

ANNEXURE 8

**Geotechnical Assessment
(Riverbank Stability)**

prepared by

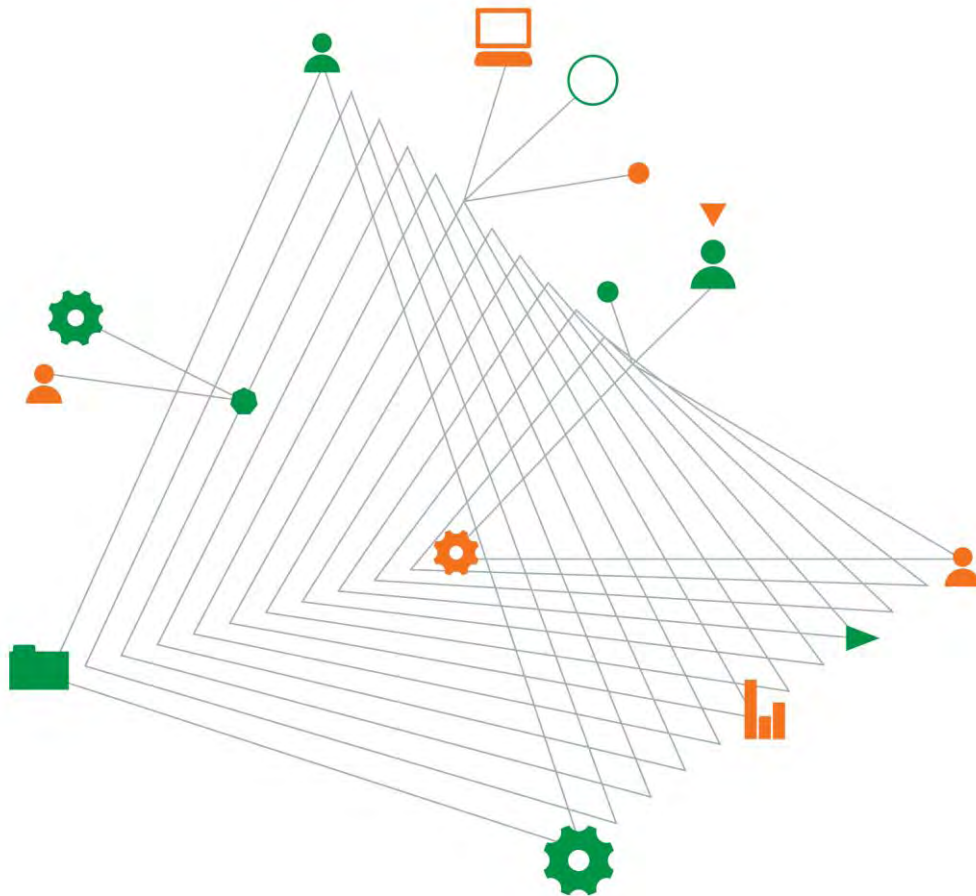
Coffey Geotechnics

Manildra Group C/- Cowman Stoddart Pty Ltd

**Proposed modifications to DDG Dryer,
biofilters, cooling towers, mill feed silo and
container storage area, Bomaderry NSW**

Geotechnical Assessment

2 April 2016



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Proposed modifications to DDG Dryer, biofilters, cooling towers, mill feed silo and container storage area, Bomaderry NSW

Prepared for
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2 April 2016

Document authorisation

Our ref: GEOTWOLL03658AH-AC

Dear Stephen,

Please find enclosed our report which documents the findings of a geotechnical assessment of the potential effects of the development of the proposed DDG dryer plant, in particular the biofilters, cooling towers, silo and container storage area, on the stability of the northern bank of the Shoalhaven River, the banks of Abernethy's Creek and eastern bank of Bomaderry Creek. The river and creeks are located in the vicinity of the various components of the DDG Dryer Plant at the Manildra Shoalhaven Starches Plant in Bomaderry NSW.

We draw your attention to the document following the report text entitled 'Important Information about Your Coffey Report' which should be read in conjunction with this report. Should you have any questions in relation to this report please contact the undersigned in our Wollongong office.

For and on behalf of Coffey



Jon Thompson CPEng
Principal Geotechnical Engineer

Quality information

Revision history

Revision	Description	Date	Author	Reviewer	Signatory
Rev0	Report	2/04/2016	DT	JPT	Jon Thompson

Distribution

Report Status	No. of copies	Format	Distributed to	Date
Final	1	PDF	Stephen Richardson (Cowman Stoddart Pty Ltd)	2/04/2016

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Important information about your Coffey Report

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Figure

Figure 1 – General location of proposed biofilters, cooling towers and silos

1. Introduction

Manilda Group is proposing modifications to the approved Shoalhaven Starches Expansion Project (SSEP), specifically, the reduction in the number of DDG Dryers from 6 to 4 and their relocation, construction of two new biofilters, relocation of cooling towers, and construction of a new mill feed silo/structure within the Manildra Shoalhaven Starches Plant, located on Bolong Road, Bomaderry, NSW. Geotechnical advice is required in relation to the proximity of the proposed container storage area to Bomaderry Creek.

This report, prepared by Coffey Geotechnics Pty Ltd. (Coffey), provides a geotechnical assessment in relation to:

- The proximity of the proposed biofilters to the Shoalhaven River and the potential effects of the proposed structures on the stability of the river bank.
- The potential effects of the construction of a new silo and cooling towers on the stability of the nearby banks of Abernethy's Creek.
- The potential effects of the proposed container storage area on the stability of the nearby bank of Bomaderry Creek.

2. Scope of work

The geotechnical assessment includes the following scope of work:

- Site visit by a Coffey Principal Geotechnical Engineer on 15 December 2015 to observe the existing surface conditions over the sites for the silo, cooling tower and biofilters and surrounds, including the nearby northern bank of the Shoalhaven River and banks of Abernethy's Creek;
- Site visit on 15 February 2016 by a Coffey Principal Geotechnical Engineer, to observe the existing site surface conditions along the eastern bank of Bomaderry Creek and the area between Bomaderry Creek and the Container Storage Area;
- Review of existing subsurface information from previous Coffey investigations in the vicinity of the proposed silo, cooling towers and biofilters; and
- Provide a report summarising the outcome of our assessment and recommendations.

3. Site description

The proposed DDG Dryer Plant is generally situated towards the south-western part of the Manildra Shoalhaven Starches plant on the southern side of Bolong Road in Bomaderry. The proposed sites for the silo, cooling tower, biofilter structures and container storage area as assessed in this report are located as shown in Figure 1. The site surface conditions in the vicinity of each structure and the nearby areas between the proposed sites for these structure or storage areas, including the river and creek banks, are described below.

3.1. Biofilters

The site of the proposed additional biofilters is approximately 25 to 30m north of the northern bank of the Shoalhaven River on the western side of the existing biofilters. The site is near level and has a paved gravel surface (refer Photograph 1). The existing biofilter structures are essentially large tank structures with concrete block walls and concrete floor slabs (refer Photograph 2). We understand

from discussions with Manildra that these structures are supported on high level footings with no piles present.

The land to the west of the site is currently vacant and the areas to the north and east are being used for storage of shipping containers with heavy forklift vehicles moving between the containers.

On the southern side of the site for the biofilters, there is a wire mesh fence and then a riparian corridor with a medium dense vegetation cover of mostly small to medium trees (3 to 15 years old) and some mature trees up to about 40 years old (Refer Photograph 5). The tree covered area extends to the top of the very steep river bank which is near vertical in parts. There is a row of trees along the crest of the river bank. The river bank is about 3m above the high tide water level of the river and during the heavy rainfall and flood event of August 2015, the river level rose to within about 1m of the top of bank and the bank was severely eroded with widespread undercutting and collapse of the bank occurring (Refer Photographs 3 and 4). The loss of ground from the bank was up to about 1.5m. Some sections of the bank have been weakened by this erosion and some further local collapse would be expected, particularly if further significant rainfall events were to occur. Currently the top of the river bank is about 25m from the fence line adjacent to the biofilters.



Photograph 1 – View of site for biofilters looking west with riparian corridor to left of photo between the site and the river



Photograph 2- View of western side of existing biofilter and gravel surfaced area over site of proposed biofilters. Tree covered riparian corridor in background to south of site.



Photograph 3 – View of northern bank of the Shoalhaven River about 25m to south of site for biofilters. Note undercutting and partial collapse of bank with some mature trees along top of bank.



Photograph 4 – View of river bank about 25m south of biofilters showing recent erosion and collapse and edge of river at low tide.



Photograph 5 – View of riparian corridor with medium dense tree cover between the site for biofilters and the river bank, with Shoalhaven River to right of photo.

3.2. Cooling towers

The site for the proposed cooling towers is approximately 20m west of Abernethy's Creek (also known as Abernethy's Drain) and about 26m north of the northern bank of the Shoalhaven River, and is adjacent to (east of) the existing cooling towers. The western bank of Abernethy's Creek, at its closest point to the proposed cooling towers, is unsupported and has a slope of about 45 degrees as shown in Photograph 7 below. The bank has a thick grass cover which disguises the surface, however, there was no visible evidence of any recent instability of the bank. Some improvements to surface drainage along the top of the bank have been made with a concrete strip provide to divert surface runoff to the creek.

The site for the cooling towers is paved partly with an asphalt surfacing and partly gravel surface as shown in Photographs 6 and 8. The ground surface within and around the site for the cooling towers is near level and comprises paved areas to the east and south, paved areas and some structures to the north with many existing structures to the west and north-west. The site is relatively remote from the northern bank of the Shoalhaven River which is about 26m to the south of the site for the cooling towers.



Photograph 6 – Site of proposed Cooling Towers looking north with Abernethy's Creek to far right of photo. Asphalt and gravel paved surface.



Photograph 7 – View of western bank of Abernethy's Creek looking north. The top of the creek bank is about 20m from the site for the Cooling Towers.



Photograph 8 – View of site for Cooling Towers looking west with top of western bank of Abernethy's Creek in foreground, right lower corner of photograph.

3.3. Silo

The site for the proposed silo is located about 5 to 10m east from the top of the eastern bank of Abernethy's Creek. We understand the new silo structure will be supported on a piled footing system to rock.

The site has already been partially developed with a concrete slab and four support points for a future structure (refer Photograph 11). There is a paved area between the concrete slab and the top of the eastern bank of Abernethy's Creek with asphalt surfacing (refer Photograph 10). The top of the eastern bank of Abernethy's Creek has been supported by a sheet pile wall and the soil exposures between the sheet piles and the existing pavement have been plugged with concrete (refer Photograph 9). The top of the sheet pile wall protrudes above the pavement surface about 200mm which allows surface water to be diverted away from this section of the creek bank. The top of creek bank was about 2.5m above the water level in the creek at this location.

There was no evidence of any significant cracking or displacement of the paved area between the sheet pile wall and the site for the silo.

The site of the proposed mill feed silo is approximately 5m east of Abernethy's Drain and adjacent to existing Dryer 7 (north).



Photograph 9 – View of eastern bank of Abernethy's Creek looking north, with the site for the silo located about 5m to 10m east of the top of bank. Note sheet pile wall along top of bank supporting paved area above the bank.



Photograph 10 – View of near level paved area between site for silo and top of eastern bank of Abernethy's Creek.



Photograph 11 – View of site for Silo from top of eastern bank of Abernethy's Creek.
Concrete plinth formed for location of silo.

3.4. Container Storage Area

The container storage area is located to the west of the DG Dryer Plant on a near level area and near the western perimeter of the site of the Manildra Shoalhaven Starches Plant in Bomaderry. Between the proposed container storage area and Bomaderry Creek to the west, the ground surface is slightly undulating to near level over a riparian area about 12m to 20m wide. The existing weighbridge is about 12m from the top of the creek bank at its nearest point. The nearest stacked shipping containers in the Container Storage area to the eastern bank of Bomaderry Creek will be a further 6m to the east as shown in Figure 1, Site Plan.

The eastern bank of Bomaderry Creek is about 6m high and is generally very steep with slopes ranging from about 45° to 70° with some near vertical and locally undercut sections. The near vertical or undercut sections of bank generally occur just above the current water level in the creek. Water covered the whole bed of the creek at the time of our observations. There were a number of trees along the top of the high creek bank and some located on the bank, including a few that are more than 50 years old. There are many smaller trees over the riparian area between the top of the creek bank and the container storage area.

There was some evidence of instability and erosion in the eastern bank of Bomaderry Creek having occurred at various stages in the past, including recent erosion and slumping that likely occurred during the significant rain event that occurred in August, 2015. There was no evidence of any recent large scale failure of the creek bank in this area, and the presence of some large trees in this area also indicates that the trees have not been affected by any significant instability of the creek bank.

Photographs 12 to 18 below show the proposed Container Storage area and the land between the storage area and Bomaderry Creek.



Photograph 12 – View of eastern side of container storage area located over a fill platform, with weighbridge in background to left of photo.



Photograph 13 – View to north-west along the bank of Bomaderry Creek to west of the container storage area. Note riparian corridor with many small to medium trees, steeply sloping creek bank and near level area above bank.



Photograph 14 – View to east from top of creek bank looking towards container storage area. Gently sloping to near level area with numerous small to medium trees.



Photograph 15 – View looking south along Bomaderry Creek noting that the creek is tidal at this location and water extends across full width of creek.



Photograph 16- Erosion at toe of eastern bank of Bomaderry Creek with some undercutting present.



Photograph 17 – Large tree at top of eastern bank of Bomaderry Creek with many smaller trees over slope.



Photograph 18 – View across top of creek bank where erosion has occurred due to rabbit burrows. Undulating shape of creek bank indicates previous slumping and erosion of bank.

4. Local geology and hydrogeology

Reference to the 1:100,000 Kiama Soil Landscape Series Sheet (9028, First Edition), produced by the Department of Conservation and Land Management NSW (1993) indicates that the site is located on Shoalhaven Soils. These soils are described as moderately deep prairie soils on levees, red earths and yellow and red podzolic soils on terraces and alluvial soils and gleyed podzolic soils on the floodplains.

Reference to the 1:250,000 Wollongong Geological Series Sheet (S1 56-9, First Edition) prepared by the NSW Department of Mines (1952) indicates the site is likely to be underlain by Quaternary alluvium, gravel, swamp deposits and sand dunes.

Based on observations made of the site, surrounding topography, and proximity of the nearby Shoalhaven River, groundwater is expected to be located at a depth of about 3m to 4m and flow to the south towards the river.

5. Inferred geotechnical model and groundwater

The general subsurface conditions and the inferred geotechnical model used in this assessment have been based on several previous boreholes from previous assessments including:

- Proposed dryer plant (Coffey report GEOTWOLL03658AE-AA, dated 26 August 2015), Boreholes CBH501 and CBH502; and
- Preliminary Environmental Site Assessment and Geotechnical Investigation, Proposed Ethanol Expansion, Shoalhaven Starches Plant, Bomaderry (Coffey Report ENVIUNAN 00111AA, dated 25 June 2008).

The subsurface conditions in the general vicinity of the proposed cooling towers and silo are likely to be similar to those encountered within Boreholes CBH501 and CBH502 as documented in GEOTWOLL03658AE-AA. Based on this report:

- Groundwater inflows were encountered in the drilled boreholes at depths of 2.6m and 2.7m below existing ground surface level at the time of investigation;
- In the vicinity of the proposed silo and cooling towers, the depth to rock is expected to generally increase to the east of Abernethy's Creek and the alluvial soils would generally be deeper and softer;
- At the site of the proposed biofilters, the depth to rock is expected to be somewhat shallower. Previous shallow boreholes about 40m to the east of the biofilters encountered deep topsoil from 0.5m to 1.0m overlying alluvial firm to stiff silty to sandy clays and medium dense clayey silts and sands to depths of 2.0m; and
- At the site of the proposed container storage area the depth to rock is expected to be similar or somewhat shallower than the depths indicated below and the alluvial soils will generally be stiffer with some loose or soft zones.

The subsurface conditions encountered in these boreholes are summarised in Table 1 below.

Table 1 - Summary of subsurface conditions encountered in Boreholes CBH501 and CBH502.

Geotechnical unit	Description	Depth to top of unit below current ground level ⁽¹⁾ (m)	Unit thickness ⁽¹⁾ (m)	Consistency / Relative density	Comment
Fill	Asphalt	0.0	0.04	-	Only in CBH501
Fill	Silty CLAY: Low plasticity, dark brown, with some fine to medium grained sand, trace of fine to medium sub-angular or angular gravel	0.0 to 0.04	1.2 to 2.7	-	-
Alluvial Soils	Clayey SAND: Fine to coarse grained, grey, low plasticity clay	2.8	2.6	Very loose	Only in CBH501
Residual Soil	Silty CLAY / Sandy CLAY / CLAY: Low to high plasticity, orange/brown/mottled dark grey/black, fine to coarse grained sand	1.2 to 5.4	4.1 to 4.3	Firm to stiff	-
Extremely Weathered Material	CLAY: Medium to high plasticity, pale grey/mottled pale red/brown, with some fine to coarse grained black sand, trace of gravel sized ironstone fragments	5.5 to 9.5	1.7 to 2.5	Firm to stiff	-
Highly Weathered to Slightly Weathered Sandstone	SANDSTONE: Fine to coarse grained, yellow/brown/pale grey/orange/dark grey, low to high strength with some inter-bedded clayey material	8.0 to 11.2	-	-	Some extremely weathered seams (Refer to logs for the details)

Notes: The depths and thicknesses of the various units are based on a limited number of boreholes and may not represent the maximum or minimum values across the site or all materials beneath the site. In the area proposed for container storage a fill platform and granular pavement was formed some years ago over the alluvial soils.

6. Discussion and conclusions

6.1. Effects on Shoalhaven River bank stability due to construction of proposed biofilter structures

The objective of this assessment was to assess the effects of the proposed development of the biofilter structures on the stability of the nearby northern bank of the Shoalhaven River. For this assessment we have considered the proximity of the proposed structures to the river bank, the current profile of the river bank and the site conditions between the river bank and the site for the biofilters, the subsurface conditions in the vicinity of the biofilters and the loads implied by the proposed structures. It is assumed that the new biofilters will be founded at high level (within upper 1m of the soil profile).

Coffey has assessed that the proposed biofilters for the DDG Dryer Plant will not effect on the stability of the river bank due to the relatively low foundation loads applied to the upper soil profile, the setback of the structures from the river bank and the observed surface and inferred subsurface conditions in the vicinity of the site.

Coffey should be advised of any changes to the design of the proposed structures in relation to its position, extent of building footprint and foundation loads.

6.2. Effects on stability of Abernethy's Creek banks due to construction of silo and cooling towers

For this assessment we have considered the proximity of the proposed structures to the banks of Abernethy's Creek, the current profile of the banks and the surface conditions between the banks and the sites for the silo and cooling towers, the subsurface conditions in the vicinity of the structures and the loads implied by the proposed structures.

Coffey has assessed that the proposed Silo and Cooling Towers for the DDG Dryer Plant will not affect the stability of the banks of Abernethy's Creek due to the relatively low foundation loads implied by the structures to the upper soil profile assuming that heavily loaded structures or concentrated loads will be transferred by deep piles to rock, the setback of the structures from the banks and the observed surface and inferred subsurface conditions between the sites for the structures and the creek banks.

6.3. Effects on stability of Bomaderry Creek bank due to container storage area

For this assessment we have considered the proximity of the container storage area to the eastern banks of Bomaderry Creek, the current profile of the creek bank and the surface conditions between the bank and the site for the container storage area, the subsurface conditions in the vicinity of the container storage area and the loads implied by the stacked shipping containers.

Coffey has assessed that the proposed storage of shipping containers to the west of the DDG Dryer Plant will not affect the stability of the banks of Bomaderry Creek due to the relatively uniform distribution of loads implied by the stacked containers to the current fill platform and upper soil profile, the setback of the containers from the eastern bank of Bomaderry Creek, and the general subsurface conditions in this area.

7. Conclusions and recommendations

The above report summarising our assessment and advice is based on our visual assessment of the sites for various structures and container storage area which form part of the DDG Dryer Plant development, together with a review of available subsurface information.

In areas where vegetation has been established along the river and creeks, the trees should be maintained. Drainage from the development should not be concentrated along the top of the creek or river banks that could contribute to erosion or failure of the banks. No fill should be placed along the tops of the river or creek banks. Coffey should be advised of any observed significant changes to the ground surface conditions along the northern bank of Shoalhaven River bank, the banks of Abernethy's Creek, and the eastern bank of Bomaderry Creek.

We draw your attention to the document following the report entitled 'Important Information about Your Coffey Report' which should be read in conjunction with this report.

Important information about your Coffey Report

As a client of Coffey you should know that site subsurface conditions cause more construction problems than any other factor. These notes have been prepared by Coffey to help you interpret and understand the limitations of your report.

Your report is based on project specific criteria

Your report has been developed on the basis of your unique project specific requirements as understood by Coffey and applies only to the site investigated. Project criteria typically include the general nature of the project; its size and configuration; the location of any structures on the site; other site improvements; the presence of underground utilities; and the additional risk imposed by scope-of-service limitations imposed by the client. Your report should not be used if there are any changes to the project without first asking Coffey to assess how factors that changed subsequent to the date of the report affect the report's recommendations. Coffey cannot accept responsibility for problems that may occur due to changed factors if they are not consulted.

Subsurface conditions can change

Subsurface conditions are created by natural processes and the activity of man. For example, water levels can vary with time, fill may be placed on a site and pollutants may migrate with time. Because a report is based on conditions which existed at the time of subsurface exploration, decisions should not be based on a report whose adequacy may have been affected by time. Consult Coffey to be advised how time may have impacted on the project.

Interpretation of factual data

Site assessment identifies actual subsurface conditions only at those points where samples are taken and when they are taken. Data derived from literature and external data source review, sampling and subsequent laboratory testing are interpreted by geologists, engineers or scientists to provide an opinion about overall site conditions, their likely impact on the proposed development and recommended actions. Actual conditions may differ from those inferred to exist, because no professional, no matter how qualified, can reveal what is hidden by earth, rock and time. The actual interface between materials may be far more gradual or abrupt than assumed based on the facts obtained. Nothing can be done to change the actual site conditions which exist, but steps can be taken to reduce the impact of unexpected conditions.

For this reason, owners should retain the services of Coffey through the development stage, to identify variances, conduct additional tests if required, and recommend solutions to problems encountered on site.

Your report will only give preliminary recommendations

Your report is based on the assumption that the site conditions as revealed through selective point sampling are indicative of actual conditions throughout an area. This assumption cannot be substantiated until project implementation has commenced and therefore your report recommendations can only be regarded as preliminary. Only Coffey, who prepared the report, is fully familiar with the background information needed to assess whether or not the report's recommendations are valid and whether or not changes should be considered as the project develops. If another party undertakes the implementation of the recommendations of this report there is a risk that the report will be misinterpreted and Coffey cannot be held responsible for such misinterpretation.

Your report is prepared for specific purposes and persons

To avoid misuse of the information contained in your report it is recommended that you confer with Coffey before passing your report on to another party who may not be familiar with the background and the purpose of the report. Your report should not be applied to any project other than that originally specified at the time the report was issued.

Interpretation by other design professionals

Costly problems can occur when other design professionals develop their plans based on misinterpretations of a report. To help avoid misinterpretations, retain Coffey to work with other project design professionals who are affected by the report. Have Coffey explain the report implications to design professionals affected by them and then review plans and specifications produced to see how they incorporate the report findings.

Data should not be separated from the report*

The report as a whole presents the findings of the site assessment and the report should not be copied in part or altered in any way.

Logs, figures, drawings, etc. are customarily included in our reports and are developed by scientists, engineers or geologists based on their interpretation of field logs (assembled by field personnel) and laboratory evaluation of field samples.

These logs etc. should not under any circumstances be redrawn for inclusion in other documents or separated from the report in any way.

Geoenvironmental concerns are not at issue

Your report is not likely to relate any findings, conclusions, or recommendations about the potential for hazardous materials existing at the site unless specifically required to do so by the client. Specialist equipment, techniques, and personnel are used to perform a geoenvironmental assessment. Contamination can create major health, safety and environmental risks. If you have no information about the potential for your site to be contaminated or create an environmental hazard, you are advised to contact Coffey for information relating to geoenvironmental issues.

Rely on Coffey for additional assistance

Coffey is familiar with a variety of techniques and approaches that can be used to help reduce risks for all parties to a project, from design to construction. It is common that not all approaches will be necessarily dealt with in your site assessment report due to concepts proposed at that time. As the project progresses through design towards construction, speak with Coffey to develop alternative approaches to problems that may be of genuine benefit both in time and cost.

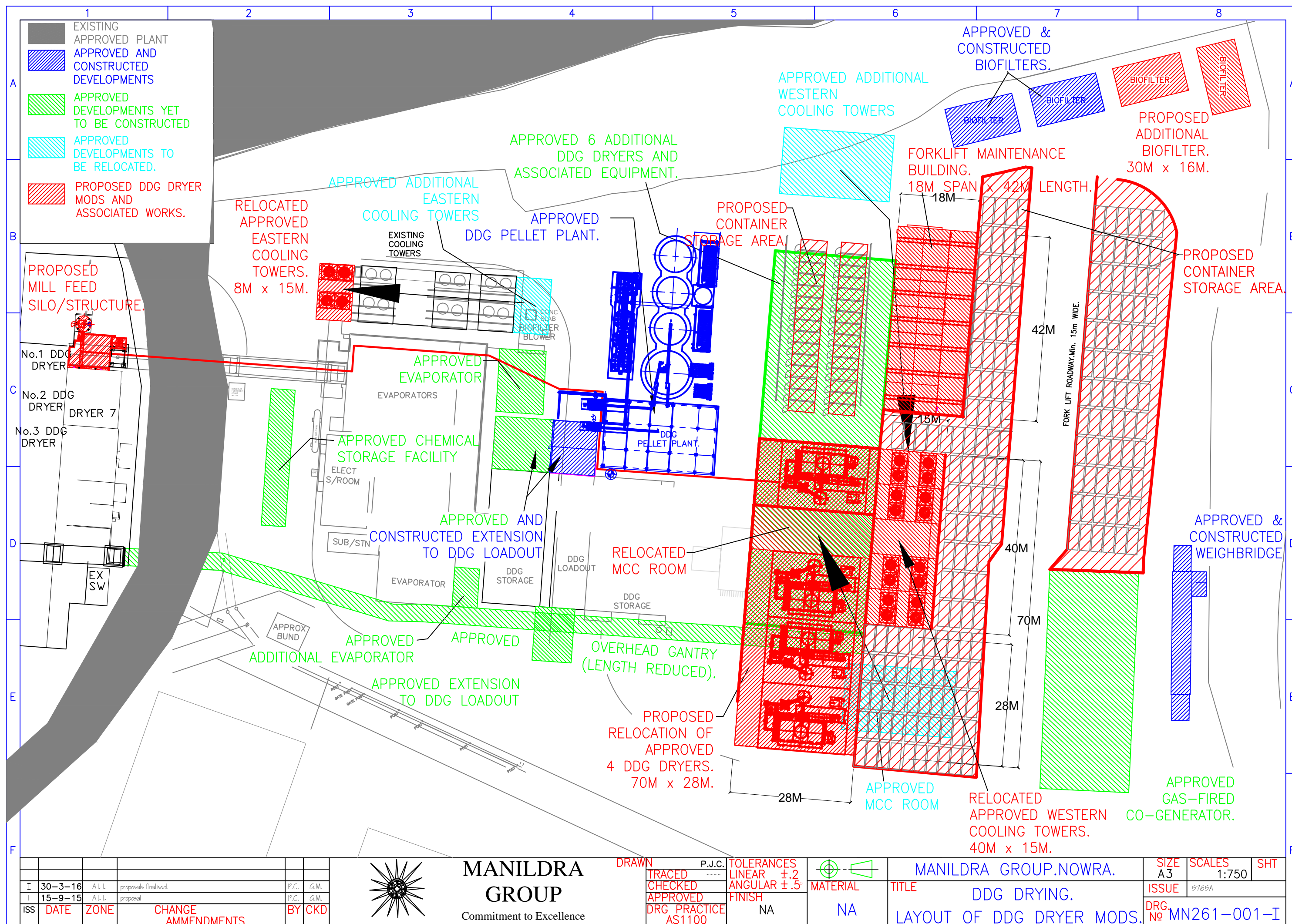
Responsibility

Reporting relies on interpretation of factual information based on judgement and opinion and has a level of uncertainty attached to it, which is far less exact than the design disciplines. This has often resulted in claims being lodged against consultants, which are unfounded. To help prevent this problem, a number of clauses have been developed for use in contracts, reports and other documents. Responsibility clauses do not transfer appropriate liabilities from Coffey to other parties but are included to identify where Coffey's responsibilities begin and end. Their use is intended to help all parties involved to recognise their individual responsibilities. Read all documents from Coffey closely and do not hesitate to ask any questions you may have.

* For further information on this aspect reference should be made to "Guidelines for the Provision of Geotechnical information in Construction Contracts" published by the Institution of Engineers Australia, National headquarters, Canberra, 1987.

Figure 1 – Site Plan (as provided by Manildra)

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I	30-3-16	ALL	proposals finalised.	P.C.	G.M.
I	15-9-15	ALL	proposal	P.C.	G.M.
ISS	DATE	ZONE	CHANGE AMMENDMENTS	BY	CKD