






APPENDIX B


Geomorphological Assessment

Reach reference	1 (Upstream of GSK)	
Conservation Status	8 – High	
Channel type	Spring-fed chalk stream (winterbourne)	
Baseline Geomorphological Characteristics		
<ul style="list-style-type: none">• Reach 1 is an ephemeral stream with a very shallow channel and low banks.• Bed and banks consist of earth and colonised by grass with some aquatic plants in damper areas.• Flow conditioned primarily by groundwater, either from a spring or from higher groundwater levels in the chalk aquifer below. No known abstractions locally.• Channel location conditioned by geology, as on border of chalk (baseflow fed) but then flows over Lambeth clays.• No evidence of active channel processes due to limited discharge and flow capacity and low gradient.• No channel modifications, but flow conditions may have been modified by the construction of ponds and highways drainage upstream of headwaters, which could modify the amount of baseflow present.• On day of visit the stretch was predominantly dry with only small areas of shallow standing water observed.• Riparian vegetation is a mixture of grass and scrub herbs, with patches of hedgerow, and scattered trees and shrubs.		
Does the geomorphology support good ecology (for WFD)?		
<ul style="list-style-type: none">• The shallow channel and intermittent flow of the headwater reach naturally reduce the potential for diverse aquatic habitats. Stream cover from marginal shading and input of woody debris from surrounding trees contribute to some habitat complexity.• Due to the sporadic drying of the channel it is unlikely that habitats within this reach can sustain year round water-dependent plant communities. However ephemeral flow is a natural characteristic of headwater chalk-fed streams and adapted vegetation communities and invertebrates could be present.		
Restoration Recommendations / Opportunities for long list		
<ul style="list-style-type: none">• None proposed – conservation status typical of small chalk stream headwater.• Other potential actions - Potential to investigate impacts of highways drainage and pond construction if this is affecting groundwater patterns local to the stream.		


A – Upstream view	
	
B – Downstream view	
	


Reach reference	2 (GSK)	
Conservation Status	1 – Culverted	
Channel type	Highly modified channel – realigned and extensively culverted	
Baseline Geomorphological Characteristics		
<ul style="list-style-type: none">• Reach 2 is a highly modified reach which runs through the GSK plant.• This section was not fully accessed during the site walkover.• The channel has been modified by digging a straight, overdeep course with steep banks.• Through the GSK site the channel is partially culverted and other modifications include sheet piling bank protection and sluice gates (Royal Haskoning report for Adur District Council, 2009).• Channel flows on clay geology rather than chalk, which appears to maintain a larger amount of flow in the channel by reducing any loss of flow from the bed and allowing ponding.• Gradient is very low and channel bed actually rises toward culvert entrance, which will also pond back flow.• Baseflow supplemented by runoff/drainage from GSK site increasing discharge.• Vegetation clearance at downstream extent (bank vegetation cut and reeds cleared from channel).		
Does the geomorphology support good ecology (for WFD)?		
<ul style="list-style-type: none">• The extensive physical habitat modification and barriers to flow through this section mean that the channel is unlikely to support typical aquatic fauna and flora.• This creates a disconnect between the natural headwaters of the stream and the downstream reaches, disrupting water body continuity.		
Restoration Recommendations / Opportunities for long list		
<ul style="list-style-type: none">• Re-route entire channel out of GSK site and through land to east (noting that ground levels and GSK requirements may constrain this option).		




Reach reference	3 (GSK to Deacon Way culvert)	<div>A – Left to right bank downstream of GSK</div> 
Conservation Status	3 – Low	
Channel type	Modified channel – realigned and widened	
Baseline Geomorphological Characteristics		
<ul style="list-style-type: none">• Reach 3 is a modified reach which runs between the GSK site and Deacon Way culvert, with the landfill site on the left bank.• This section was not fully accessed during the site walkover.• The channel is a mostly straight, overwide and overdeep course with steep banks.• There is a substantial depth of water in the channel but visible flow is negligible, being ponded by the very low bed gradient and control of Deacon Way culvert at the downstream end which represents a topographic high point in the bed• There is likely to be a considerable depth of fine sediment on the bed due to the low flow velocity, sourced from a combination of runoff from neighbouring agricultural and urban areas• Extensive reed growth in channel potentially slows flow and traps fine sediment.		
Does the geomorphology support good ecology (for WFD)?		
<ul style="list-style-type: none">• The very limited flow velocities observed mean that this section of channel provides a standing water rather than flowing water habitat type.• Reed beds and other aquatic plants are present which would provide potential cover for fish.• Extensive fine sediments mean only silt-tolerant species are likely to be present.• Potential water quality issues would limit ecology due to lack of pollutant dispersal resulting from sluggish flow.		
Restoration Recommendations / Opportunities for long list		
<ul style="list-style-type: none">• Re-route channel to east of landfill (meandering channel with marginal and wetland habitats).• Create managed reedbed at upstream end.• Block Deacon Way culvert inlet.• Retain channel as a backwater linked to new channel.• Retain channel as an isolated standing water habitat (not connected to new channel).		


B – Upstream view from Deacon Way culvert inlet




Reach reference	4 (Deacon Way culvert)	<p>A – Deacon Way culvert outlet</p> 
Conservation Status	1 – Culverted	
Channel type	Culverted	
Baseline Geomorphological Characteristics		
<ul style="list-style-type: none">Reach 4 comprises Deacon Way culvert, which takes the flow of Teville Stream through a rectangular box culvert inlet with trash screen and exits from a pipe culvert at Willowbrook Road.Significant urban drainage connections in culvert increase discharge through this section.		
Does the geomorphology support good ecology (for WFD)?		
<ul style="list-style-type: none">Culvert is likely to act as a significant disruption to hydromorphological and ecological continuity in the stream, no fauna and flora likely to be present in the culverted section due to shading and lack of substrate		
Restoration Recommendations / Opportunities for long list		
<ul style="list-style-type: none">Block Deacon Way culvert inlet.Re-route channel to east of landfill (meandering channel with marginal and wetland habitats).Retain channel downstream of culvert along Willowbrook Road as a backwater and potential reedbed, and also to maintain discharge of surface water drainage from within culvert.		

Reach reference	5 (Deacon Way culvert to railway line – Willowbrook Road)	A – Upstream view along Willowbrook Road 
Conservation Status	3 – Low	
Channel type	Realigned, overdeepened	
Baseline Geomorphological Characteristics		
<ul style="list-style-type: none">• Reach 5 flows between the Deacon Way culvert outlet and the railway culvert.• The channel has been straightened and is constrained by Willowbrook Road on the right bank and the new amenity tip (on landfill) on the left bank.• Recent bank profiling works undertaken on left bank associated with development of amenity tip.• Substantial reed growth in channel further downstream where flow becomes slower.• Likely to be significant fine sediment on bed due to slow flows, low gradient and wide channel.• Short section of meandering channel upstream of railway culvert.		
Does the geomorphology support good ecology (for WFD)?		
<ul style="list-style-type: none">• Culverts at either end of reach are likely to act as significant disruptions to hydromorphological and ecological continuity in the stream.• The very limited flow velocities observed in the downstream section of this reach provide standing water rather than flowing water habitat type.• Reed beds and other aquatic plants are present which would provide potential cover for fish.• Extensive fine sediments mean only silt-tolerant species are likely to be present.• Potential water quality issues would limit ecology due to lack of pollutant dispersal resulting from sluggish flow.		
Restoration Recommendations / Opportunities for long list		
<ul style="list-style-type: none">• Block Deacon Way culvert inlet.• Re-route channel to east of landfill (meandering channel with marginal and wetland habitats).• Retain channel along Willowbrook Road as a backwater and potential reedbed, and also to maintain discharge of surface water drainage from within culvert.		

Note, geomorphologist has not visited reaches 6-9 which were added to the scope, therefore the following summaries are based on a review of aerial and site photographs (including those from Jacobs modelling team visit in Feb 2011 and provided by Malcolm Ward from Oct 2011 site visit)

Reach reference	6 (Railway line to landfill culvert)	<div>A – Upstream view to railway culvert</div> 
Conservation Status	3 – Low	
Channel type	Realigned, overdeepened	
Baseline Geomorphological Characteristics		
<ul style="list-style-type: none">• Reach 6 flows between the railway culvert and the culvert at the landfill site.• The channel has been straightened and deepened.• Allotments line the right bank while the left bank is wooded and grassland.• Scrubby vegetation and trees line both banks, with some overhanging into the channel.• Some patches of reeds in channel but less extensive than upstream reaches.• Likely to be significant fine sediment on bed due to slow flows, low gradient and wide channel.		
Does the geomorphology support good ecology (for WFD)?		
<ul style="list-style-type: none">• Culverts at either end of reach are likely to act as significant disruptions to hydromorphological and ecological continuity in the stream.• The limited flow velocities observed in the downstream section of this reach provide standing water rather than flowing water habitat type.• Bankside vegetation and reed beds are present which would provide potential cover for fish.• Extensive fine sediments mean only silt-tolerant species are likely to be present.• Potential water quality issues would limit ecology due to lack of pollutant dispersal resulting from sluggish flow.		
Restoration Recommendations / Opportunities for long list		
<ul style="list-style-type: none">• Re-meander channel in more natural planform to land on east side – this would need to be a lined channel due to historic landfill.• Vegetation management.		

B – Channel adjacent to allotments




Reach reference	7 (Landfill culvert and STW)
Conservation Status	1 – Culverted
Channel type	Culverted
Baseline Geomorphological Characteristics	
<ul style="list-style-type: none"> • Reach 7 consists of the culverts running through the landfill and STW. • The culvert inlet is at a relatively new grill screen. • The culvert is understood to be in relatively poor condition and ownership is unclear. • At outlet, stream flows through a number of structures at STW, flow is very ponded and water quality appears poor. • Channel then culverted to Brooklands Park. 	
Does the geomorphology support good ecology (for WFD)?	
<ul style="list-style-type: none"> • Culvert is likely to act as a significant disruption to hydromorphological and ecological continuity in the stream, no fauna and flora likely to be present in the culverted section due to shading and lack of substrate. • Potential water quality issues would limit ecology (dead fish observed by EA on site visit in Oct 2011). 	
Restoration Recommendations / Opportunities for long list	
<ul style="list-style-type: none"> • De-culverting (although likely to be significant constraints on feasibility). • Investigations into impacts on water quality and fish passage through structures at the STW. 	

A – Culvert inlet




B – Structures at STW culvert outlet






Reach reference	8 (Landfill culvert to Brooklands Lake)	
Conservation Status	4 – Moderate	
Channel type	Low gradient and tide-locked	
Baseline Geomorphological Characteristics		
<ul style="list-style-type: none">• Reach 8 flows through Brooklands Park, an area of public access / amenity value.• Banks are extensively reinforced by a combination of gabions and steel sheet piling.• Channel alignment also constrained by local ground levels (probably previous landscaping / earthworks resulting from lake dredging).• Reed growth evident.• Likely to be significant fine sediment on bed due to slow flows, low gradient and wide channel.• Water levels and flows are controlled in this section by the tidal flap discharge from Brooklands Lake.		
Does the geomorphology support good ecology (for WFD)?		
<ul style="list-style-type: none">• This area of the stream would naturally be a type of tidal creek, but is now constrained by bank protection and by lake level control at Brooklands.• The very limited flow velocities observed in the reach provide standing water rather than flowing water habitat type.• Reed beds and other aquatic plants are present which would provide potential cover for fish.• Extensive fine sediments mean only silt-tolerant species are likely to be present.• Potential water quality issues would limit ecology due to lack of pollutant dispersal resulting from sluggish flow.		
Restoration Recommendations / Opportunities for long list		
<ul style="list-style-type: none">• Replacement of hard bank protection with soft engineering, or 'greening' of bank protection.• Removal of hard bank protection to allow more natural tidal habitats to form – this would probably require a change in land use in the park area.• Any restoration needs to be taken in context of tidal and fluvial flows including future management of Brooklands Lake.		

A – Channel in Brooklands Park



B – Channel in Brooklands Park



Reach reference	9 (Brooklands Lake and outfall)	<p>A – Channel entering Brooklands Lake</p> 
Conservation Status	Not scored – artificial lake	
Channel type	Lake	
Baseline Geomorphological Characteristics		
<ul style="list-style-type: none">• Reach 9 comprises Brooklands Lake and the outfall into the sea.• The lake was created in the late 1950s as part of the restoration of a previous waste site.• Lake levels are influenced by tide-locking – it can only discharge through its outlet when the tidal flap is open. It can also be controlled by the outlet structure.• When levels are lower, exposed mudflats are present and there are also extensive reed beds at the margins of the lake.• The outlet is through a culvert under the A259 and shingle beach, and then through a piped structure out to the beach foreshore.		<p>B – Outlet sluice from Brooklands Lake</p> 
Does the geomorphology support good ecology (for WFD)?		
<ul style="list-style-type: none">• The lake is an artificial habitat in an area that was naturally tidal creeks but then lately reclaimed land.• The lake provides standing water rather than flowing water habitat type.• Reed beds and other aquatic plants are present which would provide potential cover for fish.• Potential water quality issues could limit ecology.• Piped and culverted outlet and tidal flap / sluice structure will prevent natural migration of fish between sea and tidal habitats.		
Restoration Recommendations / Opportunities for long list		
<ul style="list-style-type: none">• Changes to outfall structure and operation to improve fish and eel passage.• Potential works within lake to create more features to re-create tidal creek habitats within overall lake.• Control of water levels / changes in the lake size or function will have implications for flow upstream.		<p>C – Outfall into English Channel</p> 