Scarborough/Wombarra Flood Mitigation

Alternative to the Tunnel Proposal

Restoration Option Q : The Everybody Wins Solution

Briefing Paper and Request for Feasibility Study

Prepared by the Wombarra Preservation Group in conjunction with concerned academics, local residents, and environmentalists from the Australian Conservation Foundation, Nature Conservation Council of NSW, Women's Environmental Education Centre, the Total Environment Centre and Greening Australia.

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Background

City Rail has put forward **two engineering schemes** to secure the Illawarra Rail Line from disorganised drainage conditions on old mine land at Scarborough/Wombarra. The first involved a **culvert enlargement program**, and was partly constructed before being halted by Wollongong Council out of concern for public safety. A second scheme known as Option G, proposes to collect 9 small creeks in an open channel uphill of the rail, sending waters to the local beach via a 10 ft x 10 ft **tunnel under Scarborough** township. Due to resident opposition, this scheme has also been put on hold by Council, pending further investigation.[1] City Rail has been asked to look at moving the tunnel outfall further north along the coast. This latest proposal is referred to here as Option J (see Attachments I-V).

Channel/Tunnel Options G and J

Option G and Option J have similar drawbacks:

a.
cost: Option G is estimated at $6 million, with Option J having $3 million added on that;

b.
estimated **construction time** for Option G is 18 months - 3 years, with an additional year for J:

c.
both channel/tunnel proposals offer only a **temporary** (50 year) bandaid solution to local stormwater management;

d.
operation may be impeded by disorganised flows and **waste residues** on mine land resulting in new floods at Wombarra;

e.
operation may be impeded by **subsidence** at the South Clifton Landslide threatening homes in Goodrich Street, Scarborough;

f.
leakage of **methane gas** into the tunnel section could present an explosive hazard to homes and roads above the tunnel;

g.
social amenity will be lost during construction due to blasting and trucking of 185,000 m^3 of spoil.

h.
permanent environmental costs may include disturbance of groundwater leading to future **subsidence** of homes, and **saltwater intrusion** from the ocean;

i.
cliff face and **beach erosion** are likely effects near the tunnel exit;

j.
marine plants and **fish spawning grounds** will be threatened by turbidity and concentrated outputs of acidic mine runoff on to the beach;

k.
responsibility and costing for **maintenance** remains an unresolved issue between City Rail and Wollongong Council;

l.
liability in case of operational failure of a channel/tunnel crossing unstable mine lands remains unclear and City Rail is not prepared to guarantee the work;

m.
Option G still encroaches on private property for construction of energy dissipators; **real estate values** will most probably fall as a result of visual and functional injury to the locality.

Neither Option G nor J meet requirements of the Australian Government's Ecologically Sustainable Development (ESD) Strategy, 1992.

A Whole Systems Strategy for Stormwater Management

Using maps and site data provided by Longmac, Webb McKeown, City Rail, SMEC; observations by local residents; advice from the Australian Mining Industry Council; land management and bioengineering guidelines, this Brief attempts to put forward a **whole systems** approach to water management.

To date, the flood mitigation options put forward by City Rail have involved large scale construction engineering introducing some unknown effects on public safety and environmental sustainability in the longer term (see Attachment III). For economic reasons perhaps, basic **principles of stormwater management** and flood control have been passed over in the design of these options.

Potential floodwaters should be attended to **at source** to minimise social/environmental disruption and engineering costs.

Waters should be **dispersed** in small stream flows rather than concentrated together, thereby avoiding heavy localised flood impacts.

Water courses should be **bioengineered**, not turned into concrete channels which increase velocity and hence potential for damage.

The **natural infiltration/surface runoff ratio** should be preserved to protect the subterranean geology from failure.

One option which applies these principles of stormwater management is the **Restoration Option Q**. This was not closely examined by City Rail, but does involve aspects of some earlier discussed options.

The Aim of Restoration Option Q is to:

1. retard floodwaters at source on old mine lands using hydro-bioengineering technologies;
2. make use of rail culverts already in existence;
3. disperse creeks through the community in small courses following natural stream beds as closely as practicable;
4. protect all existing homes in the Scarborough/Wombarra communities,using minimal bioengineering treatments on creeks at high velocity spots (see Attachment II);
5. save the marine ecology from erosion and pollution impacts.

The Community and Option Q

As a result of cummulative bandaid stormwater solutions over a number of years, the Scarborough/Wombarra community has suffered continuing washouts during heavy rains. The severest floods were experienced in 1985, 1988 and 1991, following closure of South Clifton Colliery in the early 1980s. In June 1991, the Station rail embankment south of blocked culverts at Creek G, collapsed entering homes in Broadridge Street; cars and caravans were written off; phones and soil lines uprooted; new gullies (10 ft and 30 ft deep) were eroded in gardens; and 1,000s of tonnes of soil washed out to sea.

The Scarborough/Wombarra community has long been aware that the source of flood problems is disorganised creek drainage on mine land west of the rail line. City Rail community consultation reports show residents pointing to this, and asking for restoration of creeks to original water courses along with a Regional Drainage Survey.[2] The City Rail response was Option C "Redistribute Flow into Lined Channels Replicating Historical Conditions" (see Attachment III). However, this did not remedy disorganised runoff conditions on the mine and so presented as costly and impractical downstream.

It is important not to confuse a hydro-bioengineered creek restoration program with City Rail's Option C. Whole systems stormwater management practices were not followed in that option. Instead, courses were concreted, speeding up velocities and requiring installation of energy dissipators, etc. The threat of losing their homes to make way for this engineering infrastructure left many Wombarra residents with no choice but to go with the tunnel Option G.

South Clifton Colliery will continue to deteriorate and it is imperative that a comprehensive plan for restoration of the site be developed. The mine is particularly favorable for application of bioengineered water retarding practices, since it is well terraced. With creeks put back to original courses, existing large dams would need to be re-modelled and waste mounds removed. Spoil from the waste dump might be used to back fill mine shafts, thereby decreasing both water accumulation and the combustion potential of methane gas emissions in open shafts.

City Rail already uses some innovative bioengineered technologies for stabilising the rail corridor. If significant water retardation and infiltration is achieved upstream west of the line, City Rail could further minimise engineering design and expenditure, recommissioning existing small creek culverts as feasible.

With runoff from mine lands detained, and streams dispersed in small flows beneath the railway, creeks on properties in the community will be able to remain as they are. Where residents want to enhance security of homes and gardens, they might be encouraged to adopt small scale bioengineering measures with funding and expertise provided under a Community Landcare Scheme.

Healing the Effects of Development

The 1989 Webb McKeown hydrological and hydraulic survey indicates that due to upstream development, varying degrees of the 1 in 100 flood capacity have been lost from creeks in the Scarborough/Wombarra drainage system.[3] **The immediate task is to find a way to restore this missing capacity**. Using Restoration Option Q, this should be achievable by bioengineered rehabilitation measures close to flood source. To understand how this is possible, it is useful to go back and look at underlying processes that have led to the Scarborough/Wombarra stormwater crisis.

The following passage from a recent textbook in **Environmental Science** explains these processes:
"A stream draining a forested watershed is prevented from flooding during rains because water is being taken into the groundwater...Such a stream is not only able to support a rich aquatic ecosystem, it also serves to support much of the surrounding terrestrial ecosystem as many species depend on the water...Human activities change the nature of the surface such that the **infiltration/runoff ratio** is shifted to cause less infiltration and more runoff...Suburban development greatly increases runoff by creating innumerable hard, impervious surfaces such as roadways, parking lots, and roof tops...Whereas infiltration fills groundwater reservoirs, runoff washes directly and immediately into streams. **Stormdrains funnel runoff...Thus with even a modest thunderstorm, a quiet stream may be changed into a surging torrent in a matter of minutes.**..Floods have always been part of nature, however, with increased runoff, even a modest storm may lead to a flood. Countless communities...have experienced flooding with increased frequency and severity as expanding development has paved more of the upstream watershed; thus flood damages have generally increased, despite flood control measures."[4]

As a planning principle, the infiltration/surface runoff after development should not exceed the ratio before development. Interestingly, there is already an example of enhanced infiltration practice at work in Scarborough/Wombarra, where Creek E disappears into the local football field. No adverse environmental consequences have been observed in relation to this.

Visible environmental effects of interfering with the **infiltration/runoff ratio** include drying out of creeks alternating with flash floods and land subsidence or settling from drying out of groundwater. These are well known phenomena in Scarborough/Wombarra (see Attachment VI).

Foundation Conditions: Inferred Geology

The sub-Escarpment coastal strip presents a very fragile ecology and at this stage unfortunately, geological assessments are based largely on inference (see Attachment IX). Longmac has advised that studies of groundwater aquifers in the locality have not been done, though it is recognised that existing coal seams hold water. Longmac writes that foundation conditions for the Scarborough/Wombarra creek system are probably:
"...a surface covering of talus material with depths of bedrock ranging generally between 5 m to 10 m...The zone of underlying bedrock associated with the Scarborough Fault can be expected to be sheared, and water charged...The thickness of this shear zone could be quite wide (100 m could be inferred from the drawings of the underground workings). Current site performance shows that pockets of the talus mantle can be expected to be subject to instability almost invariably related to periodic rises of groundwater."[5]

Possible longer term sources of instability are not addressed here. Under conditions such as these, a concreted channel/ tunnel for fast removal of water from the locality, may lead to drying out of both groundwater and of surface soils as a result of reduced infiltration. The drying out of subsurface soils in turn, may produce further exhaustion of aquifers through upwards capillary movement and surface evaporation. Severe depletion of groundwaters may destabilise the landform and result in saltwater intrusion under the ground where creeks enter the sea, thereby weakening the integrity of the coastline (see Attachment VI). **Both channel/tunnel Options G and J may result in these unintended side effects.**

Hydrological Studies

In terms of a whole systems strategy for water management, the channel/tunnel option is not a good choice. **Finding an environmentally sustainable solution means analysing catchment characteristics; infiltration/runoff ratios; and water attenuation capacity upstream of flooded areas.**

The 1989 Webb McKeown hydrologic and hydraulic study computes that flat land above the Scarp accounts for 1/3 rd of the Scarborough/Wombarra catchment. However, residents observe that water falls over the cliff face have declined in recent years, possiblly as a result of development and drainage diversions above. This observation is backed up by the drying out of rainforest in patches at the base of the Scarp.

Webb McKeown do not look at the Scarborough/Wombarra creek catchments in great detail. Their work was commissioned to support the City Rail culvert enlargement program 1989-90 and their data draws on City Rail surveys made downstream of creek diversions on mine land. The hydrological focus of this material is capacity of creeks at rail and road culvert crossings. Not surprisingly, Webb McKeown conclude that the existing creek system is inadequate for managing a 1 in 100 storm event.

What is especially significant from an environmental standpoint, is their assessment that the pipe on South Clifton Colliery which takes water from Creek G and dam overflow from Creek F, will carry only 40% of a peak 1 in 100 flow. This means that waters will dam up behind the opening of the 5 ft pipe that takes Creek G under the mine. Overflow will traverse the concrete surface of the Colliery entrance area, and bank up again at the rail line above Wombarra. In past years, this has had catastrophic consequences for rail infrastructure, and for homes along Horse, H, I and J Creeks, since the Creek G outlet is readily blocked by debris. And presently, new enlarged rail culverts at G are closed off at Council's request.

Looking at Option G, the design function of the proposed 10 ft wide open concrete channel running across the mine upstream parallel to the rail, is to pick up disorganised mine runoff and direct it to the tunnel drop shaft. This somewhat bandaid way of dealing with floodwaters does nothing to remedy the South Clifton Landslide or deterioration of the mine site at large.

Webb McKeown reject possible re-establishment of original catchments as a solution, because they rightly perceive elimination of diversion channel F and more overflow into Horse Creek, as disadvantageous to the community downstream. The hydrologists also argue against a detention solution using existing dams. Their calculations show the dams do not have adequate retarding capacity as they are, and large impervious, walled retention structures above a township are not the way to go. However, **the introduction of hydro-bioengineering principles, shifts the premises of this argument; a) by assuming multiple small scale retention treatments on selected creeks, and b) by assuming stabilisation of the Landslide area as fundamental to mine restoration.**

Efficiency of Hydro-Bioengineering Technologies

Trees, shrubs and grasses, are mechanical pumps in the hydrological cycle, removing water from the ground and putting it out into the atmosphere through evaporation. At the same time, the root function of trees acts like an underground scaffold helping create geological stability. In order to protect these interactions, a variety of bioengineering constructions are now employed by international authorities in stormwater management.

Possibly the most advanced models in this field are practised by engineers in Baltimore, USA. Other centres of bioengineering expertise are Munich, Germany; Palmerston, New Zealand; and Edmonton, Canada.

Combining living systems and inorganic materials to preserve the natural infiltration/runoff ratio, hydro-bioengineers keep stormwater near to where it falls. On a slope, **the strategy is to create flood detention, storing waters on a temporary basis, playing for time, in order to relieve capacity demands on drainage courses downstream.**

Techniques devised to achieve these objectives are:

- revegetation to create surface sponge effect and protect soils;
- contoured swales with barriers and depressions that receive runoff then let it percolate;
- rock-filled wells situated in creek beds;
- retention ponds often supporting wildlife and/or recreational picnic grounds;
- in urban areas, roof designs that allow slow release of water and porous parking lot surfaces are used;
- heavy earth moving equipment which kills vegetation and compacts ground surfaces is avoided.

The 1993 City Rail EIS (Fig. 16) provides a total peak 1 in 100 flow for Creek G as 51 m^3/s and for Creek B as 24 m^3/s, giving a combined capacity of 75 m^3/s. The proposed channel/tunnel is expected to take 60 m^3/s , leaving 1/5 of total capacity running through creek courses downstream of the new structure (p.5-3).

However, using a whole systems approach it is not generally helpful to concentrate amounts of water together. Rather, technical design considerations suggest that it is possible, using hydro-bioengineering methods, to make up lost capacity in the Scarborough/Wombarra drainage system by general restoration work and attenuation treatments on the mine at Creeks B&D and G&F.

A rationale for doing this is provided by the Webb McKeown studies:

Existing Culvert Capacities for Peak 1 in 100 Flows

Creeks	Rail	Goodrich/Fifth	L.H. Drive	Beach
A	OK	OK	-	-
B	**35%**	NOT OK	20%(A&B)	-
C	OK	-	-	-
D	OK	**50%**	50%(A&D)	-
E	-	OK	OK	-
Horse	OK	NOT OK	OK	-
F	N/A	-	-	-
G	20%	-	**50%**	25%
H	OK	-	-	-
I	75%	-	-	-
J	OK	-	50%	-

The table shows that all creek culverts in the Scarborough/Wombarra area are not equally problematic for meeting requirements of a 1 in 100 storm event. **Creek B needs an extra 65% detention capacity; D needs 50%; G&F combined need 50%** (see Attachment II).

Taking Creek B as a model for Creeks D&G treatments: one might achieve an acceptable Creek B peak 1 in 100 flow of around 8 m^3/s, by providing adequate stormwater storage within the existing creek bed. The target 65% volume of storage must be reached by combining creek bed storage and storage attained in constructed pools. By increasing the stream bed width and providing meanders randomly along its length, the time to peak can be dramatically increased. Increasing the time of concentration through stormwater attenuation practices promotes natural infiltration, which also reduces peak discharges.

Applying methods used by the Maryland Department of Environment (USA) and extrapolating from Creek B's peak 1 in 100 flow figure of 24 m^3/s and its lowest capacity of 35%, a conservatively estimated storage volume target would be approximately 2,700m^3.
This is derived from a reconstructed creek bed cross section 2 m x 2 m, having a length of 675 m. This is possibly a little longer than the flat mine area to be traversed, say 400 m, but the overall length may be reduced by widening the stream channel to give
retention pools. The use of rock pits in the creek bed itself also enhances holding capacity and decreases velocity.[6]

Additional technologies for producing retardation and at the same time stabilising land, include biotechnical drainage using plant pump species; live fascine drains; strategic planting, boulder and log placement; transversely stabilised creek bed channels; notched log drop structures; imbricated rip rap; winged stone deflectors to create pool and riffle habitat; vegetated gabion; live wattle fences; brush mattress and fencing; pioneer planting of fast growing legume species for soil fertilisation and shade. Use of such materials is accompanied by stringent technical design criteria (see Attachment VII).

Problems on Land Upstream of the Rail

The 57 acre freehold area known as South Clifton Colliery is owned by Kembla Coal and Coke. It extends from the rail line at Wombarra to the top of the Illawarra Escarpment. The mine ceased operation in the early 1980s and is at present unproductive land. The fact that Scarborough/Wombarra's flood problems are more influenced by mining activities than by climate and Scarp geology, is demonstrated by the topographic map and map showing peak 1 in 100 flows along the coast (see Attachments I and VIII). **Note that the 51.0 m^3/sec estimate for Creek G is taken at its outlet, not catchment. In other words, it combines rainfall and runoff conditions, and this is the crux of the matter.**

Ten small creeks flow from the Scarp to the sea through Wombarra and the lower slopes of Scarborough headland. Five streams A,B,C,D,E originate north of Fifth Street in rainforested slopes behind Scarborough, while Horse Creek, G, H, I and J creeks originate above Wombarra.

In the early days, creeks were diverted southward into a channel, feeding two dams on South Clifton Colliery. Since the mine closed, dam overflows have produced several washouts affecting the Illawarra Rail Line and Wombarra homes. The existence of cleared expanses on the mine site and surface compaction of coal waste residues has exacerbated runoff, as has the wide concrete pit entrance area.

Other creeks were diverted by the mining company to build a coal dump, which sits on slip land known as the South Clifton Landslide, immediately above the rail and homes in Goodrich Street, Scarborough. On cessation of mining activities, KCC have overseen some levelling of the dump area and planting with eucalypts. The coal waste mounds are monitored by Longmac and the ground there has been observed to move in a south easterly direction (see Attachment XI a-f).

Further uphill again, is a an old tailings dam area now heavily filled, levelled and compacted with mine waste residue. Two creeks with catchment near the Maddens Plains coal dump on top of the Scarp are interupted by this filled area and the waste mounds below. Some of this water must seep into the fill, which could possibly contribute to instability of the South Clifton Landslide.

The mine bath house was demolished in 1990, but remaining debris washed on to the rail during heavy rains in June 1991, blocking the drainage culvert at Creek G. A dam some 20 ft deep by 50 ft long built up behind the rail embankment, and its overspill resulted in a rail collapse at Wombarra Station and serious environmental and property losses for the community. Thousands of tonnes of soil were washed into the Tasman Sea which remained brown with turbidity for several weeks.

Mine shafts at the pit were not backfilled after mining stopped as is normal practice. These are believed to be holding an amount of water. In 1991, local residents reported signs of slip in the revegetated waste mounds, with fissures leaking smoke. KCC advised that this was carbon monoxide and methane gas and filled the openings.

At the request of residents, one of the South Clifton Colliery dams has recently been emptied so as to provide interim flood retention. The water level of the second dam is low at present.

KCC's environmental officer advises that the company has recently lodged a B/A with Wollongong Council for drainage of the South Clifton Landslide area. However, this may have little effectiveness unless other creek diversions and runoff problems are attended to by a comprehensive restoration program.

New shrubs have been planted near the colliery entrance, however, boulders, concrete slabs, iron bars and timber debris are still found along the mine boundary above the rail.

Looking at Kembla Coal and Coke's **Coal Lease No: 587** and at the disorganised creek pattern and unstable waste matter on the Colliery , it is clear that rehabilitation is not yet complete.[7] (see Attachment XII). Without a well designed management strategy for stream courses crossing the mine, the area will continue to present a compound hazard to both the Illawarra Rail Line and communities of Scarborough/Wombarra downstream. **The channel/tunnel Options G and J do nothing to halt ongoing deterioration of the old mine area.**

The following table shows what a Works Schedule for restoration of the South Clifton Colliery Site might involve, taking into account hydro-bioengineered creek treatments for flood mitigation at Scarborough/Wombarra.

Meeting Australian Standards

KCC is a subsidiary of the multinational mining giant CRA, which is 49% owned by the London based company, RTZ. CRA's 1991 profits were over $4 billion and it is presently negotiating to take over Coal and Allied Operations.

The **CRA Gazette** describes the company as employing a diverse full time environmental team. Rehabilitation is understood as a crucial aspect of mining activity and officers continually monitor effluents and other impacts on localities where mines operate. The Weipa rehabilitation involved 4,700 hectares in North Queensland, while $17 million dollars was spent reclaiming the huge Mary Kathleen site. Subsidiaries of CRA have also worked jointly on projects with the National Parks and Wildlife Services and in the Illawarra, a Young Achievers program with high school students.

During discussion at an Illawarra Escarpment Coalition meeting in July 1991, the possibility was raised that KCC may have talked informally to Wollongong Council about donating the old mine site for parkland recreation area, but Council did not want liability for an unrestored site. If the land was made secure, it could perhaps be constituted as parkland under the supervision of a Trust. Meanwhile, although South Clifton Colliery has not yet been fully restored, the potential for this is real. Kembla Coal and Coke's environmental officer helped pioneer the much acclaimed rehabilitation of the Darling Range Jarrah Forests, which project won a UN award for reafforestation.

In an article called "Listening to Community Opinions", the **CRA Gazette** observes that the NSW Environmental Offences & Penalties Act (1989), carries a $1.5 million fine and a 7 year jail sentence for responsible company employees of an offending operation.[8]

The Australian Mining Industry Council is committed to assisting companies with correct reclamation practices during and after completion of mining. Ideally, restoration of an area should replicate pre-mining conditions (see Attachment XII). The **AMIC Handbook** notes the following statutory requirements pertaining to mine rehabilitation in NSW[9]:

Mining Act 1973	Dept. of Mineral Resources
Coal Mining Act 1973	" "
Mining Act 1992	" "
Environmental Planning & Assessment Act 1979	Dept. of Planning
Clean Air Act 1961	Environmental Protection Authority
Clean Waters Act 1970	" "
Environmentally Hazardous Chemicals Act 1985	" "
Environmental Offence & Penalties Act 1989	" "

The Waste Disposal Act (1970), Coastal Protection Act (1979), Marine Pollution Act (1987), along with the NSW Government Coastal Policy (1990) and the Federal Government's Coastal Protection Act (1993), may also be relevant guides where a mine site is adjacent to the sea. The City of Wollongong Local Environment Plan (1990) and the Illawarra Regional Environmental Plan No. 1 should be consulted regarding local requirements.

Economic Efficiency of Bioengineering

An average Australian rehabilitation rate is $8,000 per hectare, while open cut coal mine repair falls between $15-30,000 per hectare. The total cost for a bioengineering project can vary from approximately $500 to $20,000 per hectare depending on terrain and site difficulty, such as the Swiss Alps. On this basis, rehabilitation of an extremely problematic 23 hectare mine site such as South Clifton, would cost around $460,000.

An alternative indicator for estimating cost is per creek treatment, where stormwater attenuation and stabilisation works along a 1/2 km creek course would cost roughly $100,000. Schiechtl notes that a cost comparison of bioengineered slope stabilisation works along railway tracks in Germany compared very favorably with conventional construction methods. Savings are usually 1/9 to 1/4 of anticipated hard engineering expenditures.[10]

Moreover, schemes such as City Rail's earlier culvert enlargement program and the now proposed channel/tunnel options, consider only technological feasibility, not ecological tradeoffs or social amenity. The latter costs are externalised by being pushed into the future. This means that the City Rail **costing estimates on Options G and J are misleading** (see Attachment III).

While Option G, at $6 million, externalises costs, the Restoration Option builds social/environmental factors into the engineering design. For example: looking at the list of unintended drawbacks associated with implementation of channel/tunnel options (see p. 2 above), the eventuality of any one of these problems, will incur major clean up expenditure for all parties - City Rail, Council, community householders.

Concrete and steel engineered structures deteriorate with time. In fact, City Rail expects the operational life of the channel/tunnel to be only 50 years - a temporary stormwater solution. On the other hand, **Option Q improves with time as it sets into play a living system of natural checks and balances**.

The advantages of low scale material inputs and self maintenance once a functioning bioengineered ecosystem is set up are significant. Fortunately the Scarborough/Wombarra area is a warm temperate microclimate which favours fast growing. However, careful monitoring of projects in the first 3-5 years is important. Before a bio-construction becomes fully operational, some stabilisation, infrastructure repair and re-planting of nascent erosion gullies, may be necessary.

Contracts for bioengineering works should include a seasonal maintenance plan, and design guarantee, until the construction is well established. After the initial implementation period, maintenance can be tendered out privately or overseen by an appropriate government department.

Costing would probably not require a new hydrological study of culvert capacities and creeks on community land downstream of the reconstructed mine site, since existing Webb McKeown calculations could well serve as the basis for upstream works.

Timing

The time estimate for design and construction of conventional stormwater drainage Options G and J, is expected to be from 18 months to 4 years. Restoration Option Q may take only 9 months to establish.

In addition, using Options G and J, the time blow-out may be enormous, if extensive environmental impacts become apparent 10 or 30 years after channel/tunnel construction.

Major disruption of local amenities may also result from environmental impacts, and this should be factored-in to time budgeted for construction activity, since it is part of the same imposition on the community.

Safety Factor

In general, use of heavy earth moving equipment, explosives, underground labour, and trucking during conventional engineering works, introduces new risks for labour and the community, as well as for the area's geology, flora and fauna.

Tunnel or no, as long as the South Clifton pit and landslide area remain in disrepair, lower Scarborough residents will continue to live with the threat of a major Aberfan type avalanche from liquefied coal waste mounds above their homes.

Operational failure of a channel/tunnel option caused by subsidence at the South Clifton Landslide, will renew flood problems for the Wombarra community.

The channeling and concentration of stormwater in large outputs, decreases safety for the public at point of discharge on the beach. The turbidity produced is a threat to marine life.

Where creeks are dispersed in small stream flows, as in Restoration Option Q, danger to construction workers and community is minimised.

A People's Park?

The mine site Restoration Option Q is a win-win solution all round.

Kembla Coal and Coke can promote its green image and show the Australian public that the company is a model of performance responsibility in the latest reclamation techniques. The outlay will be relatively small, probably equivalent to what the company would spend in bandaid repairs to this uneconomic holding over the next five years.

The **taxpayers** of NSW win because their dollars are no longer being absorbed by City Rail's expensive engineering efforts, Options G and J.

City Rail wins by achieving rail line security at Scarborough/Wombarra while a major financial load is taken off a government body already strapped for funds. In addition, justice is seen to be done, since City Rail is already owed $20 million in compensation by KCC's parent company CRA, who accidentally undermined the Stanwell Park Viaduct in the mid-'80s.

Wollongong Council wins in demonstrating itself responsible to constituents by supporting the most advanced engineering advice, and favouring an option that protects the residents of Scarborough/Wombarra and their beautiful coastal environment.

Council might also sponsor the mine reclamation as a Public Works youth employment and training scheme, in order to relieve the plight of **unemployed youth** (55%) in the Wollongong area.

The **Culverts Committee** and **Wombarra pro-tunnel residents** win safety from flood waters. Also, their original requests to protect the natural creek system is acknowledged in a way that is feasible, less expensive, and does not sacrifice anybody's home.

The **Wombarra Preservation Group** is satisfied because Option Q protects the area for future generations.

Scarborough Action for the Environment members win relief, along with other people further north of the headland, anxious to protect their properties from the unknown impacts of an underground tunnel.

The **lower Scarborough residents** in Fifth and Goodrich Streets win in as much as the South Clifton Landslide uphill of their homes will be stabilised during full reclamation of the mine. Moreover, they will not be subject to the uncertainty of Options G and J, an open concrete drainage channel crossing unstable lands above their homes.

All local **property holders and speculators** win since real estate values can only increase with the safety and visual amenity of the area protected by a rehabilitated mine site.

The **tourism industry** should gain.

Fishermen will not lose the product of fish spawning grounds because of polluted rock pools from the tunnel exit at the north end of Scarborough Beach.

The **public at large** win back a beautiful parkland recreation area on the Scarp slopes above Scarborough/Wombarra - Picnic Flat, as it used to be known.

Protection for the **rainforest** adjacent to the South Clifton Colliery will be enhanced. This sub-escarpment rainforest is an indispensable flora and fauna corridor, linking cool temperate rainforests of Victoria and warm temperate ones in northern NSW.

The **surfing community** and **beach lovers** will enjoy a cleaner safer beach. Mothers and children will not lose their rock pool - safest swimming area at Scarborough.

A delicate **marine ecology** will be preserved.

Need for a Feasibility Study

As long as the stormwater management plan for the Scarborough/Wombarra area remains unresolved, lives and property are at risk. Authorities are moving quickly for a decision, however, it may be for an option that is technically feasible yet environmentally unsound.

If you believe Restoration Option Q has merit and you support the request for a feasibility study into it, please contact the Wombarra Preservation Group:
Michael Cordell (042) 67 4772
Tom Kelly (042) 67 1624
Ariel Salleh (02) 810 1130

You can also write to the Wombarra Preservation Group
c/- Nature Conservation Council
39 George Street
The Rocks NSW 2000

A feasibility study could be completed within 1 month and an EIS for Restoration Option Q in 3 months. Allowing 6 months for construction, a new Scarborough/Wombarra flood mitigation strategy could be working within a year.

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Notes:

1.
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Sediment and Stormwater Administration, Standards and Specifications for Infiltration Practices, (Maryland; Department of the Environment, 1984).

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9.
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Luchterhandt, J. Gruenverbau (Berlin: Bauverlag, 1966); Schiechtl, H. Bioengineering for Land Reclamation and Conservation, N. Horstman (trans.), (Edmonton: University of Alberta Press, 1980).

Attachments:

I.
Study Area Map

II.
Community Perspective

III.
City Rail Options & Tunnel Plan

IV.
NCC, TEC & Government Submissions

V.
Illawarra Mercury Articles

VI.
Hydrological Cycle

VII.
Sample Bioengineering Designs.

VIII.
Rainfall Map

IX.
Geological Map

X.
Ownership & Zoning Map

XI.
Longmac Survey Results

XII.
Mine Reclamation Requirements

Photographs: Scarborough/Wombarra 1-40

Rough Works Schedule for Mine/Creek Restoration

	Labour
Phase 1 - Design	
Geotechnical/Hydrological/ Bioengineering Consultation and Planning	3@$140 x 120 hrs
Overheads	say $5000
Phase 2 - Site Preparation	
Remove Coal Waste Mounds (say, 6 ha or 360,000 m^3 spoil) and Backfill Mine Shafts (or is spoil marketable?)	1@$50 4x$25 x 160 hrs
Contour Landslide Area Terraces and Backgrading	1@$50 2@$25 x 80 hrs
Excavate 3 Creek Courses from Scarp (say 400 m) (re-use top soil on site?)	2@$25 x 40 hrs
Phase 3 - Bioengineering	
Construct Detention Ponds/Small Drop Structures/ Imbrications on Creek Courses & Planting (residents grow local seedlings)	1@$140 1@$50 4@$25 x 240 hrs
Construct Drainage and Stabilisation Structures for Landslide & Planting	4@$25 x 160 hrs
Phase 4 - Maintenance and Evaluation	
Monitoring/Misc. Repairs	1@$140 x 40 hrs 2@$25 x 240 hrs
Costs	**204,600**

<u>Total Cost Estimate: $254,600</u>

	Equipment	Materials	Timing	Risks
Phase 1 - Design				
Geotechnical/Hydrological/ Bioengineering Consultation and Planning	-	-	wks: 1&2&3	-
Overheads				
Phase 2 - Site Preparation				
Remove Coal Waste Mounds (say, 6 ha or 360,000 m^3 spoil) and Backfill Mine Shafts (or is spoil marketable?)	bulldozer/ truck hire @$800 x 20 days	-	wks: 4,5,6,7	low (mech. use)
Contour Landslide Area Terraces and Backgrading	as above x 10 days	-	wks: 8&9	as above
Excavate 3 Creek Courses from Scarp (say 400 m) (re-use top soil on site?)	backhoe/ excavator hire @$1000 x 5 days	-	wks: 9	-
Phase 3 - Bioengineering				
Construct Detention Ponds/Small Drop Structures/ Imbrications on Creek Courses & Planting (residents grow local seedlings)	hand tools say $1000	gypsum humus treated logs rock seedstock	wks: 10,11,12, 13,14,15	-
Construct Drainage and Stabilisation Structures for Landslide & Planting	as above		wks: 16,17,18,19	-
Phase 4 - Maintenance and Evaluation				
Monitoring/Misc. Repairs	as above		first 6 mth = 6 wks yr II,1dy/mth yr III " yr V,1dy/qtr	-
	$30,000	**$20,000**		