Brook Catchment.

POTENTIAL FOR CONTAMINATION

The landfill at the southern end of the segment was unrestricted in regards to material disposal and hence it is unknown as to the types of contaminants within the ground and how highway works may be affected. There is therefore the potential for contamination and a risk to human health.

GEOTECHNICAL RISKS

- Moderate risk of shrink-swell (BGS).
- Compressible/weak ground comprising unconsolidated TFD along the segment and unknown landfill deposits at Gatewarth Farm Landfill, posing a risk to bridge construction, embankment construction and highway construction.
- TFD is likely to be unsuitable for re-use as embankment fill and hence there is likely to be a material deficit for the segment.

SEGMENT NAME	ROUTE OPTIONS ADOPTING SEGMENT	
A8	Route 36: E, P (I); Route 37: E, P (II); Route 39: E, R (I); Route 40: E, R (II); Route 41: E, R (III)	
SEGMENT DESCRIPTION	STRUCTURES REQUIRED	
The segment commences at Sankey Way (A57) and passes to the SW through recreational ground, Marina Avenue and George Road before crossing over Fiddler's Ferry Railway/disused St Helens Canal on proposed Bridge 8. The segment terminates where the bridge crosses over onto the inactive Gatewarth Farm Landfill.	Bridge 8	
GROUND GEOLOGY/ MODEL	RELEVANT BOREHOLE LOGS	
BGS 1:50,000 map shows ground to be comprised of coastal blown sand of the Shirdley Hill Sand Formation in the north and Glaciofluvial Deposits sands and gravel in the south, underlain by and sandstone of the Wilmslow Sandstone Formation.	SJ58NE52 SJ58NE8 SJ58NE1262 SJ58NE1263 SJ58NE1525 SJ58NE1526	There is a distinct lack of historical borehole logs along the segment within both zones of mapped Shirdley Sand Hill Formation (north) and Glaciofluvial Deposits (south).
Historical boreholes typically record firm to very stiff Glacial Till to depths of 6mbgl (5.3mAOD) where drilling ceased. Bedrock is reached at 34mbgl at SJ58NE8 with no detailed information given for the overlying superficial deposits. Despite being within a mapped zone of the Shirdley Sand Formation, SJ58NE1262 is the only borehole log along the segment which records sand – present as a 0.5m thick layer above the Glacial Till strata. A 0.5m thick surface of concrete/tarmac is expected where the segment intersects existing roads and Penketh Business Park.	Strata	Typical Base Level (mAOD)
	Made Ground Concrete /Tarmac Glacial Till Sandstone	7 – 6.5 6.5 - -27.5 (not proven) Proven to -27.5
	Groundwater level: 3mAOD	
TOPOGRAPHY/ EARTHWORKS		
Elevation slopes gently towards the south along the segment, starting at 11mAOD at Sankey Way (157) and decreasing to 9mAOD at the recreational ground and 7mAOD at Penketh Business Park. Elevation then experiences a small rise to 8mAOD at the entrance of proposed Bridge 8 which crosses Fiddler's Ferry Railway/disused St Helen's Canal and up to 13mAOD on the opposite side of the bridge. Approach embankment for proposed Bridge 8.		
HISTORICAL LAND USE		
There is historical industrial activity at Penketh Business Park and adjacent residential areas of Finsbury Close and Chelsea Gardens. These are:		
<ul style="list-style-type: none"> • Fiddler's Ferry Railway (on-line), disused since 1993. • Chemical manufacturing (refridgeration works) (on-line) dated from 1928. • Unspecified factories and works (on-line) dated from 1954 to 1993. • Insulated wire and cable manufacture (off-line) dated from 1896. • There are also 3No. buried tanks relating to electrical sub-station facilities dated at 1970/1971 and located 50-70m away from the segment at 357955, 387799, 358157, 387918 and 357987, 387820. 		
HYDROLOGY/ FLOOD RISK		
<ul style="list-style-type: none"> • Bridge 8 crosses over the disused St Helens Canal, which flows from the NE through Sankey Bridges to the SW. • Sankey Brook flows SW within 200m of Bridge 8 and joins the River Mersey at Sankey Valley Park. • An area of the segment at the recreational ground and beneath Bridge 8 is shown to be at risk of surface flooding from a 1 in 30 year flood event. Additional areas at Penketh Business Park and along Liverpool Road are at risk from a 1 in 100 year flood event and the entire segment from St Helens Canal to the recreational ground, as well as at Liverpool Road (A57) is at risk from a 1 in 1000 year flood event. • St Helens Canal beneath the proposed bridge is shown to be at medium risk of flooding from rivers and seas. 		
LICENSED INDUSTRIAL ACTIVITY		
Several trade directory entries are present at Penketh Business Park. These are:		
<ul style="list-style-type: none"> • MCC Fabrications Ltd (active) – metal products. • Industrial Contact Supplies (active) – distribution services. • Alpha 1 Autocosmetics (inactive) – garage services. • Darcy Industries Ltd/Lancare Ltd (inactive) – chemical manufacturing. • A & S Hose Supplies (inactive) – hydraulic equipment and accessories. • Dentwerx (inactive) – car body repair services. • THHS Ltd (inactive) – commercial vehicle component manufacturing. 		
DISCHARGE CONSENTS		

None recorded.	
SENSITIVE LAND USE	MINERAL SITES
None recorded.	None recorded.
HYDROGEOLOGY/ GROUNDWATER SOURCE PROTECTION ZONES	
<p>Glaciofluvial Deposits and deposits of the Shirdley Hill Sand Formation are classified as a Secondary A Aquifer. The Wilmslow Sandstone Formation is classified as a Principal Aquifer. The segment is within Groundwater Source Protection Zone 3 of an abstraction point located to the north at 357593, 392044.</p>	
LANDFILLS AND WASTE MANAGEMENT	
<p>Proposed Bridge 8 at the southern end of the segment crosses onto the historic Gatewarth Farm Landfill Site, operational from 1968 to 1989 by Waste Disposal Authority. Deposited waste included inert, industrial, commercial, household and special waste. There is also an historic landfill 200m to the east of Bridge 8 which was operational from 1976 to 1977 by Associated Lead Manufacturers Ltd. Deposited waste included inert and industrial waste.</p>	
POLLUTION INCIDENTS	
<ul style="list-style-type: none"> • IPC points are shown for United Phosphorus Ltd at Penketh Business Park from 1994 to 1998 for the manufacture and use of organic chemicals. • IPPC points are shown for Darcy Ltd at Penketh Business Park from 2007 to 2009 for the manufacture and use of chemicals. • 1No. minor pollution incident involving oil is recorded at Gatewarth Farm Landfill 150m from the southern end of the segment at 358100, 387500. The incident occurred in 1991 and is within the catchment of St Helens Canal. • 1No. minor pollution incident involving agricultural pollutants (animal waste/slurry) is recorded 90m to the west of the segment near Penketh Business Park at 357900, 387700. The incident occurred in 1994 and is within the catchment of the River Mersey. • 3No. HM Inspectorate of Pollution (HMIP) notices were issued for works at 358200, 387700 at present day Chelsea Gardens, 200m to the east of the segment in 1994 and 1995. Notices are given for 'unauthorised release of mercaptan-containing gases from incinerator stack', 'spillage of chloropropionic acid from a road tanker inside a bunded area' and 'spillage of 400kg chloropropionic acid'. 	
POTENTIAL FOR CONTAMINATION	
<p>There is a risk of on-line contamination from historic and present-day industrial activity around the area of Penketh Business Park along the southern section of the segment. Historical activity includes railways, chemical manufacturing and cable manufacturing. The likely contaminations from these industries include a range of metals and organic and inorganic and non-metals. These can provide a risk to human health through toxicity and flammability as well as having the potential to cause deterioration to construction materials. As the segment passes directly through these areas there is a high chance that contaminated ground will be encountered. There is also a risk of off-line contamination at hotspots occurring from specified pollution incidents around the area of Penketh Business Park.</p> <p>The waste at Gatewarth Farm Landfill may well be contaminated given that it is recorded to include inert, industrial, commercial, household and special waste, and thus has the potential to affect proposed Bridge 8 which crosses over the canal and Fiddler's Ferry Railway.</p>	
GEOTECHNICAL RISKS	
<ul style="list-style-type: none"> • Potentially compressible and weak ground comprising landfill deposits, posing a risk to bridge and approach embankment construction on the southern side of St Helen's Canal. 	

SEGMENT NAME	ROUTE OPTIONS ADOPTING SEGMENT	
B1	Route 29: D, R (II); Route 40: E, R (II); Route 48: F, R (II); Route 54: G, R (I); Route 60: H, R (I); Route 66: I, R (I); Route 70: J, R	
SEGMENT DESCRIPTION	STRUCTURES REQUIRED	
The segment commences at Eastford Road beneath proposed Bridge 2 – an existing viaduct which spans over the West Coast Main Line and Western Line. The segment travels 140m to the SE before turning to the south, crossing over Baronet Works and the Manchester Ship Canal on proposed Bridge 1 and terminating at Cheshire Road (A56).	Bridge 1: MSC Bridge 10: Eastford Road	
GROUND GEOLOGY/ MODEL	RELEVANT BOREHOLE LOGS	
<p>The BGS 1:50,000 map shows geology to comprise Tidal Flat Deposits over the northern half of the segment and deposits of the Shirdley Hill Sand Formation over the southern half of the segment. Superficial deposits are underlain by the Helsby Sandstone Formation over the northern half of the segment and the Tarporley Siltstone Formation over the southern half of the segment. Tarporley Siltstone Formation is shown to outcrop at the segment end at Cheshire Road (A56)</p> <p>Historic borehole records show the ground at the northern half of the segment to comprise up to 4m of soft sandy clay and loose sand, interpreted as TFD. Ground at the southern half of the segment is shown to comprise up to 3m of firm sandy clay, interpreted as TFD, underlain by up to 3.5m of fine to medium grained medium dense sand which is interpreted as the Shirdley Hill Sand Formation. A 1m layer of medium dense sand and gravel, interpreted as GFD, is present beneath the Shirdley Hill Sand Formation in borehole SJ58NE21. Beneath superficial deposits is hard sandstone.</p>	SJ58NE21 SJ58NE48 SJ58NE49 SJ58NW894 SJ58NE1155 SJ58NE1448	
	Strata	Typical Base Level (mAOD)
	Tidal Flat Deposits Coastal Blown Sand Sandstone	8 – 3 10 – 5 Proven to 5
	Groundwater level: 7mAOD	
TOPOGRAPHY/ EARTHWORKS		
<p>From the start of the segment at Eastford Road to the northern side of Manchester Ship Canal, elevation increases gradually from 7mAOD to 9mAOD. Elevation drops to 5mAOD over the canal and then rises rapidly to 12mAOD over its southern bank, where it then steadily increases to 18mAOD by Penketh Road (A56) over the remaining 200m of the segment.</p> <p>An approach embankment is required either side of the bridge crossing the Manchester Ship Canal.</p>		
HISTORICAL LAND USE		
<p>There are 2No. on-line areas of historic land use. These are as follows:</p> <ul style="list-style-type: none"> Railways of the Walton Old Junction at the segment start, dated from 1882 to 1954 Baronet Works along Manchester Ship Canal, where there was sawmilling and timber treatment from 1928 to 1954, unspecified works dated at 1993 and a railway running along the canal dated from 1899 to 1954. <p>There are 2No. off-line areas of historic land use. These are as follows:</p> <ul style="list-style-type: none"> A 'heap of unknown constituents' dated at 1954, 100m to the NE of the segment start. 		
HYDROLOGY/ FLOOD RISK		
<ul style="list-style-type: none"> The River Mersey – an EA main river – flows from the north and turns curves towards the west, passing alongside the start of the segment before the river channel turns northwards towards Bank Quay. The disused Runcorn and Latchford Canal passes through the start of the segment. The Manchester Ship Canal flows towards the SW, passing through the southern end of the segment. There is a risk of surface water flooding from a 1 in 100 year flood event at Eastford road where the segment passes through Runcorn and Latchford Canal. The affected area is larger for a 1 in 1000 year flood event and also includes sections of the segment at baronet Road, Chester Road (A56) and along Manchester Ship Canal. Land to the north of the Manchester Ship Canal is at a medium risk of flooding from rivers and seas. This rises to a high risk for segment start, next to the River Mersey, and near the segment end, next to the Manchester Ship Canal. 		
LICENSED INDUSTRIAL ACTIVITY		
There is 1No.on-line trade directory entry at Baronet Works, identified as Solvay Interlox Ltd - chemical distributors and wholesalers.		
DISCHARGE CONSENTS		

<ul style="list-style-type: none"> • There is 1No. on-line discharge consent point at the start of the segment at 359870, 386520. The discharge consent was issued in 1994 and has now lapsed. It was used by Solvay Intertox Ltd to discharge cooling water used in the manufacture of chemicals into the River Mersey. • There is 1No. off-line discharge consent point within 200m to the east of the segment near Runcorn and Latchford Canal. The discharge consent, issued from 1989 to 1997, was used by Solvay Intertox Ltd to discharge process water used in the manufacture of chemicals into a tributary of the River Mersey. 	
SENSITIVE LAND USE	MINERAL SITES
None recorded.	<p>Stockton Heath Sand Pit (inactive) and an adjacent sand and gravel quarry (inactive) 180m to the east of the segment end at 360270, 385908.</p> <p>Morley Common Sand Pit (inactive) 100m to the east of the segment on the northern side of Manchester Ship Canal at 360182, 386160.</p>
HYDROGEOLOGY/ GROUNDWATER SOURCE PROTECTION ZONES	
<p>Tidal Flat Deposits are classified as a Secondary Undifferentiated Aquifer and the Shirdley Hill Sand Formation is classified as a Secondary A Aquifer.</p> <p>The Helsby Sandstone Formation is classified as a Principal Aquifer and the Tarporley Siltstone Formation is classified as a Secondary B Aquifer.</p>	
LANDFILLS AND WASTE MANAGEMENT	
<ul style="list-style-type: none"> • The eastern boundary of the active Arpley Landfill Site is located 300m to the west of the segment start. The landfill currently has no restrictions on the type of waste and material that can be deposited and is licensed as a co-disposal site, meaning that non-hazardous and hazardous waste has been buried together. • There is a registered waste transport site at Walton New Junction, 180m to the SW of the segment start. The site, which had no restrictions on the source of waste, was registered in 1993 and did not receive a superseding license. 	
POLLUTION INCIDENTS	
<ul style="list-style-type: none"> • There are 2No. off-line pollution incidents within 100m of the segment start at 359800, 386500 and 359900, 386400. Both incidents involved oil pollutants and are classified as minor, occurring in 1997/1998 within the River Mersey Catchment. • Integrated Pollution Control (IPC) and Integrated Pollution Prevention Control (IPPC) points are present for Solvay Intertox Ltd at Baronet Works from 1992 to present day, given for organic chemicals (manufacture and use) and combustion processes. • Solvay Intertox Ltd is a Control of Major Accident Hazards (COMAH) and Notification of Installations Handling Hazardous Substances (NIHHS) site. 	
POTENTIAL FOR CONTAMINATION	
<ul style="list-style-type: none"> • A potential source of contamination is the chemical works at Baronet Works on the northern side of Manchester Ship Canal. The most likely contaminants are inorganic non-metals which can be toxic, providing a risk to human health, as well as having the potential to cause deterioration to construction materials. • Another potential source of contamination is the historical saw mill and timber treatment works at Baronet Works, which typically uses a variety of organic and inorganic chemicals and metals. Such substances can be considered as flammable and toxic, providing a risk to human health, with the potential to deteriorate construction materials. • Railway land along the north of Manchester Ship Canal has the potential to contain oils/solvents, metals and other inorganic compounds associated with the industry. Existing contaminants are likely to be solid metals and non-metals which pose a risk to human health. 	
GEOTECHNICAL RISKS	
<ul style="list-style-type: none"> • Compressible/weak ground comprising unconsolidated TFD along the segment, posing a risk to bridge construction, embankment construction and highway construction. • The segment is proposed to run across the disused Runcorn and Latchford Canal which is undrained. 	

SEGMENT NAME	ROUTE OPTIONS ADOPTING SEGMENT	
B2	Route 29: D, R (II); Route 40: E, R (II); Route 48: F, R (II); Route 50: F, S	
SEGMENT DESCRIPTION	STRUCTURES REQUIRED	
The segment commences at Forrest Way roundabout where Bridge 3 is proposed to cross over the River Mersey to the west. The segment travels 500m to the east where it then turns to the SE and follows the channel of the River Mersey to the Walton Viaduct at proposed Bridge 2	Bridge 3: Forrest Way	
GROUND GEOLOGY/ MODEL	RELEVANT BOREHOLE LOGS	
<p>The BGS 1:50,000 map shows geology to comprise Tidal Flat Deposits over the length of the segment. Superficial deposits are underlain by the Wilmslow Sandstone Formation over the northern half of the segment and the Helsby Sandstone Formation over the southern half of the segment.</p> <p>Historical borehole records show the ground to comprise up to 6m of loose sand and soft clay and silt which interpreted as TFD, underlain by 12m of firm clay and gravel, interpreted as GT. A 6m thick layer of sand and gravel, interpreted as GFD, is present beneath above GT in boreholes 400m to the north of the segment. Superficial deposits are underlain by sandstone at a depth of 18mbgl on the opposite side of the proposed bridge crossing the River Mersey.</p>	SJ58NE3 SJ58NE4 SJ58NE634 SJ58NE1155	There is a lack of available boreholes along the segment; the ground model below has been informed by BGS data and boreholes up to 400m away which are believed to be representative of ground conditions along the segment.
	Strata	Typical Base Level (mAOD)
	Tidal Flat Deposits Glacial Till/ Glaciofluvial Deposits Sandstone	11 - 5 5 - -2 Proven to -2
	Groundwater level: 7mAOD	
TOPOGRAPHY/ EARTHWORKS	<p>Elevation is fairly constant at 11-13mAOD as the segment travels east across the peninsula. Where the segment reaches the River Mersey and follows the channel to the SE, elevation drops steadily until it reaches 6mAOD at the Walton Viaduct.</p> <p>An approach embankment is required for the proposed bridge over the River Mersey.</p>	
HISTORICAL LAND USE	<ul style="list-style-type: none"> There is 1No. on-line areas of historic land use present as railways of the Walton Old Junction at the segment end, dated from 1882 to 1954. 	
HYDROLOGY/ FLOOD RISK	<ul style="list-style-type: none"> The segment is on a peninsula of the River Mersey, which flows northwards to Bank Quay and curves round to flow towards the SW and along the northern boundary of the Arpley Landfill Site. There is a water body 350m to the SW of the segment start, 130m to the SW of the segment end and 170m to the SW of the segment end. There are a lot of drainage channels within the eastern area of Arpley Landfill and across the peninsula, two of which are intersected by the segment. There are two sections of the segment at risk of surface flooding from a 1 in 1000 year flood event, located at the segment start and at the middle of the segment next to the River Mersey. The entire southern-eastern section of the segment that runs parallel to the River Mersey is at a high risk from flood from rivers and seas. 	
LICENSED INDUSTRIAL ACTIVITY	None recorded.	
DISCHARGE CONSENTS	None recorded.	
SENSITIVE LAND USE	MINERAL SITES	
None recorded.	None recorded.	
HYDROGEOLOGY/ GROUNDWATER SOURCE PROTECTION ZONES		
<p>Tidal Flat Deposits are classified as a Secondary Undifferentiated Aquifer.</p> <p>The Helsby Sandstone Formation and the Wilmslow Sandstone Formation are classified as a Principal Aquifer.</p>		
LANDFILLS AND WASTE MANAGEMENT		
<ul style="list-style-type: none"> The northern boundary of the active Arpley Landfill Site is located 100m to the south of the northern section of the segment. The landfill currently has no restrictions on the type of waste and material that can be deposited and is licensed as a co-disposal site, meaning that non-hazardous and hazardous waste has been buried together. There is a registered waste transport site at Walton New Junction, 180m to the SW of the segment start. The site, which had no restrictions on the source of waste, was registered in 1993 and did not receive a superseding license. 		

POLLUTION INCIDENTS

There are 2No. on-line pollution incidents affecting the segment. These are as follows:

- An incident occurred at Forrest Way roundabout at the segment start in 2004. The incident involved unknown pollutants and a significant impact to land was recorded.
- An incident occurred near Walton Viaduct at the segment end in 2001. The incident involved unknown pollutants and a significant impact to land was recorded.
- An HMIP Enforcement Notice was given at 359675, 613000 - land to the immediate SE of the segment end. It was issued in 1994 for 'breach of authorisations; release of monomers including 1.2 tonnes of vinyl chloride'.

POTENTIAL FOR CONTAMINATION

- Railway land around Walton Viaduct has the potential to contain oils/solvents, metals and other inorganic compounds associated with the industry. Existing contaminants are likely to be solid metals and non-metals which pose a risk to human health.
- 2No. on-line pollution incidents incurred a significant impact to land. The pollutants involved are unknown and hence there is a risk of existing contamination at these sites.

GEOTECHNICAL RISKS

- Compressible/weak ground comprising unconsolidated TFD along the segment, posing a risk to bridge construction, embankment construction and highway construction.

SEGMENT NAME	ROUTE OPTIONS ADOPTING SEGMENT	
B3	Route 29: D, R (II); Route 41: E, R (III); Route 43: F, P (I); Route 44: F, P (II); Route 47: F, R (I); Route 49: F, R (III); Route 51: G, P (I); Route 52: G, P (II); Route 55: G, R (II); Route 57: H, P (I); Route 58: H, P (II); Route 61: H, R (II); Route 63: I, P (I); Route 64: I, P (II); Route 67: I, R (II)	
SEGMENT DESCRIPTION	STRUCTURES REQUIRED	
The segment commences at Forrest Way roundabout where Bridge 3 is proposed to cross the River Mersey to the west. The segment follows the River Mersey to the SW along the northern edge of Arpley Landfill, crossing through a body of water at 350m, a gas extraction plant at 500m and a body of water at 700m before the segment ends at 900m.	Bridge 3: Forrest Way	
GROUND GEOLOGY/ MODEL	RELEVANT BOREHOLE LOGS	
The BGS 1:50,000 map shows geology to comprise Tidal Flat Deposits over the length of the segment. Superficial deposits are underlain by the Wilmslow Sandstone Formation. Over the length of the segment.	SJ58NE634 SJ58NE1 SJ58NE716 SJ58NE1141	There are no boreholes available which were drilled after the landfill was constructed and hence landfill thickness and composition is uncertain.
Historical borehole records show the ground to comprise up to 6m of soft silty sandy clay and clayey silty sand, interpreted as TFD, underlain by up to 6m of medium dense sand and gravel, interpreted as GFD. Sandstone was reached at 18mbgl at SJ58NE634 near the segment start and 10mbgl at SJ58NE1141 near the segment end.		
Elevation data suggests that landfill deposits along the segment are on average 6m thick, increasing up to 12m thick at the segment end. The bottom of the landfill deposits may comprise loose material from the historic dredging grounds. Note that the northern half of the segment is not within the landfill site and hence is not expected to comprise landfill deposits.	Strata	Typical Base Level (mAOD)
	Landfill	9 – 6
	Tidal Flat Deposits	2 - 3
	Glaciofluvial Deposits	-4.5
	Sandstone	Proven to -4.5
	Groundwater level: 4mAOD	
TOPOGRAPHY/ EARTHWORKS		
Elevation is fairly constant for the first 500m of the segment, ranging from 11mAOD to 13mAOD. As the segment passes through the gas extraction plant elevation decreases from 12mAOD to 1mAOD over 150m where a pit in the Arpley Landfill is present. On the opposite side of the pit elevation rises up to 21mAOD over a 90m distance, at which point it remains level for the remainder of the segment.		
An approach embankment is needed where a bridge is proposed to cross the River Mersey. Gradient exceeds 6% either side of the pit near the gas extraction plant. An embankment may be required in order to achieve highway acceptable gradients.		
HISTORICAL LAND USE		
Arpley Landfill, though which the segment passes, was previously a dredging deposit ground.		
HYDROLOGY/ FLOOD RISK		
<ul style="list-style-type: none"> The segment starts a peninsula of the River Mersey, which flows from the north at Bank Quay and then westwards along the northern edge of the Arpley Landfill Site. There is a water body along the segment path at 350m and 700m, as well as the disused Runcorn and Latchford Canal 300m to the SE of the segment. There are a lot of drainage channels within the eastern area of Arpley Landfill and across the peninsula, some of which are intersected by the segment. There is a risk of surface water flooding from a 1 in 100 year flood event at the water body near the end of the segment. A progressively larger area is affected for a 1 in 1000 year flood event. 		
LICENSED INDUSTRIAL ACTIVITY		
There are on-line 4No. trade directories for waste disposal services 200m from the segment start – 358959, 386801. 2No. of these are active under names of SCC Environment and FCC Environment.		
DISCHARGE CONSENTS		
There is 1No off-line discharge consent 100m to the NW of the segment near the gas extraction plant – 358840, 386700. The discharge consent was given for sewage disposal in 2002 and is no longer active; it was replaced by IPC Authorisation.		
SENSITIVE LAND USE	MINERAL SITES	
None recorded.	Arpley Landfill Site Gas Extraction (active) in the path of the proposed segment mid-section at 358837, 386594.	

HYDROGEOLOGY/ GROUNDWATER SOURCE PROTECTION ZONES

Tidal Flat Deposits are classified as a Secondary Undifferentiated Aquifer.
The Wilmslow Sandstone Formation are classified as a Principal Aquifer.

LANDFILLS AND WASTE MANAGEMENT

The entire segment is within the Arpley Landfill Site. The landfill license was issued in 1997 and has no restrictions on material and waste being deposited.

POLLUTION INCIDENTS

There are 2No. on-line pollution incidents affecting the segment. These are as follows:

- An incident occurred at Forrest Way roundabout at the segment start in 2004. The incident involved unknown pollutants and a significant impact to land was recorded.
- An incident, classified as minor, occurred at the segment end in 1994. The incident involved landfill surface runoff of miscellaneous pollutants.
- There is an active on-line IPPC point located 200m from the segment start under the name of 3C Waste Ltd.
- There was a reported breach in the conditions of an operating license for the facilities that the IPPC point above corresponds to.
- The landfill was reportedly fined at an unknown date for 'failure to control and minimise the escape of landfill gas, prevent escaping leachate and maintain effective measures to prevent disruption of waste material.'

POTENTIAL FOR CONTAMINATION

The entirety of the segment north of the water-infilled Acton Grange Sand Pit is within the Arpley Landfill Site. The landfill is unrestricted in regards to material disposal and hence it is unknown as to the types of contaminants within the ground and how highway works may be affected. There is also a record of uncontrolled gas escape and leachate migration. Therefore, the presence of contamination with the potential to affect human health and highway construction is considered to be high.

GEOTECHNICAL RISKS

- Moderate hazard of running sand and shrink-swell (BGS).
- Potentially compressible, weak and variable landfill deposits; unsuitable for use as subgrade for highway construction.
- Compressible/weak ground comprising unconsolidated TFD along the segment, posing a risk to bridge construction, embankment construction and highway construction.
- There is a risk of ground settlement if the water table is lowered during the infilling of existing water bodies.
- Landfill material and TFD is likely unsuitable for re-use as fill and hence there is likely a large material deficit if the two intersected water bodies are to be infilled with suitable granular material and an approach embankment constructed.
- Settlement may occur if the water table is lowered as a result of drainage water bodies. Leachate management will also be required if pumping is undertaken.

SEGMENT NAME		ROUTE OPTIONS ADOPTING SEGMENT	
B4		Route 54: G, R (I); Route 56: G, S; Route 60: H, R (I); Route 62: H, S; Route 66: I, R (I); Route 68: I, S	
SEGMENT DESCRIPTION		STRUCTURES REQUIRED	
The segment commences in the middle of a peninsula of the River Mersey where there is a proposed bridge crossing the River Mersey and Fiddler's Ferry Railway. The segment follows a linear path for 600m to the south along an unnamed road, parallel to the River Mersey.		Bridge proposed over the River Mersey and Fiddler's Ferry Railway.	
GROUND GEOLOGY/ MODEL		RELEVANT BOREHOLE LOGS	
The BGS 1:50,000 map shows geology to comprise Tidal Flat Deposits over the length of the segment. Superficial deposits are underlain by the Wilmslow Sandstone Formation over the length of the segment. Historical borehole records show the ground to comprise 6m of silt and sand, interpreted as TFD, underlain by 6-7m of sand and gravel, interpreted as GFD, and at least 10m of stiff clay and stones, interpreted as GT.		SJ58NE3 SJ58NE4	No historical boreholes are available for the southern half of the segment.
		Strata	Typical Base Level (mAOD)
		Tidal Flat Deposits Glaciofluvial Deposits Glacial Till	5 -1 Proven to -11
		Groundwater level: 7mAOD	
TOPOGRAPHY/ EARTHWORKS			
Elevation increases gently towards the south from 8mAOD at the segment start to 13mAOD at the segment end.			
HISTORICAL LAND USE			
None recorded.			
HYDROLOGY/ FLOOD RISK			
<ul style="list-style-type: none"> The segment is on a peninsula of the River Mersey, which flows northwards to Bank Quay and curves round to flow towards the SW and along the northern boundary of the Arpley Landfill Site. The segment running alongside the River Mersey is at a high risk of flood from rivers and seas. 			
LICENSED INDUSTRIAL ACTIVITY			
None recorded.			
DISCHARGE CONSENTS			
None recorded.			
SENSITIVE LAND USE		MINERAL SITES	
None recorded.		None recorded.	
HYDROGEOLOGY/ GROUNDWATER SOURCE PROTECTION ZONES			
Tidal Flat Deposits are classified as a Secondary Undifferentiated Aquifer. The Wilmslow Sandstone Formation are classified as a Principal Aquifer.			
LANDFILLS AND WASTE MANAGEMENT			
<ul style="list-style-type: none"> The eastern boundary of the active Arpley Landfill Site is located 200m to the west of the segment end. The landfill currently has no restrictions on the type of waste and material that can be deposited and is licensed as a co-disposal site, meaning that non-hazardous and hazardous waste has been buried together. 			
POLLUTION INCIDENTS			
<ul style="list-style-type: none"> There is a revoked IPC Point off-line near the segment start at 359505, 387500, given for the manufacture and use of organic chemicals by Vinamul Ltd/Celanese Emulsions Ltd from 1997 to 1999. 			
POTENTIAL FOR CONTAMINATION			
<ul style="list-style-type: none"> Considered to be low based on the lack of pollution incidents and historic land use along the segment. 			
GEOTECHNICAL RISKS			
<ul style="list-style-type: none"> Compressible/weak ground comprising unconsolidated TFD along the segment, posing a risk to bridge construction, embankment construction and highway construction. 			

SEGMENT NAME	ROUTE OPTIONS ADOPTING SEGMENT		
B5	Route 57: H, P (I); Route 58: H, P (II); Route 60: H, R (I); Route 61: H, R (II); Route 62: H, S; Route 63: I, P (I); Route 64: I, P (II); Route 66: I, R (I); Route 67: I, R (II); Route 68: I, S		
SEGMENT DESCRIPTION	STRUCTURES REQUIRED		
This segment includes two bridge options. For the first option, proposed Bridge 4 connects to the southern roundabout exit at Liverpool Road which crosses over the River Mersey and Fiddlers Ferry Railway to the south and south east – a distance of 330m. For the second option, the proposed bridge connects to the east of the roundabout at Liverpool Road (A5061) and crosses over the River Mersey and Fiddler's Ferry Railway to the south – a distance of 340m. From this point at the works on the peninsula edge, the two options join and the segment continues 360m to the SW.	Bridge 4: East Mersey/ Bridge proposed to cross over the River Mersey and Fiddler's Ferry Railway.		
GROUND GEOLOGY/ MODEL	RELEVANT BOREHOLE LOGS		
The BGS 1:50,000 map shows the geology to comprise Glaciofluvial Deposits and the Shirdley Hill Sand Formation on the northern side of the River Mersey and Tidal Flat Deposits to the south. Superficial deposits are underlain by sandstone of the Wilmslow Sandstone Formation.	SJ58NE4 Sj58NE2 SJ58NE16 SJ58NE724 SJ58NE725 SJ58NE1464		
Historical borehole logs suggest there to be 2-3m of silt and sand to the south of the River Mersey, interpreted as TFD, which is underlain by 4-6m of sands and gravels, interpreted as GFD, and up to 10m of gravelly clay, interpreted as GT. Underlying superficial deposits is sandstone which is recorded at 14mbgl. TFD is absent to the north of the river where ground comprises up to 3m of sand and gravel, interpreted as GFD, underlain by up to 3m of stiff brown clay with stones, interpreted as GT. Beneath superficial deposits is 2m of fine sand becoming sandstone, interpreted as weathered sandstone.	Strata	Typical Base Level (mAOD)	
		N	S
	Tidal Flat Deposits	5.5 – 3.5	8 – 5
	Glaciofluvial Deposits	2.5 – 1.5	5 - -1
	Glacial Till	0.5 - -0.5	Proven to -1
	Weathered Sandstone	Proven to -0.5	
	Groundwater level: 2mAOD		
TOPOGRAPHY/ EARTHWORKS	Both segment options start at 10mAOD at Liverpool Road and steadily drop to 7mAOD at the Fiddler's Ferry Railway and 3mAOD at the River Mersey. Elevation then increases to 7mAOD over a 40m length across the bank of the river and remains level for the remainder of the segment as it travels to the SW. Approach embankments are required for the proposed bridge crossing the River Mersey and Fiddler's Ferry Railway.		
HISTORICAL LAND USE	<p>There are many on-line historical heavy industry land uses around Atherton's Quay and Bank Quay through which the segment directly passes. These are as follows:</p> <ul style="list-style-type: none"> • Heavy product manufacture – rolling and drawing of iron, steel and ferroalloys, dated at 1908-1954. • Animal by-products – soap, gelatine, glue, dated 1928-1954. • Transport and cargo handling, dated at 1954. • Unspecified works from 1896 to 1993 <p>There are a large number of off-line historical industrial activity around Bank Quay, upstream of the proposed segment. These are as follows:</p> <ul style="list-style-type: none"> • Cement, lime and plaster products, dated at 1849 • Food processing, dated at 1849. • Metal casting and foundries, dated 1849-1954. • Insulated wire and cable, dated at 1910. • Chemical manufacturing, dated at 1910. • Heavy product manufacture – rolling and drawing of iron, steel and ferroalloys, dated at 1928-1954 • Animal by-products – soap, gelatine, glue, dated 1928-1954. • There are 10No. on-line historic tanks at the following locations: <ul style="list-style-type: none"> • Near Fiddler's Ferry Railway at 359565, 387971 – part of electrical sub station facilities • In the area of works on the peninsula between 359562, 387842 and 359556, 387706 – no use given 		
HYDROLOGY/ FLOOD RISK			

The segment crosses onto a peninsula of the River Mersey – an EA Main River - which flows from the south, around Bank Quay and to the SW towards Arpley Landfill Site.

- The segment is at risk of surface flooding from a 1 in 30 year flood event at Liverpool Road roundabout, Old Liverpool Road and Quay Fold. Progressively larger areas are at risk for a 1 in 100 year event and 1 in 1000 year flood event with the additional of Thewlis Street and the southern half of the segment on the peninsula.

LICENSED INDUSTRIAL ACTIVITY

There are 6No. on-line trade directory points at the depot and works on the northern side of the River Mersey. These are:

- Mike Knapp – garage mechanics (active)
- Cheshire Blind Co – blinds, awnings and canopies (inactive)
- Plantwise Technical Services – plant and machinery repair (inactive)
- Warrington Vehicle Centre – commercial vehicle servicing, repairs and accessories (inactive)
- Warrington Towbar and Trailer Centre Ltd – trailers and towing equipment (inactive)
- T & K Welding – wrought ironwork (inactive)

DISCHARGE CONSENTS

- There are 4No. on-line discharge consent points either at the works on the peninsula or at the works on the NW side of the River Mersey. They are all discharge into the River Mersey and were issued for the making of chemicals and related processes from 1984 to 1995.
- There are in excess of 20No. off-line discharge points around Atherton's Quay and Bank Quay which discharged sewage and chemical products into the River Mersey upstream of the segment crossing.

SENSITIVE LAND USE

None recorded.

MINERAL SITES

None recorded.

HYDROGEOLOGY/ GROUNDWATER SOURCE PROTECTION ZONES

Tidal Flat Deposits are classified as a Secondary Undifferentiated Aquifer; Glaciofluvial Deposits and deposits of the Shirdley Hill Sand Formation to the north are classified as a Secondary A Aquifer. The Wilmslow Sandstone Formation is classified as a Principal Aquifer.

LANDFILLS AND WASTE MANAGEMENT

None recorded.

POLLUTION INCIDENTS

- An on-line IPC Point is present near the segment start at Old Liverpool Road at 359613, 388089 for the manufacture and use of organic chemicals by Vinamul Ltd/Celanese Emulsions Ltd from 1997 to 1999. This area is also an LAPPC (Local Authority Pollution Prevention Control) point.
- An on-line IPC Point is present at the segment end at 359505, 387500 for combustion uses within the fuel and power industry by Ineos Silicas Ltd from 1991 to 1998.
- There are 2No. off-line IPCC Points around Bank Quay: Pq Silicas UK Ltd at 359885, 387808, 2006 to present and Celanese Emulsions Ltd at 359661, 387732, 2007 to present.
- There are 6No. off-line recorded pollution incidents around Bank Quay and upstream of the segment. 3No. of these occurred in 1995-1996 and involve the use of miscellaneous chemicals (359700, 387800), organic chemicals (359500, 387800) and polymer emulsion (359500, 387900). Incident severity is classified as minor. The remaining incidents occurred in 1995 and involve the use of oil pollutants, 2No. of which were minor (359700, 387900 and 359900, 387800) and 1No. of which was major (359700, 387700). All incidents occurred within the River Mersey catchment.
- There is a recorded 'breach of conditions of authorisation by failure to prevent release of unauthorised substances and failure to ensure control of process during production', occurring in 1995 at the works on the peninsula edge.
- An inactive NIHHS Point is present at 359600, 387700 at the peninsula edge.
- Authorisation was issued for the disposal of radioactive waste at Bank Quay (359700, 388010) in 1991-1995.

POTENTIAL FOR CONTAMINATION

There is a high concentration of historical heavy industrial activity at Atherton's Quay and Bank Quay. On-line land uses include soap works and iron works. The section of the segment which passes this area, and which is also next to the channel of the River Mersey, is considered most at risk of contamination; historical works provide the opportunity for organic and inorganic metal and non-metal contaminants to be present along the segment.

GEOTECHNICAL RISKS

- Compressible/weak ground comprising unconsolidated TFD along the segment, posing a risk to bridge construction, embankment construction and highway construction.
- TFD has low potential for re-use as suitable embankment fill, contributing towards a material deficit.

SEGMENT NAME	ROUTE OPTIONS ADOPTING SEGMENT		
B6	Route 40: E, R (II); Route 41: E, R (III); Route 43: F, P (I); Route 44: F, P (II); Route 47: F, R (I); Route 48: F, R (II); Route 49: F, R (III); Route 50: F, S		
SEGMENT DESCRIPTION	STRUCTURES REQUIRED		
The segments starts at proposed Bridge 8 crosses over the disused St Helen's Canal and Fiddlers Ferry Railway from Penketh Business Park. The segment travels 600m to the east through Gatewarth Farm Landfill, over Sankey Brook on proposed Bridge 5 and around the northern edge of Gatewarth Industrial Estate where it then continues to the SE for a further 400m along Forest Way. The segment ends at proposed Bridge 3 which crosses the River Mersey to the east.	Bridge 3: Forrest Way Bridge 5: Sankey Brook Bridge 8: Garston Bridge		
GROUND GEOLOGY/ MODEL	RELEVANT BOREHOLE LOGS		
<p>The BGS 1:50,000 map shows the geology to comprise Tidal Flat Deposits over the majority of the segment, with Glaciofluvial Deposits over the middle and western sections of the segment. Superficial deposits are underlain by Wilmslow Sandstone Formation.</p> <p>Historic boreholes within the eastern half of the section record up to 6m of soft silty sandy clay and clayey silty sand, interpreted as TFD, underlain by up to 12m of firm clay with stones, interpreted as GT. Beneath superficial deposits is sandstone at 18mbgl, as reached in SJ58NE634.</p> <p>The western half of the segment is within the Gatewarth Farm Landfill Site. Historic boreholes record greater than 4m of mixed Made Ground/landfill refuse, below which is 2-4m of soft to firm silty clay, interpreted as TFD, and greater than 6m of very stiff clay with gravel, interpreted as GT.</p> <p>Elevation data suggests a maximum thickness of 8m for landfill deposits.</p>	SJ58NE634 SJ58NE718 SJ58NE1513 SJ58NE1514 SJ58NE1517		
	Strata	Typical Base Level (mAOD)	
		E	W
	Landfill Tidal Flat Deposits Glacial Till Sandstone	1 - -1 -6 - -13 Proven to -13	7 - 4 5 - 0 Proven to 0
Groundwater level: 3.5mAOD			
TOPOGRAPHY/ EARTHWORKS			
<p>Starting at 7mAOD at St Helen's Canal, elevation quickly rises to 15mAOD over 90m as the segment travels SE across Gatewarth Farm Landfill. As the segment turns and travels eastwards, elevation drops to 5mAOD at a stream connected to Sankey Brook, rises to 9mAOD and then drops again to 4mAOD where the segment passes Sankey Brook. Continuing eastwards, elevation rises and remains at 7-8mAOD as the segment passes Gatewarth Industrial Estate and travels along Forrest way – rising to 12mAOD at Sunflower Drive and dropping once more to 3mAOD over the River Mersey.</p> <p>Topographic gradient exceeds 6% as the segment passes onto the landfill from the proposed bridge over St Helen's Canal/Fiddler's Ferry Railway and where the segment passes a stream connected to Sankey Brook. Embankments may need to be constructed in order to achieve highway acceptable gradients without cutting into landfill material.</p>			
HISTORICAL LAND USE			
<ul style="list-style-type: none"> There is a discrete area of on-line refuse disposal marked over the section of the segment that runs near Sankey Brook, dated at 1993 <p>There are 5No. off-line areas of historical land use, as follows:</p> <ul style="list-style-type: none"> Insulated wire and cable manufacture at Penketh Business Park on the opposite side of St Helens Canal to the segment start, dated from 1892 to 1928. The same area is marked as an unspecified factory or works from 1954 to 1993. Metal casting/foundries 200m north of the segment at Old Liverpool Road, dated from 1908 to 1954. A discrete area of sewage disposal 150m to the south of the segment at the present day water treatment facility, dated at 1993. Natural and man-made textile manufacture and products 75m to the north of the segment at present day Frankies Tyres, dated at 1849. Metal casting/foundries 75m to the east of the segment at Marigold Place, dated from 1928 to 1954. 			
HYDROLOGY/ FLOOD RISK			

- St Helen's Canal flows to the SW past the western half of the segment and beneath proposed Bridge 8 at the segment start.
- The River Mersey – an EA main river - flows to the SW from Bank Quay, along the northern edge of the Arpley Landfill to the south of the segment, and then towards the east.
- Sankey Brook flows to the SW from Sankey Bridges, through the segment and into the River Mersey. Streams connected to Sankey Brook intersect the proposed segment.
- A section of the segment near Sunflower Drive is at risk of surface water flooding from a 1 in 30 year flood event. The affected area is progressively larger for a 1 in 100 year event and 1 in 1000 year event, with the addition of sections that cross over Sankey Brook/streams connected to Sankey Brook.

LICENSED INDUSTRIAL ACTIVITY

There are 2No. on-line trade directory entries along the segment. These are:

- Pioneer Concrete (inactive) – concrete and mortar ready mixed, located at Forrest Way near Sunflower Drive.
- CPI Mortars Ltd (inactive) – concrete and mortar ready mixed, near the intersection of Sankey Brook and Barnard Street.
- In excess of 20No. off-line trade directory points are within 200m of the segment. Most of these, active and inactive, are located around Gatewarth Industrial Estate and include candle manufacturers, builder's merchants and tube bending.

DISCHARGE CONSENTS

None recorded.

SENSITIVE LAND USE

None recorded.

MINERAL SITES

None recorded.

HYDROGEOLOGY/ GROUNDWATER SOURCE PROTECTION ZONES

Tidal Flat Deposits across the site are classified as a Secondary Undifferentiated Aquifer. Glaciofluvial Deposits are classified as a Secondary A Aquifer.

The Wilmslow Sandstone Formation is classified as a Principal Aquifer.

LANDFILLS AND WASTE MANAGEMENT

The entire segment from St Helen's Canal to Sankey Brook is within the Gatewarth Farm Landfill Site – an historic landfill which reportedly holds inert, industrial commercial, household and special waste from between 1968 and 1989. There was no restriction on the type of waste that could be deposited.

POLLUTION INCIDENTS

2No. off-line pollution incidents are recorded. These are as follows:

- An incident occurred in 1992 40m to the north of the segment middle at 358500, 387500. The incident involved miscellaneous pollutants and is classified as a significant incident within the Sankey – St Helen's Canal catchment.
- An incident occurred in 1991 40m to the north of the segment near the segment start at 358100, 387500. The incident involved oil pollutants and is classified as a minor incident within the Sankey – St Helen's Canal catchment.
- An EA Prohibition Notice was issued in 1999 to the household waste recycling centre within 50m to the south of the segment, seemingly because leachate levels were not being controlled.
- There is an on-site LAPPC point at Forrest Way Near Sunflower Drive for blending, packing, loading and use of bulk cement, issue date unknown, and an off-line LAPPC point 20m to the north of the segment at Gatewarth Industrial Estate for blending, packing, loading and use of bulk cement, issued in 1993.

POTENTIAL FOR CONTAMINATION

The landfill was unrestricted in regards to material disposal and hence it is unknown as to the types of contaminants within the ground and how highway works may be affected. There is therefore a potential for contamination and a risk to human health.

GEOTECHNICAL RISKS

- Moderate risk of running sand and shrink-swell over the landfill site (BGS).
- Potentially compressible, weak and variable landfill deposits; unsuitable for use as bridge and embankment foundation strata as well as subgrade for highway construction.
- Compressible/weak ground comprising unconsolidated TFD, posing a risk to bridge construction, embankment construction and highway construction.
- Landfill deposits and TFD unsuitable for re-use as fill for approach embankments and hence a material deficit for the segment.
- Where required to level out slopes to highway acceptable gradients, cuttings can expose contaminants within the landfill.

SEGMENT NAME	ROUTE OPTIONS ADOPTING SEGMENT		
B7	Route 43: F, P (I); Route 44: F, P (II); Route 47: F, R (I); Route 48: F, R (II); Route 49: F, R (III); Route 50: F, S		
SEGMENT DESCRIPTION	STRUCTURES REQUIRED		
The segment commences at Sankey Way (A57) and passes to the south along Cromwell Avenue South and through Sankey Valley Park. The segment crosses over the disused Sankey Helen's Canal on proposed Bridge 7 at 250m and turns to the SW through Sankey Bridges. At 500m the segment intersects Old Liverpool Road where it veers to the SE and continues for a further 200m on proposed Bridge 6, passing over Fiddler's Ferry Railway and terminating at Barnard street at Gatewarth Industrial estate.	Bridge 6: Garston Viaduct Bridge 7: St Helens Canal		
GROUND GEOLOGY/ MODEL	RELEVANT BOREHOLE LOGS		
The BGS 1:50,000 map shows geology to comprise deposits of the Shirdley Hill Sand Formation over the northern edge of the segment and Tidal Flat Deposits over the middle and southern section of the segment, underlain by Glaciofluvial deposits. Superficial deposits are underlain by the Wilmslow Sandstone Formation.	SJ58NE1251 SJ58NE1370 SJ58NE1371 SJ58NE1372 SJ58NE1373 SJ58NE1514 SJ58NE1659		
Historical boreholes typically show the ground along the northern half of the section to comprise up to 3m of soft to stiff sandy clay with gravel, interpreted as TFD, underlain by very stiff clay with gravel, interpreted as GT. Along the southern half of the segment the ground is typically shown to comprise mixed Made Ground, increasing to up to 5m thick over the Gatewarth Farm Landfill, underlain by 2m of sand and gravel, interpreted as GFD and 4m of stiff sand and gravel, interpreted as GT.	Strata	Typical Base Level (mAOD)	
		N	S
	Made Ground	7 – 3	6 – 4
	Tidal Flat Deposits		
	Glaciofluvial Deposits	Proven to 4	6 – 5 Proven to 0
	Glacial Till		
	Groundwater level: 6mAOD		
TOPOGRAPHY/ EARTHWORKS	Elevation steadily drops from 10mAOD at Sankey Way (A57) to 7mAOD where the segment crosses St Helen's Canal to the south. Continuing southwards, elevation rises to 9mAOD and subsequently returns to 7mAOD where it remains level for the remainder of the segment. Approach embankments are required for Bridge 6 and Bridge 7		
HISTORICAL LAND USE	<ul style="list-style-type: none"> There is 1No. on-line historical land use of transport support and cargo handling, dated at 1849, within the path of the segment at Sankey Bridges. <p>There are 4No. off-line historical land uses within 200m of the segment. They are as follows:</p> <ul style="list-style-type: none"> A 'heap of unknown constituents' 80m to the east of the segment at Sankey Valley Park, dated at 1928. Metal casting/foundries 50m to the west of the segment on Old Liverpool Road, dated from 1908 to 1954. Natural and man-made textile manufacture and products 10m to the east of the segment on Old Liverpool Road, dated at 1849. Discrete area of refuse disposal 200m to the SW of the segment at Gatewarth Farm Landfill recycling centre, dated at 1993. There are 2No. on-site points of unknown filled ground; near Cromwell Avenue South at Sankey Valley Park (358672, 387947) and at the middle of the segment near St Helen's Canal (358559, 387761). 		
HYDROLOGY/ FLOOD RISK	<ul style="list-style-type: none"> St Helen's Canal flows to the SW through the middle of the segment, beneath the proposed bridge at Sankey Bridges. Sankey Brook flows to the south from Sankey, crossing beneath the end of the segment at a proposed bridge. The River Mersey – an EA main river - flows to the SW from Bank Quay, along the northern edge of the Arpley Landfill to the south of the segment, and then towards the east. There are two small bodies of water along the proposed segment; near Cromwell Avenue South and next to St Helen's Canal at Gatewarth Farm Landfill. 		
LICENSED INDUSTRIAL ACTIVITY	There are 5No. on-line trade directory entries located around Sankey Bridges. These are as follows: <ul style="list-style-type: none"> Sankey Bridge Autos (active) – garage mechanics Warrington Trailer Centre Ltd (inactive) – trailers and towing equipment 		

- CV Cars (inactive) – car dealers
- Buy A Van Warrington (inactive) – commercial vehicle dealers
- Sankey Bridges Car Centre (inactive) – car dealers

There are off-line trade directory entries within 100m of segment around Sankey Bridges and Gatewarth Industrial Estate. These are as follows:

- Paul Hurt Cars Warrington Ltd (active) – car dealers
- Frankies Tyres (active) – tyre repairs and re-trading
- SMR Motors (active) – car dealers
- Bennett and Skelland Ltd (active) – fabricated metal products
- Jewson (active) – builder's merchants
- Banners and Signs Ltd (inactive) – sand, gravel and other aggregates.
- Plp Motors Ltd (inactive) – car dealers
- 930 Sport Porsche (inactive) – garage services
- PLP Lookers (inactive) – car dealers
- Warrington Waste (inactive) – waste disposal services

DISCHARGE CONSENTS

There are 4No on-line sewerage discharge consents which discharge into Sankey Brook at Sankey Bridges, between Old Liverpool Road and Fiddler's Ferry Railway. They were issued as early as 1991 and there is one consent which is still active at 358550, 387620.

SENSITIVE LAND USE	MINERAL SITES
None recorded.	None recorded.

HYDROGEOLOGY/ GROUNDWATER SOURCE PROTECTION ZONES

Glaciofluvial Deposits and deposits of the Shirdley Hill Sand Formation are classified as a Secondary A Aquifer. Tidal Flat Deposits are classified as a Secondary Undifferentiated Aquifer. The Wilmslow Sandstone Formation is classified as a Principal Aquifer.

LANDFILLS AND WASTE MANAGEMENT

The proposed bridge at the southern end of the segment crosses onto the historic Gatewarth Farm Landfill Site, operational from 1968 to 1989 by Waste Disposal Authority. Deposited waste included inert, industrial, commercial, household and special waste. There is also a small historic landfill 50m to the west of the segment end which was operational from 1976 to 1977 by Associated Lead Manufacturers Ltd. Deposited waste included inert and industrial waste.

POLLUTION INCIDENTS

- There is 1No. on-line pollution incident which occurred in 1992 at Sankey Brook near the segment end. A significant impact involving miscellaneous pollutants was recorded within the catchment of Sankey – St Helen's Canal.
 - There is 1No off-line pollution incident which occurred in 1995 100m to the east of the segment at Old Liverpool Road. A minor impact involving oil pollutants was recorded within the Sankey Brook catchment.
- There are 2No on-site LAPPC points; one at Sankey Bridge Autos on Liverpool Old Road for waste of oil burners, issued in 1993, and one at Hanson Quarry Products at Gatewarth Industrial Estate for blending, packing, loading and use of bulk cement, issued in 1993.

POTENTIAL FOR CONTAMINATION

Areas of historic land use and recent industries around Sankey Bridges and Gatewarth Industrial Estate have the potential to contain a range of metal and non-metal, organic and inorganic contaminants. These can provide a risk to human health through toxicity and flammability as well as having the potential to cause deterioration to construction materials.

The waste at Gatewarth Farm Landfill may well be contaminated given that it is recorded to include inert, industrial, commercial, household and special waste, and can thus pose a risk to human health and highway construction.

GEOTECHNICAL RISKS

- Moderate risk of shrink-swell and running sand (BGS).
- Potentially compressible, weak and variable landfill deposits; unsuitable for use as bridge and embankment foundation strata as well as subgrade for highway construction.
- Compressible/weak ground comprising unconsolidated TFD, posing a risk to bridge construction, embankment construction and highway construction.
- Landfill deposits and TFD unsuitable for re-use as fill for approach embankments and hence a material deficit for the segment.

SEGMENT NAME	ROUTE OPTIONS ADOPTING SEGMENT		
C1	Route 70: J, R; Route 71: J, S		
SEGMENT DESCRIPTION	STRUCTURES REQUIRED		
The segment commences at Liverpool Road (A5061) and travels 300m to the south across Factory Lane and Fiddler's Ferry Railway. The segment meets the River Mersey where it proceeds to travel 1500m alongside the river to the eastern side of Walton Viaduct where the segment terminates with proposed Bridge 10 crossing over the River Mersey to the north.	Bridge 10: Eastford Road Existing Walton Viaduct		
GROUND GEOLOGY/ MODEL	RELEVANT BOREHOLE LOGS		
<p>The BGS 1:50,000 map shows geology to comprise Tidal Flat Deposits over the length of the segment up to the northernmost edge where there are Glaciofluvial Deposits and deposits of the Shirdley Hill Sand Formation. Superficial deposits are underlain by the Wilmslow Sandstone Formation over the northern half of the segment and the Helbsy Sandstone Formation over the southern half of the segment.</p> <p>Historical boreholes on the northern side of the River Mersey typically show the ground to comprise up to 3m of sand and gravel, interpreted as GFD, underlain by up to 3m of stiff brown clay with stones, interpreted as GT. Beneath superficial deposits is sandstone recorded at 8-9mbgl.</p> <p>Historical boreholes on the southern side of the River typically show 6m of soft sandy silt and clay (up to a maximum of 10m at SJ58NE18), interpreted as TFD, underlain by up to 5m of sand and gravel, interpreted as GFD, and at least 11m of firm clay and stones, interpreted as GT.</p>	SJ58NE4 SJ58NE17 SJ58NE18 SJ5810A SJ5810C SJ58NE725 SJ58NE726 SJ58NE1155		
	Strata	Typical Base Level (mAOD)	
		N	S
	Tidal Flat Deposits Glaciofluvial Deposits Glacial Till Sandstone	0 -7 Proven to -7	5 - 1 0 - -3 Proven to -11
Groundwater level: 7 mAOD			
TOPOGRAPHY/ EARTHWORKS			
Elevation starts at 11mAOD at Liverpool Road (A5061) and steadily drops to 7mAOD at Fiddler's Ferry Railway where it remains level as the segment travels alongside the River Mersey to the south. At 600m elevation rises to 12mAOD where it remains level for the next 800m until approaching the Walton Viaduct, at which point elevation drops to 6mAOD over a 50m length. Elevation remains at 6mAOD for the final length of the segment. Topographic gradient exceeds 6% near Walton Viaduct and a cutting may be required in order to achieve acceptable highway gradients.			
HISTORICAL LAND USE			
<p>There are several on-line areas of historical land uses through which the segment directly passes. These are as follows.</p> <ul style="list-style-type: none"> • Animal by-products (soap, glue, gelatine etc) along the first 200m of the segment, dated from 1928 to 1954 • Unspecified factory/works along the first 200m of the segment, dated from 1896 to 1993. • Animal by-products (soap, glue, gelatine etc) from 200-250m, dated at 1928. • Chemical manufacturing from 200-250m, dated at 1910. • Metal casting along the southern side of Fiddlers Ferry Railway, dated at 1849. • Unspecified factory/works from 200-300m, dated from 1896 to 1993 • A 'heap of unknown constituents' at the segment end, dated at 1954. <p>There are also a large number of off-line areas of historic land use, most of which are focused around Bank Quay and Atherton's Quay at the northern section of the segment. These include:</p> <ul style="list-style-type: none"> • Heavy product manufacture – rolling and drawing of iron, steel and ferroalloys • Insulated wire and cable manufacture • Railways • Chemical manufacture • Metal casting/foundries • Cement, lime and plaster products • Glass and glass products • Machinery; engines, building and general industrial manufacture 			
HYDROLOGY/ FLOOD RISK			

- The River Mersey flows southwards along the Walton Viaduct and then northwards towards Bank Quay alongside the proposed segment. The river turns to the west at Bank Quay and proceeds to flow to the SW along the northern boundary of Arpley Landfill.
- The disused Runcorn and Latchford Canal lies alongside the segment end.
- Sections of the segment are at risk of surface water flooding from a 1 in 100 year flood event along Factory Lane and at the transporter bridge which crosses onto the River Mersey peninsula. Areas at risk are progressively larger for a 1 in 1000 year flood event and include where the segment crosses the Fiddler's Ferry Railway.
- The entire length of the segment to the south of Fiddler's Ferry railway is at a high risk of flooding from rivers and seas.

LICENSED INDUSTRIAL ACTIVITY

Unilever is an active on-line trade directory point at Liverpool Road (A5061)
There are many off-line trade directory entries at works along the eastern side of Bank Quay. They include the following:

- M&M'S Mini Spares Ltd (active) – car body repairs
- RSJ Fabrications (active) – gate manufactures
- Dunright Engine Reconditioners (active) – engine rebuilding
- KL Joinery (active) – joinery manufacturing
- Select Finish Ltd (inactive) – French polishing
- Construction Site Scaffolding Service (inactive) – scaffolding and platforms
- Ninemeister (inactive) – garage services
- Town Tyres (inactive) – wrought ironworks
- GS Auto Body Repairs (inactive) – car body repairs
- Warrington Autogas (inactive) – garage services
- Body and Paint Repairs (inactive) – garage services
- Peugeot Only (inactive) – garage services

DISCHARGE CONSENTS

There are 7No. on-site discharge consent points located at Bank Quay along the eastern side of the River Mersey for sewage and processes associated with chemical manufacturing, dated from 1994 to 2006. Discharge is into the River Mersey.

SENSITIVE LAND USE

None recorded.

MINERAL SITES

None recorded.

HYDROGEOLOGY/ GROUNDWATER SOURCE PROTECTION ZONES

Glaciofluvial Deposits and deposits of the Shirdley Hill sand Formation are classified as a Secondary A Aquifer.
Tidal Flat Deposits are classified as a Secondary Undifferentiated Aquifer.

The Wilmslow Sandstone Formation the Helsby Sandstone Formation are classified as a Principal Aquifer.

LANDFILLS AND WASTE MANAGEMENT

- The eastern boundary of the active Arpley Landfill Site is located 300m to the west of the segment end. The landfill license was issued in 1997 and has no restrictions on material and waste being deposited.
- There is a registered waste transport site at Walton New Junction 100 to the SW of the segment start. The site, which had no restrictions on the source of waste, was registered in 1993 and did not receive a superseding license.

POLLUTION INCIDENTS

- There is an on-line IPC point on the eastern edge of Bank Quay near the transporter bridge for inorganic chemical processes within the chemical industry by Ineos Silica Ltd, dated at 2004.
- There is an off-line IPC Point 100m to the west of the segment at Fiddler's Ferry railway for combustion uses within the fuel and power industry by Ineos Silicas Ltd, dated at 1998.
- There are 2No active off-line IPPC points at the works on the peninsula, 100m to the west of the segment. There are issued to Celanese Emulsions Ltd and Pq Silicas UK Ltd.

There are 4No. off-line pollution incidents within 100m of the segment. These are:

- An incident occurred in 1995 on the peninsula to the west of the segment. The incident involved oil pollutants and is classified as a major incident within the River Mersey catchment.
- An incident occurred in 1996 on the peninsula to the west of the segment. The incident involved miscellaneous pollutants and is classified as a minor incident within the River Mersey catchment
- An incident occurred in 1995 on the peninsula to the west of the segment. The incident involved oil pollutants and is classified as a minor incident within the River Mersey catchment
- An incident occurred in 1995 50m to the east of the segment near Bank Quay Station. The incident involved oil pollutants and is classified as a minor incident within the River Mersey catchment
- Authorisation was issued for the disposal of radioactive waste at Bank Quay 30m to the west of the segment (359700, 388010), dated from 1991-1995.
- There is a recorded 'breach of conditions of authorisation by failure to prevent release of unauthorised substances and failure to ensure control of process during production', occurring in 1995 at the works on the peninsula edge.

POTENTIAL FOR CONTAMINATION

There is a high concentration of historical heavy industrial activity and pollution events around Bank Quay and the northern half of the segment. at Atherton's Quay through which the segment passes and at the surrounding area of Bank Quay. This section of the segment is considered most at risk of contamination. From the land uses listed there is the potential for a variety of organic and inorganic metal and non-metal contaminants to be present at these areas.

GEOTECHNICAL RISKS

- Compressible/weak ground comprising unconsolidated TFD along the segment, posing a risk to bridge construction, embankment construction and highway construction.
- TFD has low potential for re-use as suitable embankment fill, contributing towards a material deficit.

SEGMENT NAME	ROUTE OPTIONS ADOPTING SEGMENT	
C2	Route 50: F, S; Route 56: G, S; Route 62: H, S; Route 68: I, S; Route 71: J, S	
SEGMENT DESCRIPTION	STRUCTURES REQUIRED	
The segment commences on the northern side of proposed Bridge 10 which crosses over the River Mersey. It travels 250m to the NW over a gold driving range at which point it turns 90° and travels 300m to the SE, crossing over the River Mersey on a proposed bridge onto Chester Road (A5060)	Bridge 10: Eastford Road Proposed bridge over the River Mersey	
GROUND GEOLOGY/ MODEL	RELEVANT BOREHOLE LOGS	
The BGS 1:50,000 map shows geology to comprise Tidal Flat Deposits over the length of the segment. Superficial deposits are underlain by the Helsby Sandstone Formation over the SW edge of the segment and the Wilmslow Sandstone Formation over the middle-NE section of the segment. Historic borehole records typically show the ground to comprise up to 6m of loose fine and medium sand and gravel and soft silty sandy clay with an organic odour, interpreted as TFD, underlain by 1.5m of sand and gravel, interpreted as GFD, and at least 10m of clay and pebbles, interpreted as GT. Bedrock is not encountered.	SJ58NE1155 SJ68NW894 SJ68NW34/A	
	Strata	Typical Base Level (mAOD)
	Tidal Flat Deposits Glaciofluvial Deposits Glacial Till	3 – 0.5 -1 Proven to -6
	Groundwater level: not encountered	
TOPOGRAPHY/ EARTHWORKS	Elevation is 3mAOD at the River Mersey at the segment start. It rises to 7mAOD over the bank of the river and remains at 7-8mAOD up to the northern edge of the golf driving range, where it rises to 10mAOD as the segment turns towards the SE. Elevation remains at this level for 160m to the SE where it then rises to 13mAOD and subsequently falls to 4mAOD over the channel of the River Mersey. Approach embankment required for the bridges crossing over the River Mersey.	
HISTORICAL LAND USE	There is 1No. on-line historical land use at the segment start, marked as a 'heap of unknown constituents' and dated at 1954. There are several off-line historical land uses within 200m of the segment. These are as follows: <ul style="list-style-type: none"> • Railways of the Walton Old Junction which run to the north within 20m of the segment, dated from 1882 to 1993. • Unspecified works 50m to the north of the segment at what is now the Spectra Building, dated at 1993. • Infilled quarry of sand and gravel to the immediate east of Chester Road (A5060), dated at 1908. • There is 1No on-line point marked as unknown filled ground (pond, marsh, river, stream etc), dated at 1954). 	
HYDROLOGY/ FLOOD RISK	<ul style="list-style-type: none"> • The River Mersey is an EA main river which flows from the north along Chester Road (A5060), turning towards the NW at Walton Viaduct and continuing on to Bank Quay. The segment crosses over the river onto Chester Road (A5060) and Eastford Road. • The Manchester Ship Canal flows to the SW 500m to the south of the site • The disused Runcorn and Latchford Canal lies alongside Eastford Road at the segment start. • A section of the segment at Eastford Road is shown to be at risk of surface flooding from a 1 in 100 year flood event. The affected area is progressively larger for a 1 in 1000 year flood event and includes sections at the gold driving range and along Chester Road (A5060). • The entire segment is shown to be at high to medium risk of flooding from rivers and seas. 	
LICENSED INDUSTRIAL ACTIVITY	There are 3No. off-line trade directory entries along Chester Road (A5060) next to the segment end. These are as follows: <ul style="list-style-type: none"> • Texaco (active) – petrol filling station • Chester Road Motors (inactive) – car dealers • JK Bailey (inactive) – garage services 	
DISCHARGE CONSENTS	There are 4No. on-line sewerage discharge consents which discharge into Sankey Brook at Sankey Bridges, between Old Liverpool Road and Fiddler's Ferry Railway. They were issued as early as 1991 and there is one consent which is still active at 358550, 387620.	
SENSITIVE LAND USE	MINERAL SITES	
None recorded.	None recorded.	
HYDROGEOLOGY/ GROUNDWATER SOURCE PROTECTION ZONES		
Tidal Flat Deposits are classified as a Secondary Undifferentiated Aquifer.		

The Wilmslow Sandstone Formation and Helsby Sandstone Formation is classified as a Principal Aquifer.

LANDFILLS AND WASTE MANAGEMENT

- There is a registered waste transport site at Walton New Junction 100 to the SW of the segment start. The site, which had no restrictions on the source of waste, was registered in 1993 and did not receive a superseding license.
- Arpley Landfill is an active landfill 400m to the west of the segment. The landfill currently has no restrictions on the type of waste and material that can be deposited and is licensed as a co-disposal site, meaning that non-hazardous and hazardous waste has been buried together.

POLLUTION INCIDENTS

- An incident occurred in 1996 150m to the SE of the segment end. The incident was classified as minor and involved miscellaneous pollutants (sewage) within the Mersey catchment
- An incident occurred in 1997 at Walton Old Junction near the segment start. The incident was classified as minor and involved oil pollutants within the River Mersey catchment.
- An incident occurred in 1998 at Morley Common, 50m to the south of the segment start. The incident was classified as minor and involved oil pollutants within the River Mersey catchment.
- There is an IPC point 40m to the west of the segment start at Walton Old Junction, issued in 1994 to Celanese Emulsions Ltd for the manufacture and use of organic chemicals within the chemical industry.

POTENTIAL FOR CONTAMINATION

- A 'heap of unknown constituents' beneath the proposed segments poses a risk of contamination depending on the material that comprises the heap; the deposits pose a risk to human health and highway construction.
- An active petrol filling station is located at the segment end along Chester Road (A5060). Land has the potential to be contaminated from fuel spillages.

GEOTECHNICAL RISKS

- Compressible/weak ground comprising unconsolidated TFD, posing a risk to bridge construction, embankment construction and highway construction.
- Landfill deposits and TFD unsuitable for re-use as fill for approach embankments and hence a material deficit for the segment.

F. Geotechnical risk register

RISK REGISTER

Date: 13/04/2017

Project Phase: Phase 1

Project: Western Link

NOTE: RISK TYPES; HS = Health & Safety, T = Time, C = Cost, R = Reputation, E = Environment
 Risk: I = Intolerable, S = Significant, T = Tolerable, N = Negligible
 Likelihood: VL = Very Low, L = Low, M = Medium, H = High, VH = Very High
 Impact: VL = Very Low, L = Low, M = Medium, H = High, VH = Very High

Risk Assessment carried out by:
 Next risk assessment (Date):

Hazard	Consequences	IMPACT	LIKELIHOOD	RISK	RISK TYPE	Potential Risk Control Measures / Actions	IMPACT	LIKELIHOOD	RESIDUAL RISK	OWNER	Action (by whom and when)	Current Risk Ranking
Compressible Ground	Settlement of highways structures and/or pavements. Where highways structures/and or pavements passes over the edge of backfilled area or other passes across a transition from alluvium to denser natural deposits marked differential movement could occur with possible impacts on the gradient of highways drainage and ride quality. Potential for foundation failure.	M	H	S	C	Intrusive ground investigation to determine thickness of alluvium and known infill in relation to route options. Use of ground improvement and or piled foundations to limit settlement of highway structures over fill or compressible ground of significant thickness. Potential significant impact on construction cost and programme. Liaise with ECI contractor to evaluate risk.	M	M	T			
Landfill traverse	Failure of foundations bearing on weak landfilled material. Very large amounts of settlement can be anticipated on the biodegradable materials known to have been deposited at Gatewath Farm Landfill and Arpley Landfill. Risk to landfill liner by the use of penetrative foundation solutions.	H	VH	I	C	Consultation with EA to determine feasibility of obtaining regulatory approval to construct on former landfill sites and to obtain permits to undertake intrusive ground investigation to determine thickness and nature of deposits. Undertake foundation strategy assessment to explore engineering solutions.	H	M	S			
Buried foundations and infrastructure	Delays caused by grubbing out of obstructions. Potential for hard spots and differential settlement of highway structures and/or pavements. Potentially high within former developed areas around St Helen's Canal and within landfill crossings; elsewhere low risk.	M	M	T	T	Intrusive ground investigation at brownfield sites intersected by route options in order to determine thickness and nature of Made Ground and identify presence of buried obstructions.	M	L	T			
Earthworks (highway cuttings in contaminated ground)	From the discussion in Section 3.2.2, it is likely that the route corridors that traverse the landfill sites will be constructed in cutting. Leachates percolating into cuttings will potentially degrade the road pavement construction, resulting in more frequent maintenance cycles and exposure of maintenance staff to contaminated material. Landfills are known to contain hazardous material. Risk to controlled waters by contaminated leachate.	M	VH	S	C	Explore possibility of leachate collection system to protect highway infrastructure. Problem of leachate disposal remains. Construction of highway on elevated sections to avoid the need for highway cutting. Risk of impact on existing landfill liner	M	M	T			
Groundwater control/tunnelling in soft soils	High water-table around tunnel would require groundwater control for approaches to portals and earth pressure balancing machines to prevent groundwater ingress and ground loss.	H	H	S	C	Groundwater control could potentially involve water table lowering with potential for settlement of adjacent structures. Control measures are likely to involve on-site monitoring of movement against predicted settlement profiles. Importance of early involvement of regulatory bodies in impact assessments. Understanding of existing rail viaduct foundations and MSC construction and allowable construction tolerances against movement. Intrusive ground investigation to verify ground conditions	H	M	S			
Expansive ground	Expansion of ground due to presence of slags from former iron and steel-making processes causing damage to highways pavement and/or highways structures.	L	M	T	C	Intrusive ground investigation and laboratory testing to determine potential for expansive soil within risk areas.	L	VL	N			
Mass haul balance	Road construction dependent upon route option will require the crossing of up to six water bodies and railways and hence there will be a requirement for agreed embankment structures. Moreover, excavated landfill material and alluvial floodplain material is likely to be of low potential for material re-use and hence there is potential for a significant amount of required material input.	H	H	S	C	GI to understand the extent of compressible ground combined with further route vertical alignment development to allow assessment of mass haul.	M	M	T			

NEGATIVE CONSEQUENCE SCORE TABLE

Impact			Health and Safety	Time	Cost	Reputation	Environment
1	very low	negligible	negligible	negligible effect on programme	negligible	negligible	negligible
2	low	minor	minor injury	5% effect on programme	1% budget	minor effect on local company image/ business relationship mildly affected	minor environmental incident
3	medium	serious	major injury	12% effect on programme	10%budget	local media exposure/ business relationship affected	environmental incident requiring management input
4	high	threat to furture work and client relations	fatality	25% effect on programme	20% budget	nationwide media exposure / business relationship greatly affected	environmental incident leading to prosecution or protestor action
5	very high	threat to business survival and credibility	multiple fatalities	50% effect on programme	50% budget	permanent nationwide affect on company image/ significant impact on business relationship	major environmental incident with irreversible effects and threat to public health or protected natural resource

LIKELIHOOD SCORE TABLE

Likelihood			Probability
1	very low	negligible / improbable	<1%
2	low	unlikely / remote	>1%
3	medium	likely / possible	>10%
4	high	probable	>50%
5	very high	very likely / almost certain	>90%

		Likelihood					
		Very Low	Low	Medium	High	Very High	
		Score	1	2	3	4	5
Negative Consequence	Very Low	1	n	n	n	n	t
	Low	2	n	n	t	t	s
	Medium	3	n	t	t	s	s
	High	4	n	t	s	s	i
	Very High	5	t	s	s	i	i

Risk Key

intolerable
 significant
 tolerable
 negligible / trivial

RED
 AMBER
 YELLOW
 GREEN

i
s
t
n

20 to 25
 10 to 16
 5 to 9
 1 to 4

