Conceptual Construction-Phase Soil and Water Management Plan

for Major Project 05-0113
Seniors Living Resort, Frenchs Forest - Proposed Concept Plan

Lots 1110, 1111, 1113, 1336, DP 752038;
Lot 20, DP 842523; Lot 80, DP 846099
Oxford Falls Road, FRENCHS FOREST

Prepared by:

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23 October 2008

SEEC Reference: 08000336

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Document Certification

This report has been developed based on agreed requirements as understood by SEEC Morse McVey at the time of investigation. It applies only to a specific task on the nominated lands. Other interpretations should not be made, including changes in scale or application to other projects.

Any recommendations contained in this report are based on an honest appraisal of the opportunities and constraints that existed at the site at the time of investigation, subject to the limited scope and resources available. Within the confines of the above statements and to the best of my knowledge, this report does not contain any incomplete or misleading information.

Andrew Macleod B.Sc (Hons), CPSS CPESC
Director, Environmental Services
SEEC Morse McVey

23 October 2008

Contents

1 Introduction

This *Conceptual Soil and Water Management Plan* (SWMP) (the "plan") has been prepared to support an application for a proposed seniors living resort on Oxford Falls Rd, Frenchs Forest (Major Project 05-0113, Seniors Living Resort - Proposed Concept Plan).

This plan contains background information and fundamental advice relating to erosion and sediment control during the construction phase of the development. It demonstrates to the consent authorities that appropriate measures can be implemented in accordance with relevant guidelines to ensure that no undue pollution of receiving waters occurs during or after construction as a result of land disturbance.

This plan relates to demolition of existing structures, construction of all buildings, road construction, drainage line works, installation of services and renovations to existing buildings. A copy of the concept masterplan for the development is included in Appendix 1 of this report.

Note that a plan such as this would normally be accompanied by a drawing or series of drawings showing the location of various erosion and sediment control works during construction. However, this project is at masterplanning stage, and a comprehensive staging plan has not yet been finalised. As such, this report is not accompanied by any drawings although these would be prepared later for the various stages of construction.

This plan is to serve as a background document when the final construction-phase SWMPs are prepared. It gives all relevant calculations for predicting soil loss and makes recommendations for appropriate management. It has been prepared following guidelines contained in *Managing Urban Stormwater: Soils and Construction* (4th Edition) (Landcom, 2004) (the "Blue Book").

This plan aims to address the Department of Planning Director General's Environmental Assessment Requirements for water quality protection during construction.

2 Background

2.1 This SWMP provides fundamental erosion and sediment control advice for this site. We consider the proposed development can proceed without undue impact on the receiving waters both during and after the construction stages providing that:

(i) the measures recommended here are implemented;

(ii) works are appropriately staged to minimise the amount of land disturbance at any one time;

(iii) erosion and sediment control works are appropriately sized and sited (e.g. sediment basins, diversion drains);

(iv) any conditions of consent that might be placed on the development following approval are appropriately addressed.

2.2 This plan should be read with the following documents also relating to this development:

(i) Water Quality Management Concept (SEEC Morse McVey);

(ii) Stormwater Concept Plan (John M Daly & Associates);

(iii) any other consultant reports relating to the site.

3 Soil and Landscape Conditions

3.1 Soil Landscape mapping for the area suggests that the proposed development lies wholly on the Oxford Falls Soil Landscape, with the Lambert and Hawkesbury Soil Landscapes occurring on surrounding lands (Chapman and Murphy 1989). An investigation of the soils reveals that this is mostly correct, although minor adjustments are made based on slope and terrain observations by experienced SEEC Morse McVey soil scientists. The updated landscape delineations are shown in Figure 1.

3.2 This report is based on the following assumptions:

(i) the lands mapped as Hawkesbury Soil Landscape in Figure 1 will not be disturbed except for installation of essential erosion and sediment control works. These lands have an extreme erosion risk due to their slope and soil conditions;

(ii) the majority of lands to be disturbed for the development are on the Oxford Falls Soil Landscape;

(iii) the soils of the Oxford Falls Soil Landscape:

- are prone to waterlogging and/or high water tables
- can become highly erodible if soil organic content decreases significantly;

3.3 Refer to Table 1 for relevant erosion and sediment control information on the Oxford Falls Soil Landscape.

3.4 Although Table 1 suggests that soils are Type C (coarse), we recommend that site-specific testing be undertaken to confirm or deny this. Sediment basins might need to be designed as total storm capture structures (i.e. for Type F - fine, or Type D - dispersible soils).

Table 1 Soil and Site Physical Characteristics (from Chapman and Murphy, 1989 and Landcom, 2004)

Landscape name	**Oxford Falls**
K–Factor	0.023
Erodibility	Low to moderate
Erosion hazard	
Concentrated flows	Very high
Non-conc. flows	High
Site slope gradients	0% to 6%
Soil textures	Coarse sands to loams
Sediment type	Type C * see note in 3.4, above
Annual soil loss[1]	185 t/ha/yr on 6% slopes (Soil Loss Class 2)
Soil Hydrologic Group	Class C/D (moderate to high runoff potential)

1 Likely annual soil loss figures are calculated using the Revised Universal Soil Loss Equation (RUSLE) (see Appendix 3) and are based on site conditions, where:

- R–Factor (Rainfall Erosivity) is 4200, and Rainfall Zone is 1, as derived from RAINER (Refer to Appendix 2),
- The maximum K–Factor for each soil landscape has been used (not site-specific) as derived from Chapman and Murphy, 1989,
- LS (Length/Slope) factor: Oxford Falls: 1.47 (6% slope, 80 m length),
- The P–Factor (erosion control factor) is assumed to be 1.3,
- The C–Factor (cover factor) is assumed to be 1.0 for bare soil on construction areas.

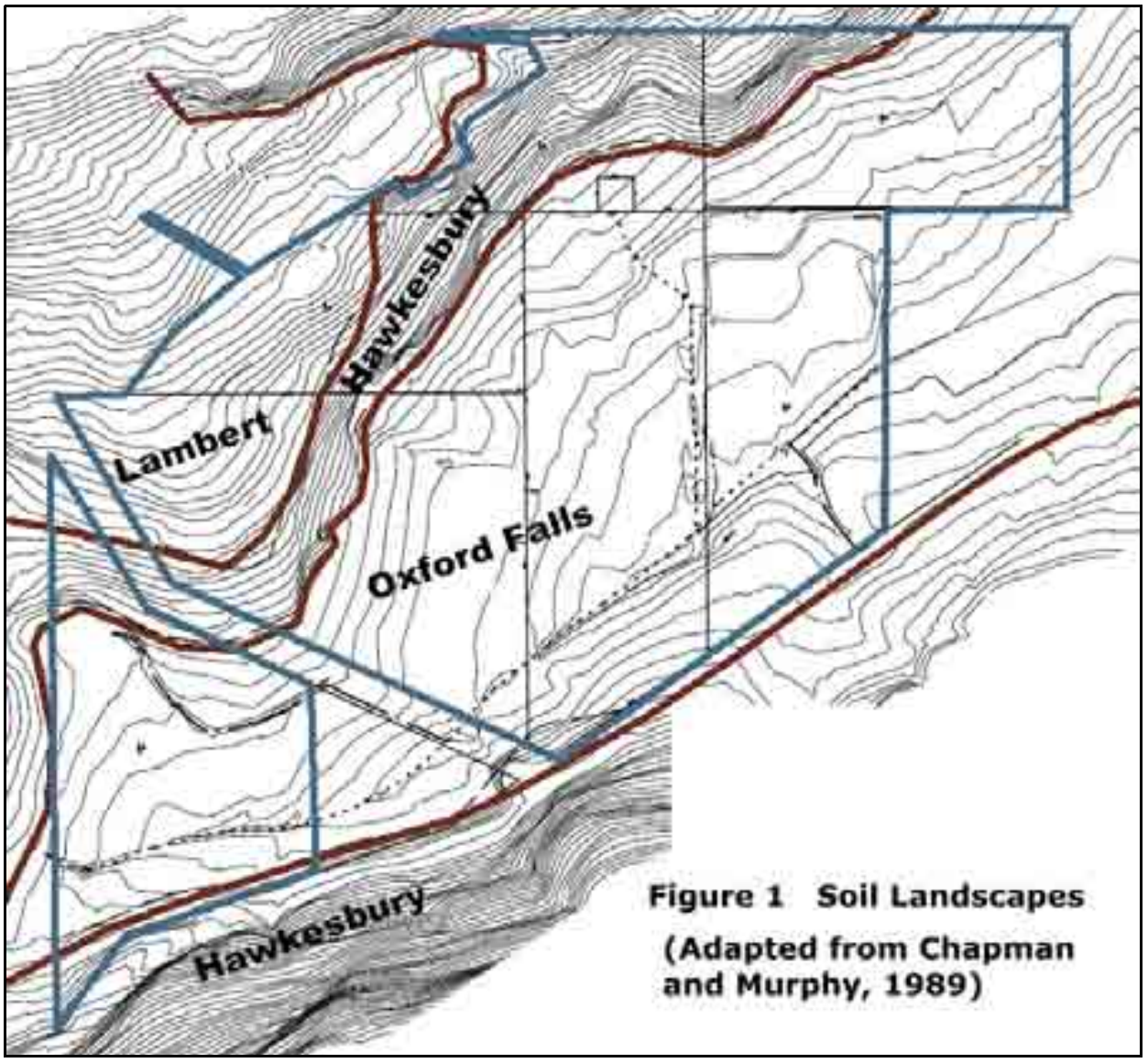

Figure 1 Soil Landscapes
(Adapted from Chapman and Murphy, 1989)

4 Background Data

4.1 When calculating the required volumes in sediment basins, use the following inputs:

(i) the 5-day 75th percentile rain depth for this site is 29.0 mm (Mona Vale - Landcom, 2004). If the receiving waters are deemed sensitive and there is a significant risk of extensive land disturbance, the 5-day 80th percentile rain depth of 35.2 mm might be used;

(ii) IFD data for Oxford Falls is contained in Appendix 2. This will be required when establishing the dimensions and lining characteristics of basin spillways or if basins will be designed for Type C (coarse) sediment;

(iii) the volumetric runoff coefficient (C_v) is 0.56 (Landcom, 2004);

(iv) the runoff coefficient (C_{10}) is 0.90 (Landcom, 2004);

(v) use the Annual Soil Loss figures from Table 1 to calculate anticipated sediment loads into sediment basins according to the area of each Soil Landscape disturbed (refer to Figure 1). Refer to Appendix 3 for further information on the Revised Universal Soil Loss Equation (RUSLE), which underpins Annual Soil Loss calculations.

4.2 When calculating the dimensions and lining characteristics of catch drains, spillways etc., use the following inputs:

(i) IFD data for Oxford Falls is contained in Appendix 2;

(ii) the runoff coefficient (C_{10}) is 0.90 (Landcom, 2004);

(iii) Tables A3, D1 and 5.2 from Landcom, 2004 provide information concerning appropriate stabilisation of catch drains, spillways, diversion structures etc. A copy of each is included in either Appendix 3 or Appendix 6.

4.3 Calculations for all permanent structures including outlet structures and permanent catch drains should assume:

(i) IFD values as shown at Appendix 2,

(ii) stability in the design storm event as dictated by Council DCPs.

4.4 Calculations for temporary structures should assume stability in at least the 10-year ARI time of concentration storm events.

4.5 According to Chapman and Murphy (1989), the Oxford Falls Soil Landscape has sediment type C soils and, as such, sediment basins can be "wet" or "dry" basins (See Standard Drawings SD 6-1, SD 6-2, SD 6-3, SD 6-4 or SD 6-5, Appendix 5). However, we recommend that type D "wet" basins (See SD 6-4 in Appendix 5) be used at this site due to the highly sensitive receiving waters.

4.6 Soils of the Oxford Falls Soil Landscape are generally unsuitable for

constructing sediment basin walls. If the basin is to have earth walls, they will need to be constructed from imported fill of an appropriate material. Alternatively, select a different style of basin wall.

5 General Instructions

5.1 Ensure that erosion and sediment control measures are in place before earthworks and engineering works commence. For each stage of the construction, the basic sequence for securing the site is as follows:

(i) install a stabilised access at every site entry/exit point. Note that a wheel wash facility will be required if tracking of sediment is to be prevented;

(ii) using barrier fence (on the upslope sides) and sediment fence (on the downslope edges), delineate the areas to be disturbed by this stage of the works program. All other areas should be clearly marked as "no-go" zones;

(iii) install the site offices, sheds and delineate parking areas;

(iv) provide rough access to enable construction of diversion structures and sediment basins. Construct in this order:

- Firstly, install 'clean' water diversions to send run-on away from works areas. Stabilise (line) them;
- Secondly, install sediment basins and stabilise them;
- Lastly, install 'dirty' water diversion to convey sediment-laden runoff from works areas into the sediment basins. Stabilise (line) them.

(v) Earthworks or construction works can now commence.

5.2 Sediment basins are to be sited at natural low points within construction areas. Note that this will most likely necessitate staging the construction program so that buildings closest to the main creek are erected last, because those locations will be required for sediment basins during other stages.

5.3 Works at this site will be staged to facilitate appropriate soil and water management works.

5.4 Soil and water management works will be coordinated according to the disturbed areas, with sediment basins and catch drains sized and designed appropriately.

5.5 Works within a creek, on creek banks, within the riparian corridor (buffer zone as determined by officers from the Department of Water and Energy) and the urban fringe zone (10 m from the edge of the riparian corridor) are all considered to be on "waterfront lands" under the guidelines in Landcom, 2004 and are therefore constrained according to timeframe. All lands within this zone are automatically assumed to be Soil Loss Class 6 (very high erosion hazard). Therefore:

(i) From 1st June to 15th November, works can proceed within the riparian areas (including the creek and its banks) using basic erosion and sediment control measures and without additional specialised provisions;

(ii) From 16th November to 31st May, works can only proceed in this zone providing that:

- ground cover lowers C-factors to less than 0.1 (Appendix 3) at all times unless the 3-day weather forecast suggests rain is unlikely; and
- ground cover materials are available onsite that can lower C-factors in disturbed areas to less than 0.1 (Appendix 3) within 24 hours if the forecast proves wrong and a rain event occurs.

Practically, this means that any works within this zone should occur in the period 1st June to 15th November. Note that all other works on the Oxford Falls Soil Landscape, which is Soil Loss Class 2, can proceed at any time of year (refer to Table 4.3 in Landcom, 2004).

5.6 Contractors will ensure that all soil and water management works are undertaken as appropriate and constructed following the guidelines stated in Landcom, 2004.

5.7 All subcontractors will be informed of their responsibilities in minimising the potential for soil erosion and pollution to downslope areas.

5.8 Waters discharged from the site are not to have sediment volumes in excess of 50 mg/L at any time. In order to meet this requirement, the onus is on the site supervisor to make changes or additions to this plan as is appropriate and to monitor discharge water quality.

5.9 Site rehabilitation is to occur progressively as works proceed to minimise the amount of disturbed land at any one time.

6 Erosion Control - General Conditions

6.1 Site disturbance will be limited in extent and nature to minimise the total area that is disturbed at any one time.

6.2 Development works will be undertaken in stages to facilitate successful erosion and sediment control.

6.3 Barrier fencing will be erected to minimise disturbance by preventing vehicular and pedestrian access to restricted areas.

6.4 Establish a site office near the entrance to the site to limit vehicular movements on disturbed areas.

6.5 Vehicular access to disturbed lands will be confined to that essential for construction work. All non essential vehicles will park at a specified location near the site office or external to the site.

6.6 The soil erosion hazard on the site will be kept as low as practicable by minimising land disturbance and ensuring quick rehabilitation. Some ways of doing this are outlined in Table 2.

Table 2 Limitations to access

Land use	Limitation	Comments
Construction areas	Limited to 5 (preferably 2) metres from the edge of any essential construction activity as shown on the engineering plans	All site workers should clearly recognise these areas that, where appropriate, are identified with barrier fencing (upslope) and sediment fencing (downslope) or similar materials.
Access areas	Limited to a maximum width of 10 metres (preferably 5 m)	The site manager will determine and mark the location of these zones on site. They can vary in position so as to best conserve existing vegetation and protect downstream areas while being considerate of the needs of efficient works activities. All site workers will clearly recognise these boundaries
Remaining lands, including revegetation areas	Entry prohibited except for essential management works	Thinning of growth might be necessary, for example, for fire reduction or weed removal

6.7 Limit disturbance to that essential for works being undertaken at any given time. Limit access to other areas through the use of barrier fence. Note that barrier fencing can be as simple as tape strung between star pickets, providing it clearly delineates no-go areas.

6.8 Where possible, stockpiles of topsoil (SD 4-1, Appendix 5), and other building and landscaping materials, will be at least five metres from areas of likely concentrated or high velocity flows, especially earth banks and roads. If

necessary, low flow earth banks (SD 5-5, Appendix 5) or drains will be constructed to divert localised run-on.

6.9 Where practicable, each phase of the construction program will be scheduled so that:

(i) the time from starting land disturbance activities to final stabilisation is a duration of less than six months; and

(ii) the duration from the conclusion of land shaping to completion of final rehabilitation is less than 15 working days.

Here, stabilisation means achieving a C-factor (Appendix 3) of less than 0.1 and setting in motion a program that should ensure it will drop permanently, by vegetation, paving, armouring, etc. to less than 0.05 within a further 60 days. Note that local water restrictions might affect this in drought times.

6.10 While C-factors are likely to rise to 1.0 during the work's program, they will not exceed those given in Table 3.

Table 3 Maximum Acceptable *C*-factors at Nominated Times During Works. Refer to Appendix 3 for further information regarding C-factors

Lands	Maximum *C*-factor	Remarks
Waterways and other areas subjected to concentrated flows, post construction	0.05	Applies after ten working days from completion of formation and before they are allowed to carry any concentrated flows. Flows will be limited to those shown in Table 5.2 of Landcom, 2004 (see Appendix 6). Foot and vehicular traffic will be prohibited in these areas
Stockpiles, post construction	0.10	Applies after ten working days from completion of formation. Maximum *C*-factor of 0.10 equals 60% ground cover
All lands, including waterways and stockpiles during construction	0.15	Applies after 20 working days of inactivity, even though works might continue later. Maximum *C*-factor of 0.15 equals 50% ground cover
All lands, post development	0.1 to 0.05	Achieve a C-factor of 0.1 within 15 working days of completion of works, and initiate a program to further reduce C-factors to 0.05 or less within 60 days.

6.11 In the short term, the requirements of Table 3 can be achieved, for example:

(i) in areas exposed to sheet flow, with a temporary vegetative cover — a suggested listing of suitable plant species is shown in Table 4 (note, these plants only protect the ground surface for up to six months). Other temporary options include the use of a suitable soil binder, e.g. Terra-Control® or equivalent;

(ii) in areas exposed to concentrated flow (e.g. diversion banks and waterways) where stabilisation is to be undertaken by temporary means the requirements of Table 3 can be met by stabilising with hessian cloth tacked with a soil binder, such as anionic bitumen emulsion (0.5 L/m^2). Also, see Table 5.2 in Landcom, 2004 (included in Appendix 6 of this report). Apply soil binders following the manufacturer's instructions.

Table 4 Plant Species for Temporary Cover

Growing Season	Seed Mix
Autumn / Winter	oats @ 40 kg/ha
	Japanese millet @ 10 kg/ha
Spring / Summer	Japanese millet @ 20 kg/ha
	oats @ 20 kg/ha

6.12 While only minimal cut and fill is likely at this site, batter gradients should not exceed:

- 2.5(H):1(V) on easterly and southerly-facing slopes
- 3(H):1(V) on northerly and westerly facing slopes;

Cut and fill areas that cannot meet these criteria will be stabilised with retaining walls.

6.13 Roofs of buildings are to be immediately connected to the stormwater infrastructure. Preferably, stormwater infrastructure (including rainwater tanks, where applicable) will be in place prior to roof completion.

6.14 Temporary cut-off drains (SD 5-5, Appendix 5) will be installed across all disturbed lands (including the accessways) to limit slope lengths to no more than 80 m under the following scenarios:

(i) if work on the site is to cease for more than three days,

(ii) at any time if rain appears likely.

The cut-off drains will limit slope length to less than 80 metres and will discharge water where it is unlikely to create an erosion or flooding hazard. Do not direct flows towards stockpiles or other hazard areas.

6.15 Where practicable, the various service and drainage connections will be coordinated so that common trenching can be used.

6.16 Where practicable, the time trenches are open will be limited to less than five working days.

6.17 Where possible, place spoil on the uphill side of trenches to divert water flow

away from the trench line. Alternatively, use temporary bunds for similar effect.

6.18 Trenches will be backfilled with subsoil and compacted to 95 per cent Standard Proctor. Then, topsoil will be replaced with sods to match surrounding ground levels.

6.19 On completion of all major works and before revegetation, disturbed soils will be left with a loose surface to encourage water infiltration and help with keying topsoil later (SD 4-2 and SD 7-1, Appendix 5).

6.20 Final site landscaping will be undertaken as soon as possible and within 15 working days from completion of construction activities. This will include revegetation to provide a quick, temporary cover before a more permanent cover is established (Clause 6.9 to 6.11 and Table 3).

6.21 Plants will be watered regularly until an effective cover has established properly and plants are growing vigorously. Fertilisers will be applied as required to help growth. Watering, fertiliser and soil amelioration requirements should be described in a separate landscape plan.

6.22 During windy weather, large, unprotected areas will be kept moist (not wet) by sprinkling with water to reduce wind erosion hazard.

6.23 Where applicable, place kerbside turf strips (SD 6-13, Appendix 5) at the edges of kerbs to stabilise the soil/kerb interface where there is a risk of run-on causing concentrated flows behind the gutter. Locations are to be determined by the site supervisor.

7 Sediment and Pollution Control - General Conditions

7.1 Stabilised site accesses (SD 6-14, Appendix 5) will be installed to all areas that are subject to disturbance and accessed from sealed roads.

7.2 Sediment fencing (SD 6-8, Appendix 5) and/or other sediment traps will be installed downslope of all disturbed lands to retain the coarser sediment fraction.

7.3 Sediment removed from any trapping device (including sediment fences) will be disposed in locations where further erosion and consequent pollution to downslope lands and waterways will not occur.

7.4 Acceptable receptacles will be provided as required, for concrete and mortar slurries, paints, acid washings, lightweight waste materials and litter.

7.5 Safe storage areas will be provided for fuels, oils, paint, poisons, fertilisers, chemicals and other hazardous materials.

7.6 Any water accumulation in an excavated area is to be pumped into a sediment basin. It is not to be discharged directly into the creek system.

7.7 Discharge waters from the site are to have sediment loads less than 50 mg/L in all rainfall events up to and including the design storm.

7.8 Sediment basins are to be flocculated (if required) before water is discharged (refer to Appendix 4 for further information on flocculation).

7.9 Demolition material can be stockpiled on site if it is expected to be re-used, otherwise it should be removed from the site.

7.10 Progressively rehabilitate and stabilise disturbed areas as works are completed. Refer to Sections 6.8 to 6.10 of this report for C-factor requirements on ground surfaces.

7.11 As stormwater infrastructure is completed, install temporary control measures to minimise the risk of sediment ingress (e.g. into gully pits along roads). See SD 6-11 and SD 6-12 in Appendix 5 for examples.

7.12 Sediment basins are to remain in place until the likelihood of sediment laden waters being washed into them becomes low. When 80 to 90% of works are complete, remove sediment basin(s) and rehabilitate the ground surface following the requirements for ground cover in Sections 6.8 to 6.10 of this report.

7.13 Sediment basins must be dry before they can be removed. Sediment laden waters accumulated in basins are not to be artificially pumped out unless it can be demonstrated that discharge waters will not have sediment values exceeding 50 mg/L.

7.14 The stabilised access(es) are to remain in place until 90% of roads are sealed and the likelihood of tracking sediment onto surrounding streets becomes very low.

7.15 As stockpile sites are no longer required, rehabilitate the ground surface using a temporary ground cover (see Sections 6.8 to 6.10) and set in motion a regime to permanently stabilise it within a further 60 days.

7.16 Secure all existing stormwater pit inlets using kerb rolls/filters (or equivalent) to prevent the ingress of sediment (SD 6-11 and SD 6-12, Appendix 5). Establish a regime for regular clearing of accumulated sediment and disposal to a suitable location away from concentrated flows.

7.17 Remove sediment and barrier fencing where appropriate as works are completed. Note that newly planted areas might require limited fencing to restrict public access until vegetation has stabilised and is maturing.

8 Erosion and Sediment Controls - Riparian Areas

8.1 Any temporary water crossings are to be designed according to SD 5-1 (Appendix 5). Wherever possible, use existing watercourse crossings until permanent structures are constructed.

8.2 Ensure that riparian vegetation stands remain undisturbed unless disturbance has been approved by DWE and DECC.

8.3 Creek bed, bank or riparian corridor works are to occur in 40 m sections, working from upstream to downstream. The previous upstream section must be completed and stabilised before work can proceed on the next section. Refer to Sections 5.8 to 5.10 of this report for requirements for land stabilisation in creeks.

8.4 Install diversion banks (SD 5-5 and 5-6, Appendix 5) at the edge of the riparian corridor for the 40 m length of creek being worked on to prevent excess run-on of overland flow into the works zone. They are to deliver overland flow to a level spreader (SD 5-6, Appendix 5) immediately downstream of the works area. Earth banks are to be progressively removed and the surface rehabilitated (see Section 6.8 to 6.10 of this report) as 40 m creek sections are completed.

8.5 As each 40 m section of creek is completed, erect barrier fencing to limit access and prevent further disturbance.

8.6 *Immediately stabilise* creek beds, banks and any other areas subject to regular concentrated water flows following reshaping/rehabilitation using an appropriate erosion control measure (see Appendices 3 and 6).

8.7 Within the riparian corridor (i.e. those lands not subject to ongoing concentrated flows), progressively rehabilitate disturbed ground surfaces to bring C-factors below 0.05 within 10 days (or less if practicable).

8.8 Sediment basins are to outlet to existing drainage pathways via an energy dissipater (SD 5-8, Appendix 5) or level spreader (SD 5-6, Appendix 5).

8.9 For all works within a creek, on creek banks, within the riparian corridor (buffer zone as determined by officers from the Department of Water and Energy) and the urban fringe zone:

(i) From 1st June to 15th November, works can proceed within these zones using the standard suite of erosion and sediment control measures listed in Sections 6 and 7 of this report and without additional specialised provisions;

(ii) From 16th November to 31st May, works can only proceed in this zone providing that:

- ground cover lowers C-factors to less than 0.1 (Appendix 3) at all times unless the 3-day weather forecast suggests rain is unlikely; and

- ground cover materials are available onsite that can lower C-factors in disturbed areas to less than 0.1 (Appendix 3) within 24 hours if the forecast proves wrong and a rain event occurs.

Practically, this means that any works within this zone should occur in the period 1st June to 15th November. Note that all other works on the Oxford Falls Soil Landscape can proceed at any time of year following the standard suite of erosion and sediment control measures listed in Sections 6 and 7 of this report.

9 Site Monitoring and Maintenance

9.1 Waste receptacles will be emptied as necessary. Disposal of waste will be in a manner approved by the site superintendent and in accordance with standard safe disposal techniques.

9.2 The site superintendent will inspect the site at least weekly paying particular attention to:

(i) removal of spilled sand, soil or other materials from near hazard areas;

(ii) ensuring barrier fencing is maintained and no-go areas are being observed by all site workers and contractors;

(iii) ensuring progressive and prompt rehabilitation of lands, that rehabilitation has effectively reduced the erosion hazard — initiate upgrading or repair as appropriate;

(iv) constructing additional erosion and/or sediment control works as might become necessary to ensure the desired water control is achieved, i.e. make ongoing changes to the SWMP;

(v) maintaining erosion and sediment control measures in a functioning condition until all earthwork activities are completed and the site is rehabilitated;

(vi) removal of trapped sediment and disposal to safe areas; and

(vii) removal of temporary soil conservation structures as the last activity in the rehabilitation program.

9.3 Revegetation areas will be inspected regularly to investigate failures and program necessary replanting as necessary.

9.4 An adequate watering and fertilising system will be maintained in revegetation areas.

9.5 Areas of localised soil erosion will be identified and appropriate preventive measures implemented. These might include:

- planting additional stabilising vegetation or wind breaks
- stabilising soils with mulches or alternative soil binders
- taking steps to minimise any concentrated stormwater flows.

9.6 Any areas of localised poor drainage will be identified and appropriate remedial action taken.

9.7 A regime for cleaning out accumulated debris is to be established for any sediment traps to remove rubbish and organic material (leaves, sticks etc.).

10 References

Chapman, G.A. and Murphy, C.L. (1989). *Soil Landscapes of the Sydney 1:100,000 sheet.* Soil Conservation Service of N.S.W., Sydney.

Chapman, G.A., Murphy, C.L., Tille, P.J., Atkinson, G., and Morse, R.J. (1989). Soil Landscape Series Sheet 9130 Sydney. Soil Conservation Service of N.S.W.

Landcom (2004). *Managing Urban Stormwater: Soils and Construction* (4th edition). NSW Government.

11 Appendices

11.1 Appendix 1: Site Masterplan by URBIS

Note - indicative landscaping concept plan only. For full details of the proposed development, refer to plans prepared by Urbis.

11.2 Appendix 2: IFD Data for Oxford Falls

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********************* RAINER /*****************************
       DEPARTMENT of CONSERVATION and LAND MANAGEMENT
Date: 31/08/2006


Rainfall Intensity (mm/h) for OXFORD FALLS
       1 hour, 2 years : 41.50
      12 hour, 2 years :  9.10
      72 hour, 2 years :  2.70
       1 hour, 50 years : 84.00
      12 hour, 50 years : 18.00
      72 hour, 50 years :  6.00
               Skewness :  0.00
Geographical factor F2 :  4.29
Geographical factor F50: 15.85

 \DUR 5m   6m   10m  20m  30m  1h   2h   3h   6h   12h  24h  48h  72h  User
ARI
1     101   95   78   57 46.3 31.6 21.0 16.4 10.7 7.06 4.50 2.80 2.06 0.00
2     129  121  100   73   60 41.0 27.1 21.2 13.9 9.10 5.84 3.65 2.70 0.00
5     163  153  127   94   77   54 35.4 27.6 18.0 11.8 7.68 4.89 3.66 0.00
10    181  171  142  106   87   61 40.3 31.4 20.4 13.3 8.77 5.64 4.24 0.00
20    207  195  162  122  101   71 46.7 36.3 23.6 15.3 10.2 6.60 5.00 0.00
50    240  226  189  142  118   84   55 42.8 27.7 18.0 12.1 7.69 6.00 0.00
100   264  250  209  158  132   94   61 47.7 30.9 20.0 13.5 8.88 6.78 0.00
User 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00

Estimated Rainfall Factor (R): 4200   Estimated 1:10 Storm (S10): 2750
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	Years						
min	1	2	5	10	20	50	100
5	90	115	142	162	185	215	237
6	85	109	138	154	177	205	227
9	81	104	132	148	169	197	217
10	78	100	127	142	162	189	209
11	75	96	122	137	157	182	202
12	72	92	118	132	151	176	195
13	69	89	114	128	146	171	189
14	67	86	110	124	142	166	184
15	65	84	107	120	138	161	179
16	63	81	104	117	134	157	174
17	61	79	101	114	131	153	170
18	60	77	99	111	128	149	165
19	58	75	96	108	125	146	162
20	57	73	94	106	122	142	158
21	55	71	92	104	119	139	155
22	54	70	90	101	117	137	152
23	53	68	88	99	114	134	149
24	52	67	86	97	112	131	146
25	51	65	84	95	110	129	143
26	49.8	64	83	94	108	127	141
27	48.9	63	81	92	106	124	138
28	48.0	62	80	90	104	122	136
29	47.1	61	78	89	102	120	134
30	46.3	60	77	87	101	118	132
31	45.5	59	76	86	99	117	130
32	44.7	58	75	85	98	115	129
33	44.0	57	74	83	96	113	126
34	43.3	56	73	82	95	111	124
35	42.6	55	71	81	93	110	122
36	42.0	54	70	80	92	108	121
37	41.4	53	69	79	91	107	119
38	40.8	52	68	78	90	106	118
39	40.2	52	68	77	89	104	116
40	39.7	51	67	76	87	103	115
41	39.1	51	66	75	86	102	113
42	38.6	49.9	65	74	85	101	112
43	38.1	49.4	64	73	84	99	111
44	37.6	48.7	63	72	83	98	110
45	37.2	48.1	63	71	82	97	108
46	36.7	47.5	62	70	82	96	107
47	36.3	47.0	61	70	81	95	106
48	35.9	46.4	61	69	80	94	105
49	35.5	45.9	60	68	79	93	104
50	35.1	45.4	59	67	78	92	103
51	34.7	44.9	59	67	77	91	102
52	34.3	44.4	58	66	77	90	101
53	33.9	43.9	58	65	76	89	100
54	33.6	43.5	57	65	75	89	99
55	33.2	43.0	56	64	74	88	98
56	32.9	42.6	56	64	74	87	97
57	32.6	42.2	55	63	73	86	96
58	32.2	41.8	55	62	72	85	96
59	31.9	41.4	54	62	72	85	95