APPENDIX 6

Alternative Management Approach:

Appendix 6.1 - Alternative Management Approach

The isolated South East Wetland at the corner of Wideman Road and Erbsville Road was reviewed by the environmental study team and MNRF in 2014/2015. Appendix 2.5 contains the correspondence with MNRF including an enhancement option. The future protection of this wetland feature and the small tributary which sustains it (which drains from an existing stormwater pond located south of Wideman Road) is constrained by the planned widening of Erbsville Road by the Region (to a 30.5 m right of way), which will require additional property on the west side of Erbsville Road. This widening will ultimately impact the wetland and the tributary, which is primarily in a roadside ditch. Enhancement options were explored, and an enhancement alternative was identified which would relocate the tributary watercourse away from Erbsville Road, and divert it into an extensive cattail marsh in the PSW. Removal of the SE wetland would be compensated through wetland creation adjacent to the PSW and along the floodplain of Wideman Creek. Despite MNRF's decision to add the SE Wetland into the PSW complex, they also recommended that the enhancement alternative be further discussed with Grand River Conservation Authority (GRCA). Hence it is recommended that further discussions be undertaken with GRCA as well as the City of Waterloo and the Regional Municipality of Waterloo to determine if an enhancement alternative will be acceptable.

The enhancement alternative provided to MNRF is presented in Figure A6.1, wherein the SWM pond tributary is re-routed to the PSW, the SE Wetland is removed, coupled with extensive wetland expansion and enhancement beside the PSW and along the Creek corridor. Localized groundwater discharge is collected in a French drain for discharge to Wideman Creek via a short new channel.

These measures would consolidate protected habitat, and provide net benefits to the local ecosystem area, quality and functions for the long term. Existing groundwater data and a preliminary grading assessment support the viability of this approach. From a fluvial perspective, diversion of surface flow away from the SWM pond tributary will benefit Wideman Creek as the overall water quality and thermal regime will be improved. Road runoff and sediment can be addressed separately from a water quality perspective through appropriate ditch design. Table A6.1 summarizes the enhancement opportunities under this alternative.

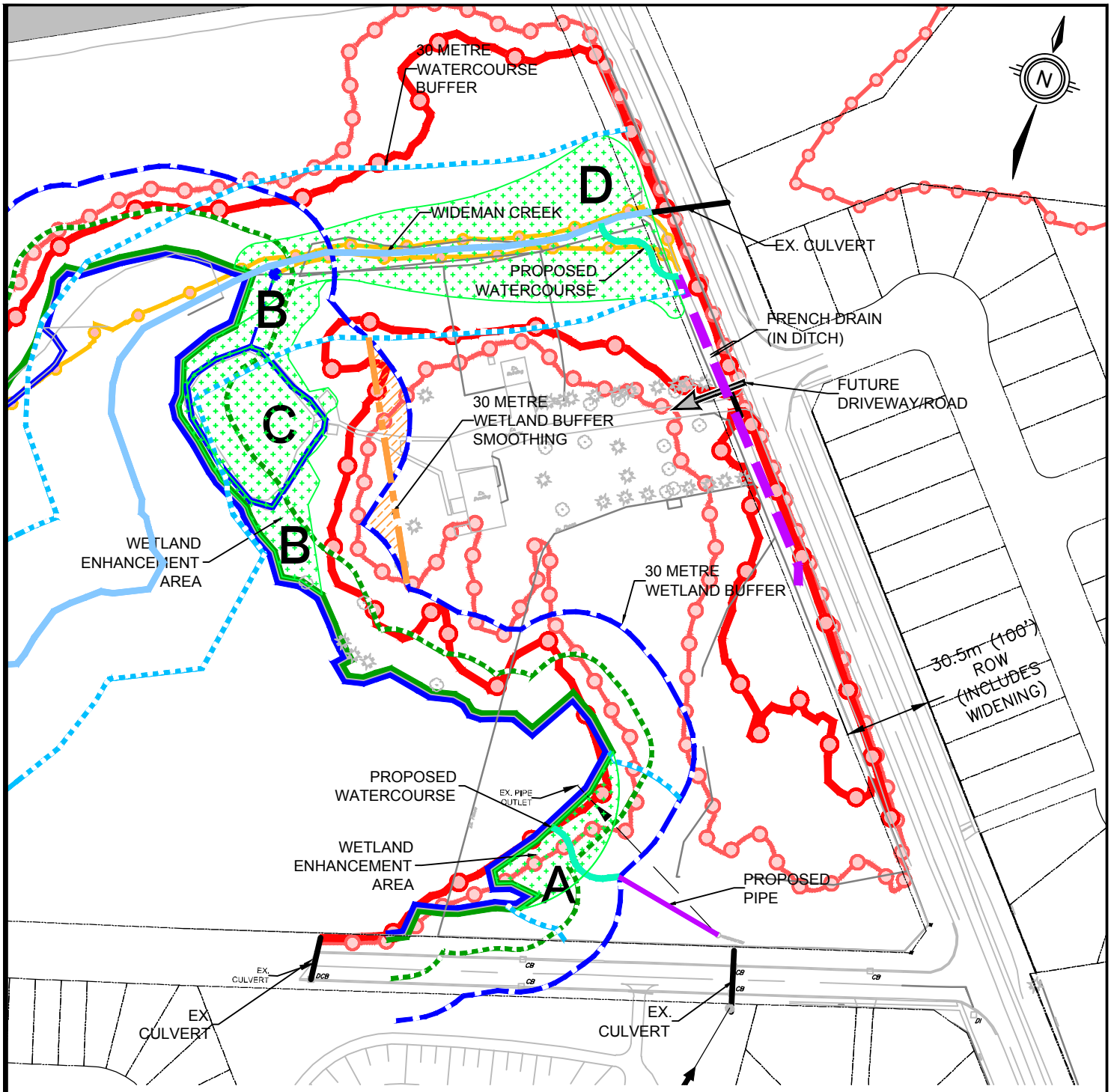
Table A6.1 South East Wetland Alternative Enhancement Opportunities

Existing Functions / Values	Enhancement Action	Outcomes
Wetland Area		
Existing SE wetland is 0.78 ha total, including 0.57 ha of mineral meadow marsh and 0.2 ha of cattail mineral shallow marsh.	Creation of new wetland areas along edges of existing PSW and in PSW; potential for more than 1 ha of more diverse wetland and associated habitats.	There will be an increase in total wetland area.
Flora & Fauna		
SE Wetland supports a native plant community (meadow marsh and shallow marsh) but also contains a colony of invasive Common Reed (*Phragmites australis*)	Potential for plant and/or seedbank salvage; eradication of Common Reed; creation of more diverse wetlands ranging from open water to thicket swamp.	The new wetlands would support more diverse native plant communities and would be less likely to degrade over time than the SE Wetland.

Existing Functions / Values	Enhancement Action	Outcomes
Breeding and foraging habitat for amphibians (Spring Peepers and Northern Leopard Frogs); these are reliant on the PSW for completion of their yearly life cycles.	Wetland creation would take amphibian breeding habitat into consideration; an improved riparian corridor and open culvert created connecting to downstream habitats along Wideman Creek. Construction to avoid key breeding periods (birds, amphibians); wildlife rescue from SE wetland.	PSW populations will be sustained and potentially enhanced. Concentrates habitats away from the roads for a net benefit. Noise, road kills and future road works will have lower impacts on the new wetlands.
Foraging habitat for provincially threatened Barn Swallow	Functions will be replicated in new wetland habitats.	Relocating Barn Swallow foraging habitat away from roads will benefit the species in long term.
Aquatic Resources		
Existing SWM pond tributary supports warmwater baitfish.	Existing SWM pond tributary replaced with two new channels, one connecting SWM pond culvert outlet to PSW (eventually flowing into Wideman Creek); the new second channel fed with groundwater via French drain, outletting to Wideman Creek; enhancement of dug pond and its overflow outlet system.	Existing SWM pond bottom draw reduces temperature of outflows. Shading and nighttime cooling of flows through PSW; enhancement of existing dug pond can also reduce outflow temperature to Creek; groundwater release to Creek just upstream of Erbsville Rd. culvert. Likely overall benefits to Wideman Creek thermal regime and fishery.
Hydrology / Fluvial Geomorphology		
SWM pond tributary conveys flows to Wideman Creek (a cold water system); includes a section of roadside ditch before entering Creek.	Stream will be diverted a short distance to the west, within the buffer of the PSW. Flows will still outlet to Wideman Creek.	From a fluvial perspective, there are no issues within the PSW; potential impacts of the additional flow on Wideman Creek between the PSW and Erbsville Road (which currently does not receive SWM flow inputs) need to be considered. There is potential for adjustment in the channel, but considered low risk based on the flow rates; easily tracked with a monitoring program. Improved future condition of watercourse.
Flood mitigation by intercepting storm runoff from surrounding lands including roads. This acts to smooth out sharp runoff peaks during storm events.	Flood functions will be replicated in created wetlands. Local surface flows of backyards/roof runoff may reinforce water balance of new wetlands.	No net impacts; lower sediment impacts and potential enhancements to baseflow and quality. Potential enhancement of flood storage.
Groundwater discharge in a section of the roadside ditch in vicinity of the driveway at 665 Erbsville Road.	Groundwater discharge area protected with flows collected and conveyed through a French drain, with outflow into a short section of new channel outletting to Wideman Creek upstream of road crossing culvert.	Improvement to condition of groundwater discharge and improved riparian/fish habitat. The roadside slope is currently eroding into the ditch; French drain will remove this source of degraded water quality.
Fine sediment trapped in SE Wetland but road runoff and	Water quality improvements through opportunity for	Re-routing the watercourse closer to the PSW and away from roads

Existing Functions / Values	Enhancement Action	Outcomes
downstream sediment loading are prevalent.	stormwater to drop excess sediments, potential removal of excess nutrients or contaminants via uptake by wetland vegetation. Road runoff treated separately.	will reduce negative impacts from existing road runoff and future increased impacts of widened road.

Insert Figure A6.1 formerly 8.1.



LEGEND

- WETLAND BOUNDARY
- 30 METRE WETLAND BUFFER
- ESPA BOUNDARY
- 15 METRE ESPA BUFFER
- CENTRELINE EX. WATERCOURSE
- CENTRELINE PROP. WATERCOURSE
- 30 METRE WATERCOURSE BUFFER
- EXISTING FLOODLINE
- FLOODLINE BASED ON CULVERT REPLACEMENT
- WETLAND BUFFER SMOOTHING
- 30 METRE WETLAND BUFFER SMOOTHING AREAS
- FUTURE DRIVEWAY/ROAD
- EX. PIPE
- EX. CULVERT
- PROP. FRENCH DRAIN
- PROP. PIPE
- WETLAND ENHANCEMENT AREA

FIGURE A6.1
ALTERNATIVE APPROACH

ERBSVILLE SOUTH ENVIRONMENTAL STUDY

WATERLOO, ON

SCALE	1:2000
DATE	NOVEMBER 2016
PROJECT No.	34168

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FILE:J:\34168_TechndStudy\5.9 Drawings\59civil\current\34168_FIG-A6.1.dwg LAYOUT:FIG-A6.1
LAST SAVED BY:Paul.kiggins, Wednesday, December 07, 2016 1:36:08 PM PLOTTED BY:Paul Kiggins Wednesday, December 07, 2016 1:36:19 PM

Appendix 6.2 – Geomorphology Monitoring Program

As with any channel rehabilitation there is a need for a period of monitoring to ensure that the design as implemented is functioning as intended (within reasonable limits) and that there are no developing problems that could affect the long-term viability of the channel or habitat. The degree to which a channel is monitored is a function of the complexity of the design and the value of the habitat. Specifics of the monitoring plan are outlined below.

Frequency and Duration of Monitoring

Monitoring requires an adaptive monitoring approach which allows for a change in frequency as time progresses, as long as the results are positive and there are no emerging problems. Considering all factors, the duration and frequency for geomorphology monitoring components is required to be as follows:

- Post-construction as-built survey
- Monitoring in years 1, 2, and 3post-construction
- Geomorphology monitoring will occur twice per monitoring year (once in the spring and once in the fall)

Geomorphic monitoring is based on the concept of triggers, targets, and responses. This is an adaptive monitoring approach which allows natural change in the system to occur without intervention. It also allows for the setting of objectives and triggers that would alert the researcher to rapid or uncontrolled change in fluvial process, by which remedial action would possibly be required. Monitoring is to include the following components:

1. Monitoring will be undertaken by a qualified fluvial specialist and reviewed by a senior geomorphologist.
2. Monitoring shall occur at the frequency and duration outlined above (years 1, 2, and 3) post-implementation and shall occur two times per year, after spring freshet and prior to the onset of winter conditions for geomorphic components.
3. An initial baseline survey should be completed after the channel has been constructed; subsequent surveys should be tied into this baseline survey.
4. A detailed photo record of the entire channel should be undertaken. Photos should start at the upstream end of the channel and be sufficiently spaced to allow for coverage of the entire channel. GPS locations of the photos should be recorded and these should be the locations from where subsequent photos are taken.
5. Detailed channel monitoring reaches are required for all rehabilitated areas. The length of each reach is to be reviewed by the fluvial specialist and senior fluvial geomorphologist at the planning stage. Each reach should have monitoring sections that reflect the diversity of the channel in that reach, and that are representative of the system as a whole.
6. Each monitoring reach will be comprised of surveyed cross-sections from the base of the corridor side slope to the base of the side slope on the opposite side. Surveys can be done using either total station survey or GPS using a base station/rover configuration (ie RTK GPS).
7. The start and end of each cross-section will be instrumented with an iron bar or similar monument and the position of those monuments will be surveyed.
8. Spacing of survey points in each cross-section will be sufficient to pick up important channel and floodplain features, including top and bottom of banks and channel centerline as well as at least 5 floodplain points on each side.

9. Monitoring reaches should also be surveyed in longitudinal profile, in order that changes in bed form may be tracked, and that potentially destabilizing features such as knickpoints may be identified.
10. Substrates sampling should be undertaken as part of the geomorphic monitoring component (see detail below).
11. After each monitoring visit, the survey results will be overlain and reporting of any changes will occur. It is up to the monitoring geomorphologist, in discussion with the regulating agencies, to determine if any action is required after the visits.
12. An annual report will be filed with the regulating agencies during monitoring years, showing the results of the surveys and photo record, noting any discrepancies or deficiencies that may require attention, as well as recommendations for action (if any). If there is concern about the stability of the channel a site meeting should be called to review the issues and decide on an appropriate action.

Stability targets and associated triggers will be determined to track lateral and vertical stability in the channel. There are six principal monitoring parameters that address channel function; each are presented in the tables below along with the monitoring specifics, targets and response.

Monitoring Parameter: Cross-sectional Form and Area	
Monitoring Specifics	Up to ten pairs of top-of-bank benchmarked cross-sections (riffles and pools) will be installed in representative reaches within the area of channel rehabilitation.
Target	- Cross-sectional area should not increase or decrease in excess of 10% - Cross-sectional form should be maintained within accepted limits (visual comparison only)
Response	- target applies to after Year 1 cross-sectional modifications, which may include sediment removal or bank/bed reconstruction required to re-establish desired channel morphology. - any subsequent adjustments in excess of the target will require further investigation into the causes

Monitoring Parameter: Longitudinal Profile	
Monitoring Specifics	A section of channel within each reach (encompassing a minimum of 4 riffle-pool sequences at each site) will be surveyed. The details of the survey will include tops, crests and ends of riffles, upper, middle and lower pool depths as well as any breaks in slope, etc.
Target	- Inter-pool and energy gradients should not differ in excess of 5% - Riffle grades should not increase or decrease in slope more than 10% - Riffle crest elevations should not increase or decrease to the point of impacting upstream bedforms (visual analysis)
Response	- after Year 1, adjustment that exceeds targets will require repair at the discretion of the geomorphologist and may include riffle re-construction and/or pool clean-out

Monitoring Parameter: Substrate Composition	
Monitoring Specifics	A pebble count at each monitoring cross-section will be completed annually. The results will be tabulated and a particle size distribution will be generated.
Target	- Due to the dynamic nature of the channel, some change in substrate composition is anticipated - As a performance target, adjustment in excess of an order of magnitude will act as a trigger.
Response	- after Year 1, adjustments in excess of an order of magnitude or greater will be noted and flagged. - due to the dynamic nature of the channel substrate no action will be taken until Year 5 unless the adjustment is identified as a potential risk to the function of the channel.

Monitoring Parameter: Substrate Stability	
Monitoring Specifics	Change in bed elevation is to be determined through the use of repeated section surveys. If the section shows, upon overlay from the previous survey, that change has occurred which exceeds the target, then action will be considered.
Target	- Degradation or aggradation of bed material in excess of 5 cm annually at the section location will act as a trigger. - Disturbance or reworking of the substrate in excess of 5 cm (with minimal vertical adjustment in bed surface elevation) will be noted but will not be considered detrimental to channel stability
Response	- after Year 1, losses of greater than 5 cm of bed material will be scrutinized to determine the cause and possible mitigation, which may include the re-installation of larger substrate - accumulation of greater than 5 cm of material will also be investigated. If determined that the accumulation is detrimental, a plan for sediment removal will be developed - if observed, systemic adjustments in excess of the targets will be subject to a larger scale investigation into the causes

Monitoring Parameter: Lateral Migration	
Monitoring Specifics	Change in creek location is to be determined through the use of repeated section surveys. If the section shows, upon overlay of the previous surveys, that change has occurred which exceeds the monitoring targets, then remedial action may be considered.
Target	- Annual migration rates exceeding 10 cm per year in pools and 10 cm per year in riffles will trigger an assessment of the channel conditions at the site.
Response	- After Year 1, adjustment that exceeds the recommended targets will be assessed by the geomorphologist to determine whether the adjustment is localized or representative of systemic site conditions. Remedial action may be recommended based on the extent and nature of the issue.

Monitoring Parameter: General Performance	
Monitoring Specifics	A series of photographs at each cross-section location will be included with the monitoring data package, and does not supplant photographic records from other disciplines. Digital submission of monitoring photographs will be geotagged (via embedded EXIF metadata), in order that their position can easily be plotted on a map. Monitoring photos will also be submitted as a Google Earth® file, for ease of viewing within the context of the broader rehabilitation site.
Target	No Target – information only
Response	No Target – information only