



**MWH**

***BUILDING A BETTER WORLD***

**CENTROC CARBON PLUS  
SUSTAINABILITY INDICATOR FORECASTS  
A1244700**

**SEPTEMBER 2010**

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## CENTROC CARBON PLUS

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## TABLE OF ACRONYMS

BAU	Business As Usual
Capex	Capital expenditure
CH <sub>4</sub>	Methane
CO <sub>2</sub>	Carbon dioxide
CO <sub>2</sub> -e	Carbon dioxide equivalent tonnes
CTW	Central Tablelands Water
CFR	Concrete Faced Rockfill
emp-y	Employment years
Ha	Hectares
IG	Infrastructure Group
IPCC	International Panel on Climate Change
ISA	Integrated Sustainability Analysis
LCA	Life Cycle Assessment
MJ	Mega Joules
ML	Megalitres
Opex	Operating expenditure
PSC	Project Steering Committee
RCC	Roller-compacted concrete
TBL	Triple Bottom Line
WELS	Water Efficiency Labelling Scheme
WSS	Water Security Study

## EXECUTIVE SUMMARY

In response to the worst drought on record for the region, Centroc undertook to complete a Water Security Study to investigate and recommend solutions to improve water supply security across the Centroc region. The key recommendations of the Water Security Study included a water conservation and demand management program and a suite of new and upgraded infrastructure.

In reading this report, it is important to recognise that the adopted Water Security Study (WSS) took into account minimising energy consumption as part of the assessment of the most appropriate strategy to adopt. The connection to Lake Rowlands was assessed as being significantly less energy intensive than the strategy investigated involving connection from Chifley Dam. In addition, on balance of all the triple bottom line assessment criteria examined (of which energy was one), the connection to Lake Rowlands was preferable.

Although the WSS took into account energy and greenhouse gas emissions, a comprehensive assessment of the carbon impact of the proposed scheme is required, as is a plan to ensure that those emissions are minimised and offset. However,

This is the basis for the development of The Carbon Plus Study in Central NSW.

### Project Scope

The scope of this project is to undertake a strategic level planning assessment of the options to sustainably manage the carbon emissions of the adopted water security study and to develop a plan of action to implement the most appropriate of those options in parallel with the continued implementation of the recommendations of the water study.

The project is being conducted in six stages:

1. Develop sustainability assessment framework and indicators.
2. Develop a stakeholder consultation plan.
3. Prepare forecasts for the identified indicators including carbon emissions.
4. Identify options for carbon neutrality and improved sustainability outcomes.
5. Develop implementation plans.
6. Reporting.

The results of stage three are the subject of this report.

### Modelling Approach

Forecasts for the sustainability indicators selected in Stage 1 of the project have been developed using the University of Sydney's Integrated Sustainability Analysis (ISA) tool. The forecasts have been produced for the Centroc region water supply systems, in the current mode and as identified in the WSS. These forecasts will provide the basis for identification of mitigation options in Stage 4 of the study.

The ISA approach is readily applied at a strategic stage. Data required for ISA modelling is primarily financial information (e.g. capital expenditure on materials, labour and equipment, operating expenditure on chemicals and energy) and for Centroc this information was produced from the analysis undertaken in development of the WSS. Additional information on energy consumption and materials requirements for major infrastructure is also readily estimated and can be used to supplement the ISA modelling.

The water supply cases modelled were:

1. Business as Usual (BAU) Capital and Operating expenses (Opex) over 50 years;
2. WSS Capital & Opex over 50 years
3. WSS Total case describes the forecast for the entire Centroc water supply system with the WSS infrastructure projects implemented.

The cases above were modelled for the whole Centroc water supply system and for each distinct catchment area (Lachlan and Macquarie).

In stage 1 of this project, the recommended sustainability assessment framework was developed. The identified indicators relevant to forecast generation are summarised below:

- Greenhouse gas emissions (tCO<sub>2</sub>-e);
- Energy consumption (TJ);
- Material flow (t);
- Water consumption (ML);
- Land disturbance (ha);
- Employment (emp-y);
- Family income – wages and salaries (\$'000);
- Gross Operating surplus (\$'000);
- Imports (\$'000); and
- Total expenditure (\$'000).

### Data Collection and Assumptions

Modelling was undertaken using financial data related to the WSS infrastructure projects (WSS Capital, WSS Opex) and ongoing operation of the water supply system (BAU Capital, BAU Opex). This data included a comprehensive breakdown of expenditure into categories. In addition, estimates were made of:

- Electricity and chemicals consumed for operation of the WSS infrastructure;
- Fuel consumed by fleet vehicles; and
- Labour, major materials, equipment, land use, energy and direct emissions related to WSS and business as usual capital projects.

The full list of modelling data and assumptions is included in Section 2.4 and Appendix 1.

### Results

While the total expenditure over the 50 year period will increase by 27% between the BAU and WSS cases, the greenhouse gas emissions, energy consumption and materials flow is expected to increase by significantly more.

The majority of greenhouse gas emissions generated are a result of ongoing operation of the water security infrastructure. Emissions generated due to operation are approximately 14 times those generated from capital construction. The greenhouse gas emissions generated for operation of the system are largely related to the consumption of electricity for pumping. Likewise the higher material flow is related to coal consumed in generation of this electricity.

Macquarie catchment energy consumption is approximately 4 times higher (17,300 TJ in total compared to 4,000 TJ) than the impacts in the Lachlan catchment. The majority of the energy consumption is incurred in operation rather than in supply and construction of capital infrastructure. The higher energy consumption in the Macquarie catchment is related to the higher electricity consumption for pumping in this catchment compared to that consumed in Lachlan.

The gross operating surplus or profits generated by the WSS projects will total approximately \$240 M over the 50 year period with approximately one third of the profits generated from capital and two thirds from operation. Gross operating surplus increases to a greater extent than total expenditure for the WSS case, which is related to the higher energy requirement for operating the water supply system in this catchment and consequent gross operating surplus generated in the electricity industry.

It is estimated that over the 50 year period, the WSS project construction and operation will result in an increase in employment, across the whole supply chain, of approximately 6,000 employment years (emp-y). There will be a similar number of jobs generated in the capital construction stage (approximately 3,000 emp-y) as in the operational stage (approximately 3,000 emp-y over the 50 year study period). Capital and operational impacts for other indicators are comparable. Total employment in the Lachlan catchment is greater than in the Macquarie catchment (approximately 4,100 emp-y compared to 1,800 emp-y in Macquarie). This is in proportion to the higher capital investment related to the Lake Rowlands augmentation project in Lachlan.

Total water use impacts of the WSS projects over the 50 year period are 24,000 ML (this total equates to approximately 70% of annual Centroc water demand in 2009). Direct water use impacts during the capital and operating periods are minimal, with a significant proportion of water use again associated with electricity production.

Land disturbance impacts related to the WSS projects are relatively minor totalling 11,000 ha over the 50 year period. Approximately half of these impacts are related to capital construction and direct impacts due to the footprint of the infrastructure total only 300 ha in total. The remaining land disturbance impacts are related to activities in the agricultural sector deep in the supply chain. Land disturbance in the Lachlan catchment is greater than in the Macquarie catchment and the difference is largely related to the capital component.

The family income generated as a consequence of the WSS projects over the 50 year period is approximately \$416 M with approximately half the income generated in the construction period and half due to operation and maintenance.

Imports will total some \$67 M over the period and this figure is in proportion to the total capital expenditure. The level of imports in the Lachlan catchment is somewhat greater than in the Macquarie catchment in line with the higher project expenditure.

While the demand management program implementation will have a small impact on employment over the 50 year period, the benefits in reduction of water use on energy consumption and greenhouse emissions are proportionally higher indicating that the demand management program provides an efficient means of achieving reductions in these impacts.

### **Sensitivity Analysis**

A sensitivity case was modelled to test the impact of an alternative Lake Rowlands augmentation dam construction technique (Concrete Faced Rockfill (CFR)) on the outcomes of the analysis.

The full supply chain greenhouse gas emissions related to the CFR dam construction are approximately 33% lower than for the RCC dam. Energy consumption is also 20% lower. These impacts are due to the reduced concrete required for the CFR dam construction and the subsequent reduction in energy consumption and emissions related to manufacture of cement. The water use over the full supply chain for the CFR dam is approximately 20% less.

The CFR dam has a significantly higher materials flow impact and this is due to the quantity of quarried rockfill required for construction of the dam wall.

### **Conclusions**

Key conclusions from the modelling are as follows:

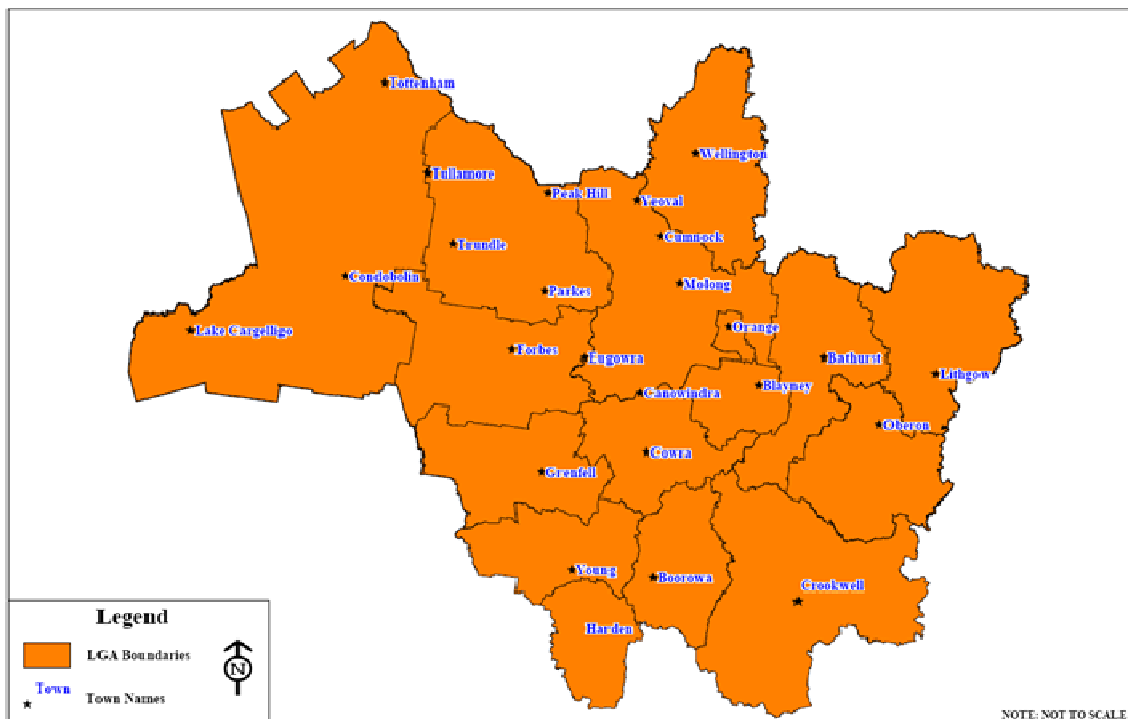
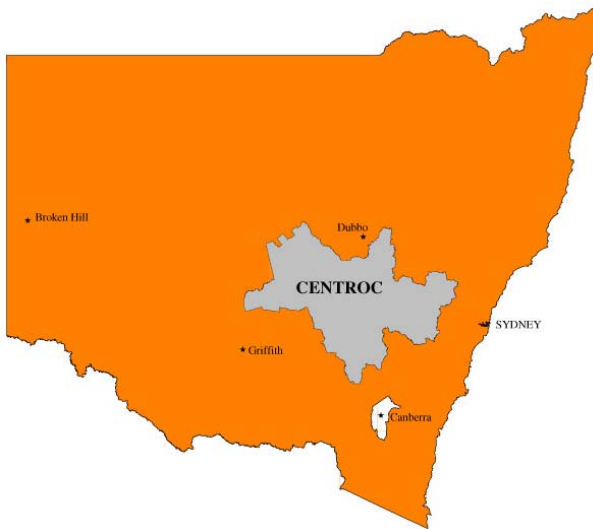
- Without mitigation measures in place, the proposed WSS projects are more energy intensive than the current water supplies and will increase the emissions, energy and material flow “footprint” of the Centroc water supply operations by 80-85%.
- The impacts incurred as a consequence of the capital construction are minor in comparison to the energy, greenhouse and materials flow impacts incurred due to operation of the system over the 50 year study period (e.g. Emissions arising from capital construction are 1/14th of the emissions arising from operation of the system.)

- As was recognised in the original WSS, there is a significant energy requirement to operate the infrastructure, particularly in the Macquarie catchment. Consequently, options to reduce operational energy requirements, to source electricity from alternative low/no emissions sources and to offset any remaining operational emissions will be a key focus in stage 4 of this project.

## 1. INTRODUCTION

Central NSW Councils (Centroc – see Figure 1) has obtained grant funding for a Carbon Plus Study under the Planning Component of the Australian Government's *Water for the Future* initiative through the Strengthening Basin Communities Program. The aim of this feasibility study is to investigate potential solutions to minimise the carbon impact, along with other sustainability effects, arising from the program of works to secure the water supply of the Centroc region. The demand management program and infrastructure needs of the region over the next 50 years to improve the security of water supply were documented in the Centroc Water Security Study (MWH, 2009).

This report describes the methodology, assumptions and results for the modelling of sustainability impacts of the proposed program of water security works. These forecasts will provide the basis for identification and selection of the preferred options to mitigate these impacts.



## Figure 1: The Centroc Region

### 1.1 BACKGROUND

In response to the worst drought on record for the region, Centroc undertook to complete a Water Security Study to investigate and recommend solutions to improve water supply security across the Centroc region.

The water security study considered the catchment and potential water management options. A comprehensive list of options was considered including infrastructure links networking town water supplies and improving efficiency of water delivery, new and innovative water supply opportunities, re-use options for effluent and stormwater, demand management, water pricing and trading and water management structures. The study was completed in a catchment context considering the potential for mutual benefits to towns, irrigators, mining interests and water dependent environmental assets. The water planning approach adopted represented best-practice and is in line with the ambitions set out in the National Water Initiative.

The approach to this study was built on three key principles:

1. Stakeholder engagement with a Project Reference Group, Technical Group, Steering Committee and the Centroc Board;
2. Consideration of the economic, social, environmental (triple bottom line – TBL) impacts of the choices for water security improvement to inform decision making; and
3. The integration of the management of water resources, recognising the need for holistic approaches to water management.

The key recommendations of the Water Security Study included:

- **Water Conservation and Demand Management:** Underpinning the strategy adopted was the need for continued efforts, building on the work already done by the Centroc member councils, towards ensuring efficient town water demands. A region-wide water conservation and demand management strategy was recommended including aspects such as a residential retrofit of inefficient water fixtures, continuation of the Water Efficiency Labelling and Standards Scheme (WELS), continuation or expansion of Water Conservation Education programs to improve efficient water use and audits of Non-Residential Water Users to identify leaks and potential areas for improvement.
- **The recommended region-wide strategy (Strategy 2a)** included:
  - Lake Rowlands Augmentation;
  - Lake Rowlands-Millthorpe Pipeline (CTW Trunk Mains D and F duplication);
  - CTW-Orange Pipeline via Millthorpe;
  - Lake Rowlands to Gooloogong Pipeline (CTW Trunk Mains P and C duplication);
  - Gooloogong-Forbes Pipeline (including connection to Parkes);
  - Woodstock-Cowra Pipeline (presently in planning);
  - Orange-Molong Creek Dam pipeline (lower priority action resulting from the level of surety around the security of Molong. There is an existing pipeline from Molong Creek Dam into which this new pipeline would connect);
  - New minor storage and water treatment facilities at Cumnock (note: the potential for a pipeline connection to CTW will be carried through the next phase of planning);
  - New minor storage water treatment facilities at Yeoval (note: the potential for a pipeline connection to CTW will be carried through the next phase of planning);
  - New minor storage at Condobolin (off-stream from Lachlan River);

- New pipeline replacing existing channel and minor storage at Lake Cargelligo (note: a groundwater system has received emergency funding);
- Burrendong-Wellington Pipeline;
- Chifley-Bathurst Pipeline;
- Chifley-Oberon Pipeline; and
- Belubula Creek-Cadia Hill pipeline (already available).<sup>1</sup>

In November 2009, the Centroc Board adopted the recommendations of the Centroc Water Security Study.

## 1.2 KEY PROJECT DRIVERS

The Centroc member Councils recognise the need to be sustainable and to minimise the carbon impact of water security, as well as the need to proactively mitigate its impact on climate change and to adapt to the impacts of climate change. In addition, a key requirement in the securing grant funds for water projects is not only the demonstration of water efficiency (such as the demand management program which Centroc has committed to continue to progress across the region), but also demonstration that in managing water resource issues, consideration is also given to energy resource management. This is particularly important in terms of reducing emissions to mitigate climate change.

The Centroc Water Security Study took into account energy in a number of ways:

- The demand management program: the recommended program was developed through the consideration of the cost-benefit of a wide variety of water efficiency options. In deriving the cost-benefit equation, the saving of both water and greenhouse gases (from the saving of hot water and the reduction in treatment and transfer costs) was included in the assessment. In fact, the water efficiency program will potentially offset the energy consumed in operating the new infrastructure by in the order of 30%.
- Using a triple-bottom-line approach that used the minimisation of energy as a criterion to select the recommended strategy.

However, a comprehensive assessment of the carbon impact of the proposed scheme is required, as is a plan to ensure that those emissions are minimised and offset. In so doing, the provision of the energy required to power the water security strategy infrastructure elements and the opportunities to mitigate the carbon emissions, raise the potential for new and innovative approaches to renewable energy and participation in the carbon economy. This is the basis for the development of The Carbon Plus Study in Central NSW.

The Carbon Plus Study offers a unique opportunity to holistically confront and manage the challenges facing the communities of the Central Region of NSW. It brings together a number of critical elements to enable the communities of the region to be strengthened and to adjust to climate change. The Carbon Plus Study will provide:

- A way to address the carbon emissions from the water security strategy, so that the water security strategy does not exacerbate the climate change problem;
- A comprehensive community engagement program that seeks to engage and involve the community in planning for its future and in adaptation processes;
- Developing opportunities to enhance the sustainability and productivity of the region through improved landscape and ecosystem health and economic development; and
- Development of an implementation plan for the Carbon Plus and Water Security Strategies so that both strategies can be implemented in a co-ordinated and holistic way.

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<sup>1</sup> Emergency infrastructure was not considered here. This will be examined as relevant in Task 4.

### 1.3 PROJECT SCOPE

The scope of this project is to undertake a strategic level planning assessment of the options to sustainably manage the carbon emissions of the adopted water security study and to develop a plan of action to implement the most appropriate of those options in parallel with the continued implementation of the recommendations of the water study.

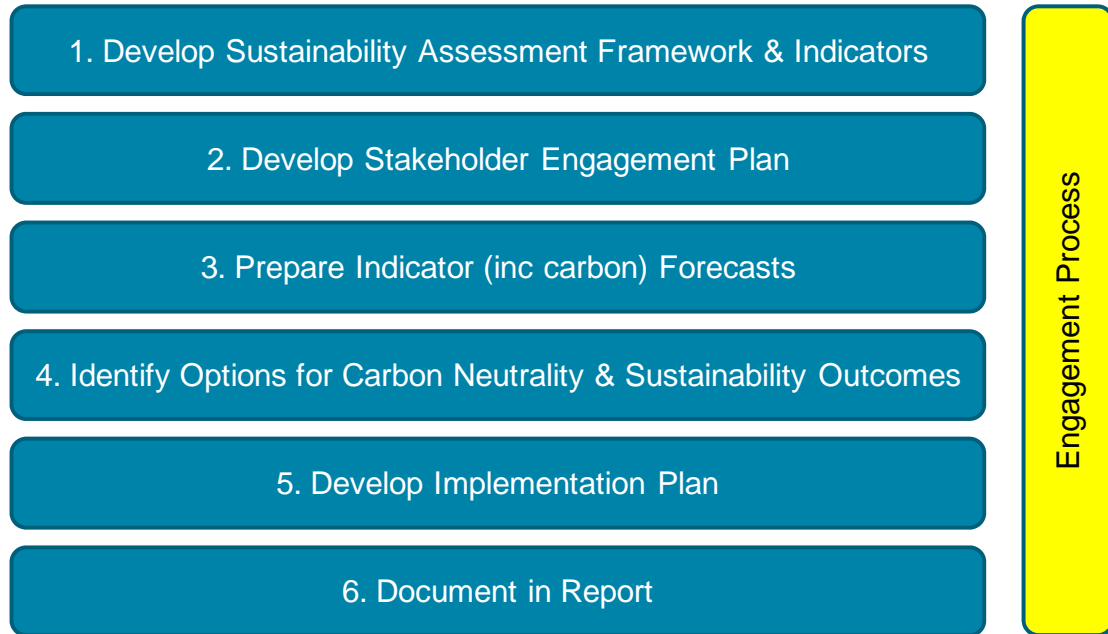
The project is being conducted in six stages (Figure 2):

1. Develop sustainability assessment framework and indicators: these indicators form the basis of assessing the carbon management options to identify the most appropriate options from a Triple Bottom Line (TBL – economic, social and environmental) basis. This stage was completed in June 2010 and is documented in the MWH report Centroc Carbon Plus: Sustainability Assessment Framework.
2. Develop a stakeholder consultation plan: this plan identifies key stakeholders and means of engaging them in the process of developing and assessing the options considered in the Carbon Plus Study. The adopted plan will then be implemented during the course of the project. This stage was completed in June 2010 and is documented in the MWH report Centroc Carbon Plus: Stakeholder Consultation Plan.
3. Prepare forecasts for the identified indicators including carbon emissions: before attempting to solve a problem, it is important to understand (and where possible, measure) the extent of the issue. Developing forecasts of carbon emissions from the existing water supply system and comparing those to the forecasts as a result of implementing the Water Security Study recommendations helps to quantify the extent of potential impact of the program. The results of this stage are the subject of this report.
4. Identify options for carbon neutrality and improved sustainability outcomes: in this phase, a wide spectrum of potential management actions will be identified and assessed (against the TBL defined in phase 1) to identify the most suitable actions to adopt for the Centroc region. This assessment will include identifying opportunities to:
  - a. avoid generating and minimise emissions;
  - b. substitute fossil fuel generated power with renewable or alternative energy sources;
  - c. ensure the purchase of sustainable (e.g. recycled. Recyclable and low embodied) materials; and
  - d. to offset emissions through sequestration and offset programs.

While the intent of the options identification step is to identify opportunities to mitigate the impacts of the Water Security Study works specifically, it is likely that many of these initiatives will be independent of the Water Security Study, and may be implemented prior to the Water Security Study projects.

5. Develop implementation plans: following determination of the actions to be put in place to manage the impact of the water security program on carbon emissions, an implementation plan will be developed showing the anticipated timing, capital and operating costs for the recommended sustainability improvement strategies for the region.
6. Reporting: the study process and findings will be documented in a comprehensive technical report.

Built into our approach is stakeholder input to the planning process obtained through a series of facilitated workshops. This integrated approach to planning and engagement was successful in the Water Security Study and helped to identify mutually beneficial outcomes. The process also added to the depth of options considered and the level of support for the overall strategy finally adopted. The promise made to stakeholders in terms of their involvement in this project will be similar to the previous project: a commitment to keep them informed, listen to and acknowledge their concerns and to provide feedback on their input influenced decision making.



**Figure 2: Study Process**

## 1.4 INDICATOR FORECASTS

This report describes the methodology, assumptions and results for the Stage 3 modelling of sustainability impacts. Forecasts for the sustainability indicators selected in Stage 1 of the project have been developed using the University of Sydney's Integrated Sustainability Analysis (ISA) tool, building on the data generated in formulation of the Water Security Study (WSS). The forecasts have been produced for the Centroc region water supply systems, in the current mode and as identified in the WSS. These forecasts will provide the basis for identification of mitigation options in Stage 4 of the study.

## 2. METHODOLOGY

This section sets out the methodology adopted to develop the sustainability indicator forecasts.

### 2.1 INTEGRATED SUSTAINABILITY ANALYSIS

Forecasts of the carbon, energy and broader sustainability impacts of the adopted water security study have been developed using the University of Sydney's hybrid ISA approach.

Traditional Life Cycle Assessment (LCA), using software tools such as Gabi4 and Simapro, involves a detailed assessment of environmental impacts using the physical flow of materials and goods. Where data is available, these tools allow detailed analysis of industrial processes to calculate materials inputs and outputs, for example how much iron ore and electricity is used to make, say, 1 kilogram of steel. The tools also have inbuilt databases to calculate the ecological, water and carbon impact of production processes.

There are two main drawbacks to applying traditional LCA methods to projects at a strategic stage and of the scale of the Centroc WSS. Firstly, detailed design data is not available, making robust modelling of the physical flow of materials and goods difficult. Secondly, undertaking a detailed analysis of the project footprint for the Centroc water security infrastructure projects would require extensive modelling effort using traditional LCA tools.

The ISA team at the University of Sydney has developed an alternative LCA approach which is based upon a combination of national economic and physical data. The ISA methodology uses the structure and the flow of money through the national economy (obtained through economic input-output tables) and national level physical data, such as water use statistics or carbon accounts. The input-output table provides information on how much each industry sector spends on purchasing goods or services from every other industry sector. As such, the input-output tables provide information on the flow of money through the economy.

National level physical data is available for industry sectors and this allows sustainability impacts such as water use or carbon emissions from each sector to be identified. This impact information is then combined with the monetary input-output table in the ISA model to allocate physical impacts throughout the economy. Where additional information is available (e.g. direct emissions of greenhouse gases) the ISA approach allows for supplementation of the modelling with known impacts rather than relying solely on the monetary modelling.

The ISA approach is readily applied at a strategic stage. Data required for ISA modelling is primarily financial information (e.g. capital expenditure on materials, labour and equipment, operating expenditure on chemicals and energy) and for Centroc this information was produced for the analysis undertaken in development of the WSS. Additional information on energy consumption and materials requirements for major infrastructure is also readily estimated and can be used to supplement the ISA modelling as described above.

### 2.2 CASES MODELLED

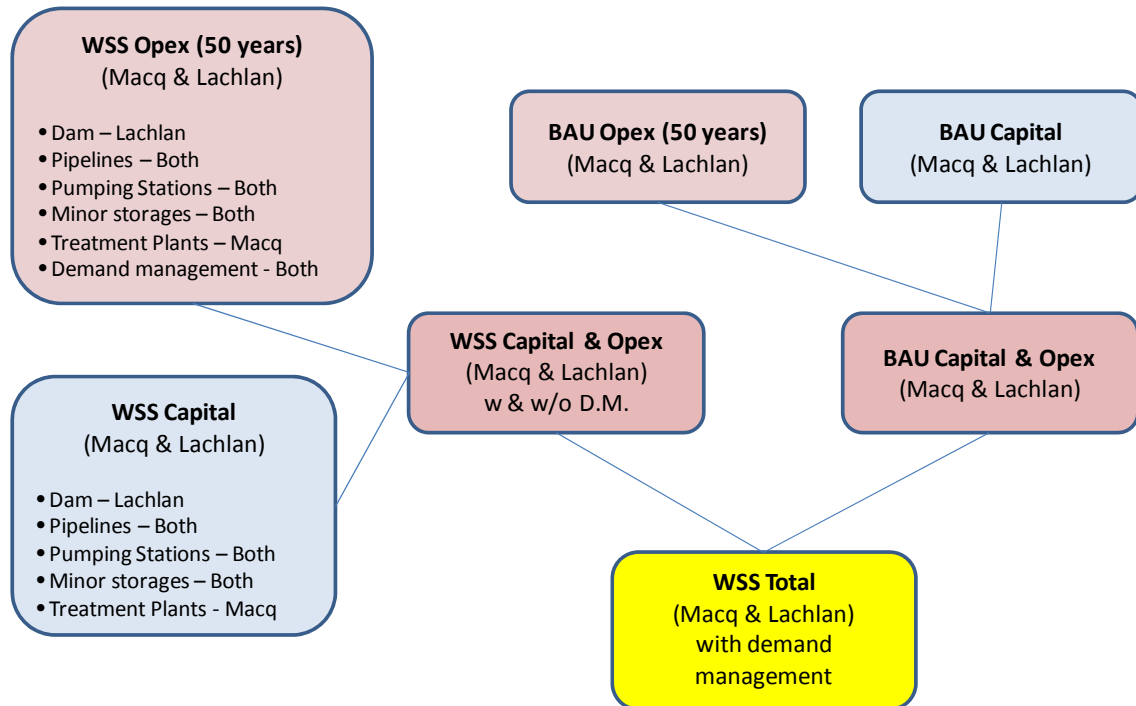
Figure 3 shows the cases modelled using the ISA approach. These are:

- Total Business as Usual (BAU) Capital and Operating expenses (Opex), which comprises:
  - BAU Opex over 50 years; and
  - BAU Capital over 50 years (existing water supply system asset renewals and capital projects unrelated to water security).
- WSS Capital & Opex comprising:
  - WSS Opex over 50 years; and
  - WSS Capital over 50 years.
- WSS Total case describes the forecast for the entire Centroc water supply system with the WSS infrastructure projects implemented. The case comprises:

- BAU Capital & Opex; and
- WSS Capital & Opex.

The cases above were modelled for the whole Centroc water supply system and for each distinct catchment area (Lachlan and Macquarie).

## Schematic of cases



**Figure 3: Cases modelled**

### 2.3 INDICATORS MODELLED

In stage 1 of this project, the recommended sustainability assessment framework was developed in consultation with the Centroc Infrastructure Group (IG) and the Carbon Plus Project Steering Committee (PSC). As part of the development of the framework, the group identified the key regional economic, environmental and social drivers, relevant to the WSS and Carbon Plus project, and corresponding sustainability indicators.

Identification of the indicators served two purposes:

- To identify impacts to be modelled using the ISA approach to produce baseline and WSS forecasts; and
- To identify indicators to be used in assessment and ranking of mitigation options in Stage 4 of this project.

The identified indicators are described below and summarised in Table 1. Note that, as shown in this table, not all indicators are relevant to the baseline and WSS forecasts but were selected due to their relevance to the evaluation of mitigation options in stage 4 (options assessment) of the project. As a consequence, forecasts for these indicators (Health and Safety, Amenity) have not been produced.

#### 2.3.1 ENVIRONMENTAL

The environmental priorities identified were to minimise the impact of the WSS on climate change, resource use and biodiversity.

### Impact on Climate Change

Climate change is a serious issue for Australia and the Centroc member Councils recognise the need to minimise the carbon impact of water security, while proactively adapting to the impacts of climate change and taking action to reduce its severity.

The indicator chosen for this priority is:

- Greenhouse gas emissions expressed in tonnes CO<sub>2</sub>-e (carbon dioxide equivalent tonnes): This is a measure of the weighted sum of the key greenhouse gases calculated using global warming potentials, which account for the potential contribution each gas has on global warming.

### Resource use and biodiversity

The water security study program comprises a mix of demand management and infrastructure projects. Construction of the infrastructure identified in the study's region-wide strategy will involve the fabrication of pipework and other structural elements using resources from the environment including energy, land and materials. Note that the greenhouse gas emissions produced as a consequence of extracting, refining, manufacture, fabrication and electricity generation will be encapsulated in the Greenhouse Gas Emissions indicator described above and indicators in this priority grouping are intended to describe the tax on the environment related to the extraction and/or use of resources rather than the emissions impact caused by these activities.

The indicators chosen for this priority are:

- Primary energy use expressed in Mega Joules (MJ): This is a measure of the combustion of non-renewable fossil fuels (e.g. coal, natural gas, fuel, petrol, diesel, kerosene) required throughout the project. Included in this energy use is operational energy used directly to run infrastructure and the embedded energy in the materials and supplies used in both the operation and construction of infrastructure. Note that in this indicator, electricity consumption is expressed in terms of the primary energy source utilised to generate the electricity consumed (e.g. coal).
- Materials flow expressed in tonnes (t): Materials flow describes the mass of resources and other biomass extracted from the natural environment throughout the project lifecycle. This indicator provides an aggregate measure of the mass of materials that must be extracted from the environment throughout the project lifecycle. For example, the measure would include how much iron ore needs to be initially extracted in order to make the steel needed in structural components. Material flow can be used as an indicator of resource depletion.
- Water consumption expressed in mega litres (ML): The quantity of mains water, self-supplied water, reuse water and in-stream water used throughout the project lifecycle.
- Land use disturbance in disturbance weighted hectares (ha): This indicator seeks to provide an estimate of the land use in terms of area occupied and environmental impact throughout a project life cycle, For example, using this measure, occupation of industrial land would be deemed to have a lower land use disturbance than occupation of pristine bushland. Land use disturbance can be considered as a proxy measure for biodiversity impact but it is important to note that local effects (e.g. the existence of a threatened species on a certain site) will not be captured by this high level indicator and would need to be treated separately in the assessment framework.

### 2.3.2 SOCIAL

Key social priorities were enhancing community wellbeing and providing leadership in progressing sustainable options by being early adopters of innovative solutions.

#### Community wellbeing

The impact on the community of the water security program and options identified for mitigation of sustainability impacts is an important consideration for the Centroc member Councils. The indicators chosen as proxy measurement of community wellbeing are as follows:

- Employment expressed in employment – years (emp-y): Is a measure of the level of full time plus 50% part –time employment of employees and employers. Employment is included as a proxy for community wellbeing due to its implications on factors such as social cohesion and government revenue (which is subsequently redistributed to fund for community facilities and services).
- Wages and Salaries expressed in 2010 A\$. Workshop 1 had identified household income as a social indicator. The indicator has been expressed as wages and salaries as this is the output that will be generated from the ISA modelling (i.e. household income can also be sourced from other areas unrelated to the project or options under investigation, the calculations here are for wages and salaries both directly and indirectly associated with the scenarios).

In Stage 4, when options for mitigation of energy, climate change and broader sustainability impacts are identified, health and safety and amenity impacts will also be included in the assessment framework.

### **Community leadership**

Government agencies can play a key role in facilitating the uptake of new technologies by supporting the development of new technology and by being early adopters of viable, innovative solutions. This is to be a consideration in selection of options to optimise sustainability outcomes under the water security study program. In stage 4, when options for mitigation of energy, climate change and broader sustainability impacts are evaluated, an assessment of health and safety and amenity impacts will also be included in the assessment framework.

### **2.3.3 ECONOMIC**

The key economic priorities identified are economic prosperity and project affordability which are described below.

#### **Economic prosperity:**

Economic prosperity on a national and regional scale is a key consideration for both Centroc member Councils and the broader community. The indicators selected are:

- Gross operating surplus expressed in 2010 A\$: This indicator is a measure of operating profit generated due to inputs to the project or option from business sectors. The higher the gross operating surplus generated, the greater the capacity of business sectors to invest in innovation and expansion.
- Imports expressed in 2010 A\$: Imports are the value of goods and services purchased from foreign sources. The lower the level of exports, the less exposed the option will be to international resource constraints and potential price increases. In addition purchase of local goods and services will lead to greater direct benefits to the Australian economy. (In Workshop 1, there was a question, which was taken on notice, as to how the impacts of imports are calculated. Impacts from imports are calculated at the moment as if they are produced in Australia. This is standard Input/Output LCA practice. However, the University of Sydney is working to develop a full global Input/Output model, which accounts for imports based on global data. Such a model is cutting-edge research and the University has advised that this tool will not be operational for at least a year.)

#### **Project affordability**

The affordability of selected sustainability assessment options identified will be important in the evaluation of mitigation options in Stage 4 of this project. This indicator has been included in the forecast modelling as it allows for comparison of the relative shift in indicator performance compared to the shift in total project expenditure. This analysis allows disproportionate shifts in impacts to be highlighted.

The indicator selected for project affordability is:

- Total expenditure/Net Present Value expressed in 2010 A\$: This indicator is a measure of the whole of life cost of a project or option.

**Table 1: Recommended Indicators**

CATEGORY	PRIORITY	INDICATOR	BASELINE & WATER SECURITY PLAN FORECAST	OPTIONS ASSESSMENT
Environmental	Impact on climate change	Greenhouse gas emissions	✓	✓
	Resource use and biodiversity	Primary energy use	✓	✓
		Materials flow	✓	✓
		Water consumption	✓	✓
		Land use disturbance	✓	✓
Social	Community wellbeing	Employment	✓	✓
		Wages and Salaries	✓	✓
		Health and safety (Scored by IG/PSC)	-	✓
		Amenity (visual impact etc) (Scored by IG/PSC)	-	✓
	Community leadership	Innovation & leadership (Scored by IG/PSC)	-	✓
Economic	Economic prosperity	Gross operating surplus (profits) (at national and regional level)	✓	✓
		Imports	✓	✓
	Project Affordability	Total Expenditure/Net Present Cost/ % improvement	✓/-	✓

## 2.4 DATA COLLECTION AND ASSUMPTIONS

MWH provided the ISA team with financial data related to the WSS infrastructure projects (WSS Capital, WSS Opex) and ongoing operation of the water supply system (BAU Capital, BAU Opex). This data included a comprehensive breakdown of expenditure into categories. In addition, MWH also provided estimates of:

- Electricity and chemicals consumed for operation of the WSS infrastructure;
- Fuel consumed by fleet vehicles; and
- Labour, major materials, equipment, land use, energy and direct emissions related to WSS and business as usual capital projects.

The physical data was used by the ISA team to fine tune the model estimates for the WSS and BAU cases with financial data used in the remainder of the analysis.

In preparing data for modelling of this type, particularly at a strategic stage, it is necessary to make assumptions as detailed design or operating data is not available. Where assumptions were made in the data preparation or modelling, these were documented and reviewed with the PSC and IG. The full list of assumptions is included in Appendix 1 and key assumptions are described below.

**2.4.1 WATER SECURITY STUDY OPERATION**

Forecast operating costs, produced for the WSS, were used in the ISA modelling (Table 3). The ISA modelling requires operating expenses to be allocated to energy, labour, materials and services for each expenditure area. The WSS itemised energy and chemical costs, and the remaining operating costs have been allocated to labour, materials and services in accordance with the business as usual allocation shown in Table 2.

**Table 2: Allocation of operating costs**

% OF OPERATING COST (EXCL CHEMICALS AND ENERGY)	LABOUR (MAINTENANCE & OPERATIONAL)	OTHER OPERATIONAL EXPENSES	OTHER MAINTENANCE EXPENSES
Lake Rowlands augmentation	40%	22%	38%
Pipelines	47%	13%	40%
Network water storages (tanks)	18%	28%	54%
Reservoirs	18%	28%	54%
Pump stations	36%	31%	43%
Water Treatment Plants	55%	30%	15%

**Table 3: Water Security Study Operating Expenditure**

COMPONENT	TOTAL (\$/Y)	MAINTENANCE & DEPRECIATION (\$/YR)	ENERGY (\$/Y)	CHEMICALS (\$/Y)
<b>DAM UPGRADE</b>				
Lake Rowlands augmentation	1,900,000	1,900,000	0	0
<b>PIPELINES</b>				
Lake Rowlands augmentation	14,000	14,000	0	0
Chifley Dam to Bathurst	101,000	101,000	0	0
Chifley Dam to Oberon	92,500	92,500	0	0
Lake Rowlands to Cowra via Woodstock	30,000	30,000	0	0
Lake Rowlands to Forbes via Gooloogong (incl. connection to Parkes)	160,000	160,000	0	0
Lachlan River to Lake Cargelligo	25,000	25,000	0	0
Lake Rowlands to Orange via Millthorpe	117,000	117,000	0	0
Orange to Molong Creek Dam	105,000	105,000	0	0
Burrendong Dam to Wellington	90,000	90,000	0	0
Lake Rowlands to Millthorpe and Cadia Hill Link	200,000	200,000	0	0
Lake Rowlands to Gooloogong	250,000	250,000	0	0
Minor storage at Cumnock	5,500	5,500	0	0
Minor storage at Yeoval	5,500	5,500	0	0

COMPONENT	TOTAL (\$/Y)	MAINTENANCE & DEPRECIATION (\$/YR)	ENERGY (\$/Y)	CHEMICALS (\$/Y)
Minor storage at Condobolin	12,000	12,000	0	0
Minor storage at Lake Cargelligo	10,500	10,500	0	0
<b>WATER PUMPING STATIONS</b>				
Lake Rowlands augmentation	43,000	15,000	28,000	0
Chifley Dam to Bathurst	1,320,000	220,000	1,100,000	0
Chifley Dam to Oberon	1,060,000	160,000	900,000	0
Lake Rowlands to Cowra via Woodstock	6,200	6,000	200	0
Lake Rowlands to Forbes via Gooloogong (incl. connection to Parkes)	101,000	80,000	21,000	0
Lachlan River to Lake Cargelligo	77,000	15,000	62,000	0
Lake Rowlands to Orange via Millthorpe	0	0	0	0
Orange to Molong Creek Dam	80,000	60,000	20,000	0
Burrundong Dam to Wellington	820,000	120,000	700,000	0
Lake Rowlands to Millthorpe and Cadia Hill Link	380,000	170,000	210,000	0
Lake Rowlands to Gooloogong	281,000	220,000	61,000	0
Minor storage at Cumnock	2,950	1,200	1,750	0
Minor storage at Yeoval	3,000	1,200	1,800	0
Minor storage at Condobolin	36,500	8,000	28,500	0
Minor storage at Lake Cargelligo	19,000	5,000	14,000	0
<b>MINOR STORAGES</b>				
Minor storage at Cumnock	2,200	2,200	0	0
Minor storage at Yeoval	2,600	2,600	0	0
Minor storage at Condobolin	16,000	16,000	0	0
Minor storage at Lake Cargelligo	10,000	10,000	0	0
<b>WATER TREATMENT PLANT</b>				
Cumnock	104,000	76,000	0	28,000
Yeoval	104,000	76,000	0	28,000
<b>DEMAND MANAGEMENT</b>				
COMPONENT	PLUMBING	EDUCATION	NOTES	
Demand Management expenditure	75%	25%	Expenditure equal to cost of distribution and treatment	
Hot water heating savings in ave \$ pa	505,463			
	Macquarie	Lachlan		
Share of savings	-234,850	-270,613		

## 2.4.2 WATER SECURITY STUDY CAPITAL

Capital cost estimates developed for the WSS were used in the ISA modelling, as shown in Table 6. Direct capital costs for the WSS infrastructure components were assigned to labour, materials and plant categories based on MWH experience, Rawlinsons cost estimating manual and information in the public domain (e.g. Environmental Impact Statements) for similar projects. The cost assumptions are tabulated in Table 4.

It is important to recognise that these are strategic level estimates. Local conditions will have a significant impact on the final proportion of costs related to labour, materials and services.

**Table 4: Allocation of direct capital costs**

% OF CAPITAL COST	MATERIALS	LABOUR	EQUIPMENT
Lake Rowlands Dam	30% 27% Concrete (Roller-compacted concrete - RCC) 3% Steel	40%	30%
Pipelines	50% 35% DICL 15% uPVC	37.5%	12.5% <sup>2</sup>
Network water storages (tanks)	60% 35% DICL 15% uPVC	30%	10%
Reservoirs	00%	30%	70% (Earthworks)
Pump stations	60% 3% Concrete 10% Steel 25% Plastics 35% Pumps 12% Electrical 15% Fabricated Metal Products	30%	10%
Water Treatment Plants	60% 18% Concrete 6% Steel 3% Plastics 9% Pumps 18% Electrical 6% Other Industrial Machinery (filters etc)	40%	10%

For assessing land disturbance, it has been assumed that the Lake Rowlands augmentation inundation area is 50% pasture and 50% unused land. The inundated area assumed for the augmentation was 170 hectares (GHD, 2006).

<sup>2</sup> There is some uncertainty about the split of labour and equipment for pipelines. This will be further investigated in Task 4. Changes might have a small impact on the indicator of employment reported here.

Water treatment plant, pump station and pipeline land disturbance has been assumed to result in impact on pasture.

For pipelines, the rate of disturbance has been assumed 50% of the affected area, as once installed the land is likely to be available for other uses.

For other infrastructure the land disturbance is assumed to be 100% as the land is unlikely to be available for other uses once the infrastructure is in place.

Diesel and water use (for dust suppression) in construction have been estimated by pro-rata calculation of consumption from other capital projects in accordance with expenditure on equipment use.

Greenhouse gas emissions for construction have been calculated from diesel consumption figures using Australian Greenhouse Accounts (2009) factors.

For the Lake Rowlands augmentation and the small storages at Cumnock and Yeoval, emissions due to inundation have been calculated in accordance with International Panel on Climate Change (IPCC) guidelines (IPCC, 2006). It has been assumed that little vegetation clearing will be required but that emissions will arise due to the decay of organic matter in inundated vegetation and in the soil. IPCC guidance on estimation of emissions of greenhouse gases, in this case carbon dioxide (CO<sub>2</sub>) and methane (CH<sub>4</sub>), from inundation is in formative stages, with a potential approach to estimation published by the IPCC, and it is recognised that there is a great deal of uncertainty surrounding these estimates. However, it is believed that the IPCC draft approach represents the best available means of estimating these emissions at this time.

The IPCC approach assumes that emissions of CO<sub>2</sub> are greatest immediately following inundation and declines after a period of 10 years. In contrast, IPCC state that measurement studies do not indicate that the time elapsed since flooding has a significant influence on CH<sub>4</sub> fluxes. The assumed emission factors and emissions periods used to calculate emissions from inundation due to Lake Rowlands augmentation are shown in Table 5.

**Table 5: Greenhouse gas emission estimates for inundated area**

	IPCC KG CO <sub>2</sub> -E/HA/DAY (WARM TEMPERATE DRY CLIMATE)	CO <sub>2</sub> -E T ASSUMED EMISSION PERIOD - YRS	CO <sub>2</sub> -E T
CO <sub>2</sub>	5.22	10	3,250
CH <sub>4</sub>	0.044	50	2,870

**Table 6: Water Security Study Capital Expenditure**

COMPONENT	TOTAL DIRECT COST (\$'000)	SURVEY INVESTIGATION AND DESIGN (\$'000)	TOTAL CAPITAL (\$'000)
<b>DAM UPGRADE</b>			
Lake Rowlands Augmentation - roller compacted concrete structure (155,000 m <sup>3</sup> )	133,807	14,693	148,500
<b>PIPELINES</b>			
Lake Rowlands Augmentation	1,618	257	1,875
Chifley Dam to Bathurst	11,554	1,830	13,384
Chifley Dam to Oberon	10,744	1,702	12,446
Lake Rowlands to Cowra via Woodstock	3,351	531	3,882

COMPONENT	TOTAL DIRECT COST (\$'000)	SURVEY INVESTIGATION AND DESIGN (\$'000)	TOTAL CAPITAL (\$'000)
Lake Rowlands to Forbes via Gooloogong (incl. connection to Parkes)	18,600	2,946	21,546
Lachlan River to Lake Cargelligo	2,889	458	3,347
Lake Rowlands to Orange via Millthorpe	13,517	2,141	15,658
Orange to Molong Creek Dam	12,073	1,912	13,985
Burrendong Dam to Wellington	10,513	1,665	12,178
Lake Rowlands to Millthorpe and Cadia Hill Link	25,416	4,025	29,441
Lake Rowlands to Gooloogong	28,141	4,457	32,598
Minor storage at Cumnock	648	103	751
Minor storage at Yeoval	648	103	751
Minor storage at Condobolin	1,445	229	1,674
Minor storage at Lake Cargelligo	1,156	184	1,340
<b>PUMP STATIONS</b>			
Lake Rowlands Augmentation	331	72	403
Chifley Dam to Bathurst	4,833	1,042	5,875
Chifley Dam to Oberon	3,515	758	4,273
Lake Rowlands to Cowra via Woodstock	138	30	168
Lake Rowlands to Forbes via Gooloogong (incl. connection to Parkes)	1,759	379	2,138
Lachlan River to Lake Cargelligo	341	74	415
Lake Rowlands to Orange via Millthorpe	0	0	0
Orange to Molong Creek Dam	1,319	285	1,604
Burrendong Dam to Wellington	2,637	569	3,206
Lake Rowlands to Millthorpe and Cadia Hill Link	5,931	1,279	7,210
Lake Rowlands to Gooloogong	4,723	1,018	5,741
Minor storage at Cumnock	26	6	32
Minor storage at Yeoval	28	6	34
Minor storage at Condobolin	177	39	216
Minor storage at Lake Cargelligo	111	24	135,000

COMPONENT	TOTAL DIRECT COST (\$'000)	SURVEY INVESTIGATION AND DESIGN (\$'000)	TOTAL CAPITAL (\$'000)
<b>MINOR STORAGES</b>			
Minor storage at Cumnock	134	14	148
Minor storage at Yeoval	161	17	178
Minor storage at Condobolin	974	101	1,075
Minor storage at Lake Cargelligo	609	64	673
<b>WATER TREATMENT PLANTS</b>			
Minor storage at Cumnock	1,648	292	1,940
Minor storage at Yeoval	1,648	292	1,940

### 2.4.3 BUSINESS AS USUAL OPERATION

Forecast business as usual operating costs forecasts were estimated from current costs, as described in each water operations' General Purpose Financial Report and escalated for forecast 2059 demand. The forecast 2059 demand figures used to escalate the operating costs were the average annual demands generated in the water security study with current demand management programs in place as shown in Table 7. The relationship between operating cost and water demand was developed by analysing the current operating cost and demand trend of Centroc water operations.<sup>3</sup>

**Table 7: Water demand assumptions**

DEMAND NODE	BASELINE		AVE ANNUAL DEMAND – CURRENT DEMAND MANAGEMENT PROGRAMS IN PLACE (ML)	
	2009	2059	2009	2059
Bathurst	6,420	7,618	6,402	6,597
Blayney - Carcoar	907	1,044	905	1,003
Boorowa	178	172	177	162
Canowindra	332	385	331	368
Condobolin	883	1,291	880	1,116
Cowra - Koorawatha	2,836	3,494	2,826	3,191
Crookwell <sup>4</sup>	331	335	330	307
Cudal/ Cargo/ Manildra	260	302	259	288
Cumnock - Yeoval	177	201	176	184
Forbes	2,761	3,074	2,755	2,917
Gooloogong- Eugowra	156	180	155	172
Grenfell	441	513	440	490
Lake Cargelligo	428	626	427	540

<sup>3</sup> The BAU demands include those supplied by existing emergency bores.

<sup>4</sup> Insufficient data was available to assess the demands of Taralga and Gunning.

DEMAND NODE	BASELINE		AVE ANNUAL DEMAND – CURRENT DEMAND MANAGEMENT PROGRAMS IN PLACE (ML)	
	2009	2059	2009	2059
Lithgow - Portland	1,794	2,069	1,788	1,940
Molong	278	387	277	338
Murrumburrah (Harden)	792	863	790	826
Oberon	839	960	837	918
Orange	5,837	7,373	5,818	6,395
Parkes <sup>5</sup>	6,731	8,150	6,731	7,527
Wellington - Geurie	1,348	1,946	1,342	1,754
Young	1,617	2,039	1,614	1,968

The ISA modelling requires operating expenses to be allocated to labour, materials and services for each expenditure area. The General Purpose Financial Reports do not report expenditure in this level of detail. To minimise data collection requirements, detailed expense profiles were obtained for Bathurst (for large water businesses), Central Tablelands Water (for medium water businesses) and Wellington (for smaller water businesses). These profiles were used to allocate expenses for similar sized water operations to labour, materials and services.

#### 2.4.4 BUSINESS AS USUAL CAPITAL

BAU capital expenditure forecasts were developed based on the existing capital plans of Centroc member Councils, which varied in length from 4-30 years. Ongoing capital renewals were extrapolated for the remaining study period. Additional known capital projects unrelated to water security were also included in the forward estimates.

Boorowa, Lachlan, Lithgow and Upper Lachlan capital expenditure forecasts were not available. For these councils, capital renewals were estimated from asset value based on the ratio of renewals to total asset value of similar sized councils (Young, Wellington and Central Tablelands Water).

BAU capital costs have been assigned to labour, materials and services in the same ratios as described in Section 2.4.2.

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<sup>5</sup> Demand including Northparkes mines

### 3. BASELINE AND WATER SECURITY STUDY FORECASTS

ISA modelling has provided results against relevant socio-economic and environmental indicators namely:

- Greenhouse gas emissions (tCO<sub>2</sub>-e);
- Energy consumption (TJ);
- Material flow (t);
- Water consumption (ML);
- Land disturbance (ha);
- Employment (emp-y);
- Family income – wages and salaries (\$'000);
- Gross Operating surplus (\$'000);
- Imports (\$'000); and
- Total expenditure (\$'000).

Results are described in the following sections.

#### 3.1 ANALYSIS OF TOTAL IMPACTS

Forecasts for each indicator for the total business as usual case (BAU Capital and Opex) and forecasts for the water supply system with the WSS infrastructure in place (WSS Total) are shown in Table 8. It can be seen that while the total expenditure over the 50 year period will increase by 27%, greenhouse gas emissions, energy consumption and materials flow is expected to increase by significantly more. This indicates that the proposed WSS infrastructure is emissions, energy and resource intensive compared to the existing water supply system.<sup>6</sup>

Gross operating surplus increases to a greater extent than total expenditure for the WSS case, and again this will be shown to be related to the higher energy requirement for operating the water supply system in this catchment. Other indicators are projected to increase in line with capital expenditure.

It is estimated that over the 50 year period, the WSS project construction and operation will result in an increase in employment, across the whole supply chain, of approximately 6,000 employment years (emp-y).

**Table 8: BAU and WSS Total**

INDICATOR	BAU CAPITAL AND OPEX TOTAL	WSS TOTAL	DIFFERENCE (WSS MINUS BAU)	CHANGE (%)
Greenhouse gas emissions (t CO <sub>2</sub> -e)	1,988,000	3,669,000	1,681,000	85%
Energy consumption (TJ)	22,000	40,000	18,000	82%
Material flow (t)	5,483,000	8,798,000	3,315,000	60%
Water use (ML)	83,000	107,000	24,000	30%

<sup>6</sup> However, it is important to note that the adopted WSS took into account minimising energy consumption as part of the original WSS assessment and although more energy intensive than the existing supply, on balance in the triple bottom line assessment, less so than the strategy investigated involving connection from Chifley Dam.

INDICATOR	BAU CAPITAL AND OPEX TOTAL	WSS TOTAL	DIFFERENCE (WSS MINUS BAU)	CHANGE (%)
Land disturbance (ha)	43,000	54,000	11,000	26%
Employment (emp-y)	24,000	30,000	6,000	25%
Family income (current \$'000)	1,647,000	2,063,000	416,000	25%
Gross operating surplus (current \$'000)	349,000	590,000	240,000	69%
Imports (current \$'000)	302,000	369,000	67,000	22%
Total expenditure (50 years, current \$'000)	2,652,000	3,357,000	705,000	27%

Table 9 shows the breakdown of WSS impacts for capital works and ongoing operation expenses (excluding the demand management program). It can be seen from this table that the majority of greenhouse gas emissions generated are a result of ongoing operation of the water security infrastructure (WSS Opex Total). Emissions generated due to operation are approximately 14 times those generated from capital construction. Energy consumption, water use and material flow impacts are also significantly higher for the operation of the system. As will be explained in the following sections, the greenhouse gas emissions generated for operation of the system are largely related to the consumption of electricity for pumping. Likewise the higher material flow will be shown to be related to coal consumed in generation of this electricity. The higher gross operating surplus associated with the operation of the network is also related to consumption of electricity.

From Table 9 it can be seen there will be a similar number of jobs generated in the capital construction stage (approximately 3,000 emp-y) as in the operational stage (approximately 3,000 emp-y over the 50 year study period). Capital and operational impacts for other indicators are comparable.

**Table 9: WSS Capital Total vs. WSS Operating Total (excluding Demand Management)**

INDICATOR	WSS CAPITAL TOTAL	WSS OPEX TOTAL (EXCL DEMAND MANAGEMENT)
Greenhouse gas emissions (t CO <sub>2-e</sub> )	128,000	1,855,000
Energy consumption (TJ)	1,500	20,000
Material flow (t)	837,000	3,017,000
Water use (ML)	1,500	27,000
Land disturbance (ha)	5,000	6,000
Employment (emp-y)	3,000	3,000
Family income (current \$'000)	230,000	207,000
Gross operating surplus (current \$'000)	65,000	188,000
Imports (current \$'000)	35,000	34,000
Total expenditure (50 years, current \$'000)	351,000	379,000

Table 10 and Table 11 show the WSS project impacts for each catchment excluding the demand management programs. Macquarie catchment energy consumption (and consequently greenhouse gas emissions and materials flow impacts) is approximately 4 times higher (17,300 TJ in total compared to 4,000 TJ) than the impacts in the Lachlan catchment. The majority of the energy consumption is incurred in operation rather than in supply and construction of capital infrastructure. The higher energy consumption in the Macquarie catchment will be shown in later sections of this report to be related to the higher electricity consumption for pumping in this catchment compared to that consumed in Lachlan.

Land disturbance in the Lachlan catchment is greater than in the Macquarie catchment and the difference is largely related to the capital component. Detailed analysis in the following sections will show that land disturbance is proportional to capital investment and largely arises from agricultural sector activities deep in the supply chain.

Total employment in the Lachlan catchment is greater than in the Macquarie catchment (approximately 4,100 emp-y compared to 1,800 emp-y in Lachlan). This is in proportion to the higher capital investment related to the Lake Rowlands augmentation project in Lachlan.

Gross operating surplus generated from the WSS is greater in the Macquarie catchment and operation contributes significantly to this outcome. This will be shown in the detailed analysis to be related to the higher energy requirement for operating the water supply system in this catchment.

The level of imports in the Lachlan catchment is somewhat greater than in the Macquarie catchment in line with the higher project expenditure.

**Table 10: Macquarie WSS Capital Total vs. WSS Operating Total (exc. DM)**

INDICATOR	MACQUARIE WSS CAPITAL TOTAL	MACQUARIE WSS OPEX TOTAL (EXCL DEMAND MANAGEMENT)
Greenhouse gas emissions (t CO <sub>2-e</sub> )	22,000	1,575,000
Energy consumption (TJ)	300	17,000
Material flow (t)	65,000	2,554,000
Water use (ML)	300	18,000
Land disturbance (ha)	1,000	3,000
Employment (emp-y)	500	1,300
Family income (current \$'000)	48,000	91,000
Gross operating surplus (current \$'000)	12,000	130,000
Imports (current \$'000)	8,000	20,000
Total expenditure (50 years, current \$'000)	73,000	195,000

**Table 11: Lachlan WSS Capital Total vs. WSS Operating Total (exc. DM)**

INDICATOR	LACHLAN WSS CAPITAL TOTAL	LACHLAN WSS OPEX TOTAL (EXCL DEMAND MANAGEMENT)
Greenhouse gas emissions (t CO <sub>2</sub> -e)	106,000	281,000
Energy consumption (TJ)	1,000	3,000
Material flow (t)	771,000	462,000
Water use (ML)	1,000	9,000
Land disturbance (ha)	4,000	3,000
Employment (emp-y)	2,400	1,700
Family income (current \$'000)	183,000	116,000
Gross operating surplus (current \$'000)	53,000	58,000
Imports (current \$'000)	27,000	13,000
Total expenditure (50 years, current \$'000)	278,000	184,000

The impact of the additional demand management initiatives proposed in the WSS, over and above the current planned initiatives, is shown in Table 12. While the demand management program implementation will have a small impact on employment over the 50 year period, the benefits in reduction of water use on energy consumption and greenhouse emissions are proportionally higher indicating that the demand management program provides an efficient means of achieving reductions in these impacts.

**Table 12: Impact of proposed demand management program**

INDICATOR	LACHLAN	MACQUARIE
Greenhouse gas emissions (t CO <sub>2</sub> -e)	-156,513	-146,672
Energy consumption (TJ)	-1,760	-1,680
Material flow (t)	-270,736	-270,972
Water use (ML)	-2,242	-2,777
Land disturbance (ha)	144	355
Employment (emp-y)	-95	-91
Family income (current \$'000)	-9,644	-11,375
Gross operating surplus (current \$'000)	-8,184	-5,173
Imports (current \$'000)	-1,250	-804

## 3.2 SOURCES OF IMPACTS

Analysis was undertaken of the WSS cases to determine where impacts occur in the supply chain, specifically the production layer. In this analysis, production layer 1 refers to the Centroc council operations and the WSS projects being examined, while production layer 2 covers suppliers to Centroc and to the project (e.g. sub-contractors, materials suppliers). Production 3 layer covers the suppliers of suppliers and so forth. Generally, as the production layer increases, the influence of the organisation to change outcomes declines. Impacts beyond production layer 3 can generally be considered to be occurring in the background (national) economy.

In addition to production layer analysis, specific supply paths (structural paths) were examined to identify the major contributors to the total impacts observed. The analysis of the supply paths enables the identification of specific 'hotspots' within the supply chain. The results of the commodity breakdown, production layer and structural path analyses are presented in Sections 3.2.1 to 3.2.9.

The figures and tables referred to in the following sections are contained in Appendix 2 and Appendix 3 respectively.

### 3.2.1 ENERGY CONSUMPTION

Figure 8 to Figure 11 show the major contributing sectors to energy consumption throughout the supply chain for WSS capital and operation in both the Lachlan and Macquarie catchments.

For the two capital cases (Figure 8 and Figure 9) it can be seen that in production layer 1, the WSS project direct activities, just under 0.1 PJ (Lachlan) and 0.02 PJ (Macquarie) of energy is consumed. The total energy impact of the capital projects over the full supply chain totals approximately 1.0 PJ (Lachlan) and 0.3 PJ (Macquarie). In both cases, utilities and metal industry sectors contribute to the full supply chain impact, while in the Lachlan catchment there is also a significant contribution due to energy use in the minerals sector and this contributes to a higher energy consumption related to capital infrastructure in this catchment.

Analysis of the supply paths (structural paths) for the WSS Capital cases (Table 16 and Table 17) shows that in Lachlan catchment, the most significant contributor to energy consumption (0.20 PJ) over the supply chain is related to the production of concrete (for construction of the Lake Rowlands augmentation Roller Compacted Concrete (RCC) dam wall) occurring in production layer 2 (i.e. concrete supplied to the project by manufacturer.) The next most significant impact occurs in production layer 3 (0.11 PJ) and is due to the manufacture of iron and steel, to be used in the fabrication of construction components then used in the project. The third most significant impact (0.09 PJ) occurs in production layer 1 and relates to the energy consumed directly in construction of the infrastructure.

For the Macquarie catchment (Table 17), the most significant contributors are again iron and steel (0.05 PJ) in production layer 3 and direct energy consumption due to construction activities in layer 1 (0.015 PJ).

Figure 10 and Figure 11 show the energy consumption impact across the supply chain associated with the ongoing operation of the WSS infrastructure in the Lachlan and Macquarie catchments respectively. It can be seen that energy generation in the utilities sector is the predominant contributor to the total operating energy impacts across the supply chain of almost 3 PJ (Lachlan) and approximately 17 PJ (Macquarie)

Table 18 and Table 19 show the ranked structural paths for the WSS Opex cases in both the Lachlan and Macquarie catchments. It can be seen from these tables that the generation of electricity in production layer 2 for use in operation of the infrastructure is the most significant impact, followed by electricity supply in later production layers (e.g. electricity supply to suppliers of goods). As noted earlier, the total energy impact for the Macquarie catchment is much greater than for the Lachlan catchment and this is due to the electricity required to achieve the higher pumping requirement in the Macquarie water supply network.

### 3.2.2 GREENHOUSE GAS EMISSIONS

Figure 12 and Figure 13 show the major contributing sectors to greenhouse gas emissions in the supply chain. The profiles are similar to the energy consumption charts, with construction, minerals, metals and utilities the predominant contributors to emissions across the supply chain in Lachlan, and metals, utilities and construction the predominant contributors in Macquarie.

The greenhouse gas emissions for the Lachlan capital program (approximately 106,000 T) will exceed the emissions for Macquarie (22,000 T).

Table 20 and Table 21 show the structural path analysis for the WSS capital cases. In the Lachlan catchment, the most significant contributor to emissions is related to the production of concrete and cement (for construction of the Lake Rowlands augmentation RCC dam wall). The largest impacts occur in production layers 2 and 3 (i.e. concrete supplied to the project by manufacturer.) Direct emissions from the project including construction of the Lake Rowlands augmentation (e.g. emissions associated with diesel fuel consumption) along with emissions estimated from the additional inundated land area are the next most significant emissions.

The next most significant impact occurs in production layer 3 and is due to the manufacture of iron and steel, to be used in the fabrication of construction components which are then used in the project.

For the Macquarie catchment, the most significant contributors are related to manufacture of iron and steel used in fabrication of construction components followed by direct emissions from construction activities.

Figure 14 and Figure 15 show the emissions impact across the supply chain associated with the ongoing operation of the WSS infrastructure in the Lachlan and Macquarie catchments respectively and the structural path detail is shown in Table 22 and Table 23. Electricity generation in production layer 2, is the largest source of emissions in both Lachlan and Macquarie catchments and the energy intensive water supply network in the Macquarie catchment results in much higher operational emissions (1,575,000 T CO<sub>2</sub>-e) than for the Lachlan catchment (281,000 T CO<sub>2</sub>-e).

### 3.2.3 MATERIAL FLOW

The production layer charts of material flow for the WSS Capital cases (Figure 16 and Figure 17) indicate that the major contributing sectors are construction and mining. In the Lachlan catchment, direct materials flow impacts of approximately 376,000 t are seen in production layer 1. These impacts are due to the need for quarrying of materials to produce the RCC concrete for the Lake Rowlands augmentation wall construction as can be seen in Table 24. Mining in production layers 2, 3 and 4 provides the bulk of the remaining impact, with a total full supply chain material flow estimated at 771,000 t.

In the Macquarie catchment, the two major contributing sectors are construction and mining. However, as less quarried materials are required for construction of the infrastructure in this catchment, the impacts in production layers 1 and 2 are relatively small. The full supply chain material flow in this catchment is estimated at approximately 65,000 t. The structural analysis for the Macquarie catchment shown in Table 25 shows that the materials impacts are due to mining of coal to produce electricity for production of plastics products in production layer 4.

Figure 18 and Figure 19 show the material flow arising from the ongoing operation of the WSS infrastructure. Material flow due to mining is responsible for almost all materials flow impacts in both Lachlan (462,000 t) and Macquarie (2,554,000 t).

The structural paths provided in Table 26 and Table 27 show that these materials flow impacts are due predominantly to mining of brown coal and black for generation of electricity consumed to operate the water supply networks and throughout the supply chain.

### 3.2.4 WATER CONSUMPTION

Production layer charts of water consumption for the WSS Capital cases (Figure 20 and Figure 21) show that the water use impacts occur throughout the supply chain with the major contributing sources being on-site use of water during construction (e.g. for dust suppression) in production layer 1, water consumed in production of steel products in production layer 2 and, in the case of the Lachlan catchment, water consumed in the production of the concrete used in the Lake Rowlands augmentation RCC wall (Table 28 and Table 29). Total supply chain water use for the capital projects in the Lachlan catchment is 1,000 ML (5% of annual demand for the catchment in 2059) and approximately 300 ML for Macquarie (2% of annual demand for the catchment in 2059). The WSS water consumption impacts due to the capital infrastructure are therefore not significant in the context of overall demand.

The production layer charts (Figure 22 and Figure 23) for the WSS Opex cases follow a similar pattern as the energy, greenhouse emissions and materials flow analyses above. In both catchments, water use is largely related to the utilities sector (generation of electricity). The structural analysis (Table 30 and Table 31) shows that the water use impact is related to purchases of water (and water related services) from outside the Centroc region, along with use of water for electricity generation. The full supply chain water consumption due to operation of the WSS infrastructure over the 50 year period equates to approximately one year's demand in the Macquarie catchment and a half a year's demand in the Lachlan catchment.

### 3.2.5 LAND DISTURBANCE

The production layer charts for land use disturbance for the WSS capital cases (Figure 24 and Figure 25) follow a different pattern to many other indicators examined. Land disturbance due to the capital infrastructure totals approximately 3,700 ha (0.1% of the combined Lachlan and Macquarie Regulated Water Management Areas) of the Lachlan catchment with the most significant impacts arising right back in the supply chain. Examination of these charts and the structural paths in Table 32 and Table 32 show that the consumption of agricultural products (particularly beef products) by various sectors in production layers 4 and 5 is leading to the land disturbance impacts deep in the supply chain. The footprint of the Lachlan catchment WSS capital infrastructure in production layer 1 is relatively insignificant (242 ha) compared to the catchment as a whole and also in comparison to the full supply chain impact observed (6%).

The land use disturbance for the Macquarie catchment follows a similar trend to Lachlan. The supply chain impact in production layer 1 is relatively minor (3%) with the most significant impacts arising in production layers 4 and 5 due to consumption of agricultural products (particularly beef products).

Land disturbance due to the operation of the WSS assets over the 50 year study period are also relatively insignificant at approximately 3,000 ha (0.1% 2,626,900 ha of the Lachlan Regulated Water Management Area) over the full supply chain in the Lachlan catchment and 3,000 ha (0.2% of the 1,229,400 ha of the Macquarie Regulated Water Management Area) in the Macquarie catchment (see Figure 26 and Figure 27). Water supply and drainage services along with agriculture services contribute a significant proportion of the full supply chain impact (see Table 34 and Table 35).

### 3.2.6 EMPLOYMENT

In Lachlan, the full supply chain employment arising from the WSS capital projects is estimated to total approximately 2,400 emp-y (Figure 28). Of this an estimated 568 emp-y is employment generated in the construction industry for suppliers and subcontractors and a further 543 emp-y is direct employment in project construction in production layer 1 (Table 36). The remaining employment occurs further down the supply chain in production of materials used in construction (steel, plastics and concrete).

In Macquarie, employment follows a similar trend to Lachlan although total employment is lower in line with the lower capital investment in the catchment (Figure 29 and Table 37).

Ongoing operation of the water security infrastructure provides approximately 1,700 emp-y of employment in the Lachlan catchment over the 50 year period and 1,300 emp-y in the Macquarie catchment (see Figure 30 and Figure 31). The employment generated is predominantly related to operation of the water supply network and ongoing maintenance and renewals (Non-building repair shown in Table 38 and Table 39).

### 3.2.7 FAMILY INCOME

Production layer charts showing the impact of family income due to the capital construction and operation of the water supply projects are shown in Figure 32- Figure 33. These charts exhibit the same trends as the employment charts described in the previous section, except that for operation of the system, the family income generated in the utilities sector is proportionally higher compared to income generated in the construction sector. This is because the average wages in the utilities sector are greater than in construction.

The ranked structural paths for family income are shown in Table 40 to Table 43.

### 3.2.8 GROSS OPERATING SURPLUS

Figure 36 and Figure 37 show the gross operating surplus, or profits, that are generated in each industry sector over the supply chain as a consequence of the capital investment in the water supply infrastructure. Profits over the full supply chain total approximately \$53 M in the Lachlan and \$12 M in the Macquarie catchment. The profits are spread across many sectors and throughout the full supply chain. The ranked structural paths for gross operating surplus are shown in Table 44 to Table 47.

Gross operating surplus arising from operation of the WSS infrastructure is shown in Figure 38 and Figure 39. Profits generated over the 50 year study period total approximately \$58 M (Lachlan) and \$130 M Macquarie with the utilities sector delivering the bulk of the profits.

### 3.2.9 IMPORTS

Figure 40 and Figure 41 show the imports of overseas products and services arising from the capital investment in the water supply infrastructure. Total imports over the full supply chain total approximately \$27 M (Lachlan) and \$8 M Macquarie and it can be seen that, as with gross operating surplus, profits are spread across many sectors and throughout the full supply chain.

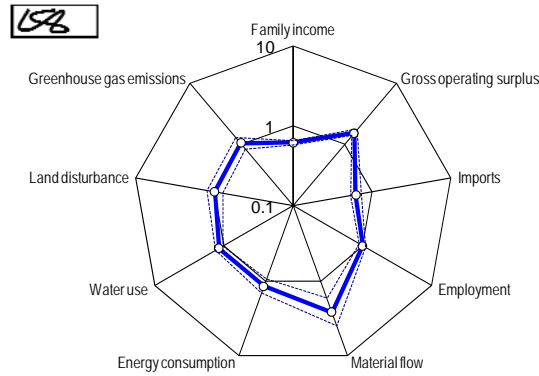
The ranked structural paths for imports are shown in Table 48 to Table 51.

Imports arising from operation of the WSS infrastructure are shown in Figure 42 and Figure 43. Total imports arisen over the 50 year study period total approximately \$13 M (Lachlan) and \$20 M Macquarie with the utilities sector delivering the bulk of the profits.

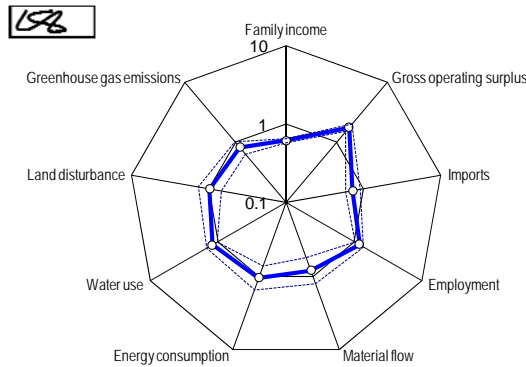
## 3.3 PERFORMANCE AGAINST INDUSTRY BENCHMARKS

Figure 4 - Figure 7 show benchmark "spider diagrams" generated by the ISA model comparing performance against and industry benchmark sector for the WSS projects. For the capital projects, the benchmark sector chosen was non-residential construction, while the benchmark for the operation of the WSS projects was the water supply, sewage and drainage sector. Better performance is demonstrated when the indicator is closer to the centre of the diagram (e.g. lower emissions, higher employment) while performance closer to the outside of the diagram is poorer. The benchmark (or industry sector average) is represented by the inner polygon (with a value of 1).

For WSS capital, Figure 4 and Figure 5 indicate that performance on most indicators is close to the benchmark, with gross operating surplus slightly outside benchmark performance. For the Lachlan catchment, materials flow impacts are also greater than for the benchmark and this is consistent with the high materials inputs needed for construction of the RCC dam wall.

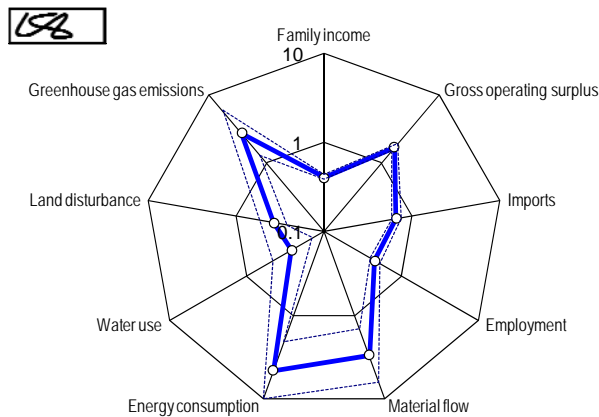


**Figure 4: Benchmark Spider Diagram for – WSS Capital - Lachlan**

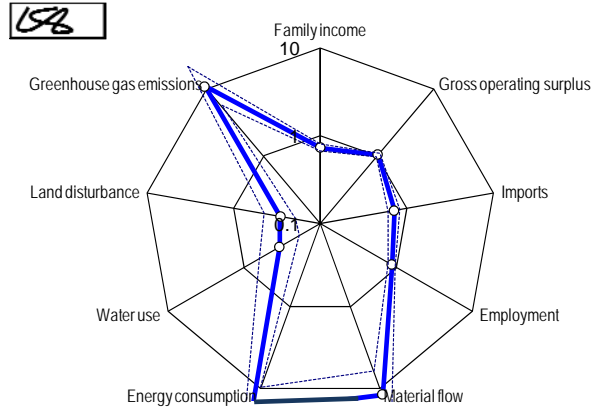


**Figure 5: Benchmark Spider Diagram for – WSS Capital - Macquarie**

For operation of the WSS projects, energy consumption falls outside the benchmark and this is consistent with the observations made previously that operation of the infrastructure is energy (electricity) intensive compared with the industry benchmark which includes gravity fed systems. Material flow and greenhouse gas emissions also fall outside benchmark performance due to the high energy requirement (Figure 6 and Figure 7).



**Figure 6: Benchmark Spider Diagram for – WSS Opex - Lachlan**



**Figure 7: Benchmark Spider Diagram for – WSS Opex - Macquarie**

### 3.4 REGIONAL EMPLOYMENT IMPACTS

The proportion of regional employment (employment that is realised within the local region) was estimated for production layers 1 and 2. These results can be seen in Table 13. It should be noted that there is also likely to be a (diminishing) component of employment in production layers 3 and above in the local region. This has not been estimated in this study and as such, the regional employment figures can be considered conservative.

**Table 13: Regional Employment**

	TOTAL EMPLOYMENT (EMP-Y) (FIRST 25 PRODUCTION LAYERS)	EMPLOYMENT WITHIN REGION (EMP-Y) (PRODUCTION LAYERS 1 AND 2)	% EMPLOYMENT WITHIN REGION
WSS Capital Total - Lachlan	1,870	491	26.3%
WSS Capital Total - Macquarie	398	74	18.5%
WSS Opex Total - Lachlan	1,579	698	44.2%
WSS Opex Total - Macquarie	951	663	69.7%
<b>TOTAL</b>	<b>4,798</b>	<b>1,926</b>	<b>40.1%</b>

The figures above were determined using estimates of the proportion of regional employment likely for each industry sector. These percentages were estimated by the Centroc PSC and IG.

**Table 14: Regional Employment Estimates by Sector**

CATEGORY	DESCRIPTION	CONSOLIDATED ESTIMATE OF SUPPLY FROM WITHIN REGION (%)	CONSOLIDATED ESTIMATE OF SUPPLY FROM OUTSIDE REGION (%)
Basic Chemicals	Chemicals used in the treatment of water	0%	100%
Cement products	Cement, lime - for RCC dam wall	67%	33%
Computer and technical services	Computer maintenance and consultancy services, quantity surveying, consulting engineering, information storage and retrieval	37%	63%

CATEGORY	DESCRIPTION	CONSOLIDATED ESTIMATE OF SUPPLY FROM WITHIN REGION (%)	CONSOLIDATED ESTIMATE OF SUPPLY FROM OUTSIDE REGION (%)
Concrete products	Concrete (particularly as used in construction of dam wall)	93%	7%
Construction machinery	Tractors, graders, earthmoving equipment	32%	68%
Construction materials	Quarried materials - eg aggregate for dam wall	100%	0%
Education	Community education services	70%	30%
Electrical equipment	Electrical equipment - particular metering and industrial controls equipment used in pump stations, treatment plants etc.	38%	62%
Electricity supply	Electricity supply to Centroc region	100%	0%
Electronic equipment	Computers, office machines, typewriters, telephone and telecommunications equipment, satellite receivers, alarm systems, hearing aids, rectifiers, video, TV, radio, and other electronic equipment	10%	90%
Fabricated construction steel	Structural steel components, reinforcing mesh, pipes	17%	83%
Fabricated metal products	Wire, fencing, valves,	50%	50%
Finished cars	Purchase of fleet cars	0%	100%
Industrial machinery and equipment	Equipment used in pump stations, treatment plants (e.g. hydrants, screens)	13%	87%
Industrial machinery repairs	Repair and maintenance of industrial machinery and equipment	77%	23%
Iron and steel manufacture	Rolling, drawing and extruding iron and steel	17%	83%
Machinery for crushing, grinding, mixing	Mixer motors & gearboxes/floculators	0%	100%
Motor vehicle repair	Maintenance of cars	100%	0%
Non- residential building construction	Services involved in the construction of non-residential buildings such as sheds, control rooms etc.	83%	17%
Non-building construction	Services involved in the construction of non-building assets (e.g. pipelines, reservoirs, civil projects)	15%	85%

CATEGORY	DESCRIPTION	CONSOLIDATED ESTIMATE OF SUPPLY FROM WITHIN REGION (%)	CONSOLIDATED ESTIMATE OF SUPPLY FROM OUTSIDE REGION (%)
Non-building repair & maintenance	Services involved in the repair and maintenance of non-building assets	73%	27%
Non-residential building repair & maintenance	Repair of above.	88%	12%
Plant leasing, hiring and renting services	Lease of construction machinery, plant or equipment	40%	60%
Plastic products	Plastic products - particularly PVC piping	7%	93%
Pumps	Pumps supplied for use in pump stations, treatment plants	13%	87%
Residential building repair & maintenance	Services involved in the repair and maintenance of residential buildings - particularly plumbing related to water demand management initiatives such as meter replacement program	97%	3%
Road freight of concrete	Freight of concrete used in non-dam construction (dam concrete would probably be supplied by batch plant)	60%	40%
Roads and bridges	Services involved in the construction or maintenance of roads (e.g. access roads)	90%	10%
Water supply	Water purchases from other water businesses	67%	33%

## 4. SENSITIVITY ANALYSIS

A sensitivity case was modelled to test the impact of an alternative Lake Rowlands augmentation dam construction technique (Concrete Faced Rockfill (CFR)) on the outcomes of the analysis. For the sensitivity, it has been assumed that a CFR dam would use approximately 15% of the concrete used to construct a RCC dam. It has been assumed that the balance of the forecast capital materials expenditure would be spent on rockfill (quarried rock) and that all other capital expenditures (labour, equipment, survey, investigation and design) remain unchanged.

While the above assumptions are highly simplified and cannot be used to assess the costs and benefits of the two types of dam construction, the sensitivity analysis provides an indication of the directional movement in impacts as the construction technique is varied.

The outcome of the sensitivity analysis is in Table 15. As can be seen the full supply chain emissions related to the CFR dam construction are approximately 33% lower than for the RCC dam. Energy consumption is also 20% lower. These impacts are due to the reduced concrete required for the CFR dam construction and the subsequent reduction in energy consumption and emissions related to manufacture of cement. The water use over the full supply chain for the CFR dam is approximately 20% less than for the RCC dam and this is associated with the supply chain energy impacts described above.

The CFR dam has a significantly higher materials flow impact and this is due to the quantity of quarried rockfill required for construction of the dam wall.

**Table 15: Sensitivity on Lake Rowlands Augmentation Construction Method**

INDICATOR	LAKE ROWLANDS AUGMENTATION RCC DAM	LAKE ROWLANDS AUGMENTATION CFR DAM	% CHANGE
Greenhouse gas emissions (t CO <sub>2</sub> -e)	67,000	45,000	-33%
Energy consumption (TJ)	640	500	-20%
Material flow (t)	654,000	1,183,000	+80%
Water use (ML)	620	500	-20%
Land disturbance (ha)	2,100	2,000	-4%
Employment (emp-y)	1,400	1,300	-7%
Family income (current \$'000)	70,793	69,300	-2%
Gross operating surplus (current \$'000)	22,483	23,239	-3%
Imports (current \$'000)	9,207	9,558	-4%
Total expenditure (50 years, current \$'000)	148,500	148,500	0%

## 5. CONCLUSIONS AND NEXT STEPS

The University of Sydney ISA assessment has provided useful insights into the performance of the water supply system across a range of indicators.

Key conclusions from the modelling are as follows:

- The analysis has confirmed that, without mitigation measures in place, the proposed WSS projects are energy intensive and will increase the emissions, energy and material flow “footprint” of the Centroc water supply operations by 80-85%.
- The impacts incurred as a consequence of the capital construction are minor in comparison to the energy, greenhouse and materials flow impacts incurred due to operation of the system over the 50 year study period (e.g. Emissions arising from capital construction are 1/14<sup>th</sup> of the emissions arising from operation of the system. This is of the order of contribution of embodied energy to operational energy is consistent with established renewable energy ratios).
- Total water use impacts over the 50 year period are 24,000 ML (this total equates to approximately 70% of annual Centroc water demand in 2009). Direct water use impacts during the capital and operating periods are minimal, with a significant proportion of water use again associated with electricity production.
- Land disturbance impacts are relatively minor totalling 11,000 ha over the 50 year period. Approximately half of these impacts are related to capital construction, but direct impacts due to the footprint of the infrastructure total only 300 ha in total. The remaining land disturbance impacts are related to activities in the agricultural sector deep in the supply chain.
- The WSS project will result in the creation of jobs, totalling approximately 6,000 employment years over the 50 year period. Approximately half of these jobs will be associated with the capital construction and half with ongoing operation and maintenance of the water supply network.
- The family income arising from the WSS projects over the 50 year period is approximately \$416 M with approximately half the income generated in the construction period and half due to operation and maintenance.
- The gross operating surplus or profits generated by the WSS projects will total approximately \$240 M over the 50 year period with approximately one third of the profits generated from capital and two thirds from operation.
- Imports will total some \$67 M over the period and this figure is in approximate proportion to the total capital expenditure.

In summary, the analysis has shown that the proposed Centroc WSS would deliver significant profits for industry sectors throughout the supply chain and will generate both direct and indirect employment. However, as was recognised in the original study, there is a significant energy requirement to operate the infrastructure, particularly in the Macquarie catchment, where the electricity needs to meet the pumping requirement, particularly for Oberon and Lithgow where water must be pumped uphill from Bathurst, is greater. The electricity requirement has flow on impacts for greenhouse gas emissions, materials flow and to a lesser extent water consumption.

These operational impacts related to electricity consumption outweigh the impact due to the capital infrastructure itself. Consequently, options to reduce energy requirements, to source electricity from alternative low/no emissions sources and to offset any remaining operational emissions will be a key focus in stage 4 of this project.

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## APPENDIX 1: DATA ASSUMPTIONS

### Business as Usual case:

1. The Business as Usual (2059) case comprises Business as Usual (2059) forecast operating expense + Business as Usual (2059) forecast capital expense
2. Business as Usual (2059) capital expense comprises Business as Usual (2059) renewals forecasts + possible non-WSS Augmentation Projects (where information was received prior to 01 August 2010)
3. Possible non-WSS Augmentation Projects and associated capital costs have been provided by Centroc councils.
4. Business as Usual (2059) renewals have been estimated from capital plans and by extrapolating renewal expenses in these plans across the remaining study period. A maintenance and renewals allowance is also included for the WSS infrastructure.
5. For Business as Usual Capital Expense, expenditure items where there is a clear pattern have been extrapolated for the remainder of the 50 year study period that is outside of the capital plan periods.
6. Boorowa, Lithgow, Lachlan and Upper Lachlan Business as Usual Capital Expenditures have been estimated based on the ratio of renewals to total asset value of similar sized councils (Young, Wellington and Central Tablelands Water). Upper Lachlan Council also provided information on 4 projects that are planned to occur in the study period. These projects were also included in the modelling in addition to the estimation for renewal projects for Upper Lachlan.
7. Central Tablelands Water provided information on one project that was outside of their capital plan. This project was not included in the modelling as it was contingent on the Lake Rowlands augmentation (part of the WSS) not going ahead.
8. Harden and Lachlan operating expenses estimated in accordance to water demand from average expenses of similar sized water businesses.
9. Forecast business as usual opex has been estimated based on 2059 demand (with current demand management programs in place) and escalated according to water demand. The relationship of operating cost and water demand has been developed by analysing the current operating cost and demand trend.
10. Expenses for each council water business have been allocated to labour, materials and services in accordance with the expense profiles for Bathurst (for large water businesses), Central Tablelands Water (for medium water businesses) and Wellington (for smaller water businesses).
11. Depreciation expense has not been included as we consider that this would result in double counting of renewals expenses.

### WSS Forecast (2059) case:

12. WSS case comprises WSS capital cost + WSS operation cost + Business as Usual (2059)
13. Capital cost, operating cost and demands are based on the Centroc Water Security Study Component 2 Options Paper.
14. Energy and chemical costs are included as per the WSS estimates. For the remaining operating expenses, allocations have been made based on experience and business as usual estimates of relative spending on labour, other operational expenses and other maintenance expenses:

% OF OPERATING COST (EXCL CHEMICALS AND ENERGY)	LABOUR (MAINTENANCE & OPERATIONAL)	OTHER OPERATIONAL EXPENSES	OTHER MAINTENANCE EXPENSES
Lake Rowlands dam	40%	22%	38%
Pipelines	47%	13%	40%
Network water storages (tanks)	18%	28%	54%
Reservoirs	18%	28%	54%
Pump stations	36%	31%	43%
Water Treatment Plants	55%	30%	15%

15. WSS capital costs are allocated as described in the following section.
16. For assessing land disturbance, it has been assumed that:
  - Lake Rowlands inundated area is low grade pasture per “Water Research Institute Ltd, Report for Central Tablelands Water: Review of Proposed Enlargement of Lake Rowlands Dam, October, 2006, GHD”
  - Pipeline disturbance is minimal as remediation of pipe route would be undertaken and use of land would be retained
  - Water treatment plant, pump station and storages result in land disturbance to pasture
17. Diesel and water use (for dust suppression) in construction have been estimated by pro-rata calculation of consumption from other capital projects in accordance with expenditure on equipment use.
18. Greenhouse gas emissions for construction have been calculated from diesel consumption figures using Australian Greenhouse Accounts (2009) factors.
19. For Lake Rowlands and earthen storages, emissions due to inundation have been calculated in accordance with IPCC guidelines assuming that the inundated area is predominantly grassland.

**Capital cost allocation for Business as Usual and WSS Forecast (2059) cases:**

20. Capital expenses for the WSS infrastructure and Business as Usual capital components have been assigned to labour, materials and plant categories based on MWH experience, Rawlinsons cost estimating manual and information in the public domain (e.g. Environmental Impact Statements) for similar projects. It is important to recognize that these are strategic level estimates and that local conditions will have a significant impact on the final proportion of costs related to labour, materials and services. The cost assumptions are described below:

% OF CAPITAL COST	MATERIALS	LABOUR	EQUIPMENT
Lake Rowlands dam	30% 27% Concrete (RCC) 3% Steel	40%	30%
Pipelines	50% 35% DICL 15% uPVC	37.5%	12.5%

% OF CAPITAL COST	MATERIALS	LABOUR	EQUIPMENT
Network water storages (tanks)	60% 35% DICL 15% uPVC	30%	10%
Reservoirs	0%	30%	70% (Earthworks)
Pump stations	60% 3% Concrete 10% Steel 25% Plastics 35% Pumps 12% Electrical 15% Fabricated Metal Products	30%	10%
Water Treatment Plants	60% 18% Concrete 6% Steel 3% Plastics 9% Pumps 18% Electrical 6% Other Industrial Machinery (filters etc)	40%	10%

**APPENDIX 2: RESULTS FIGURES**

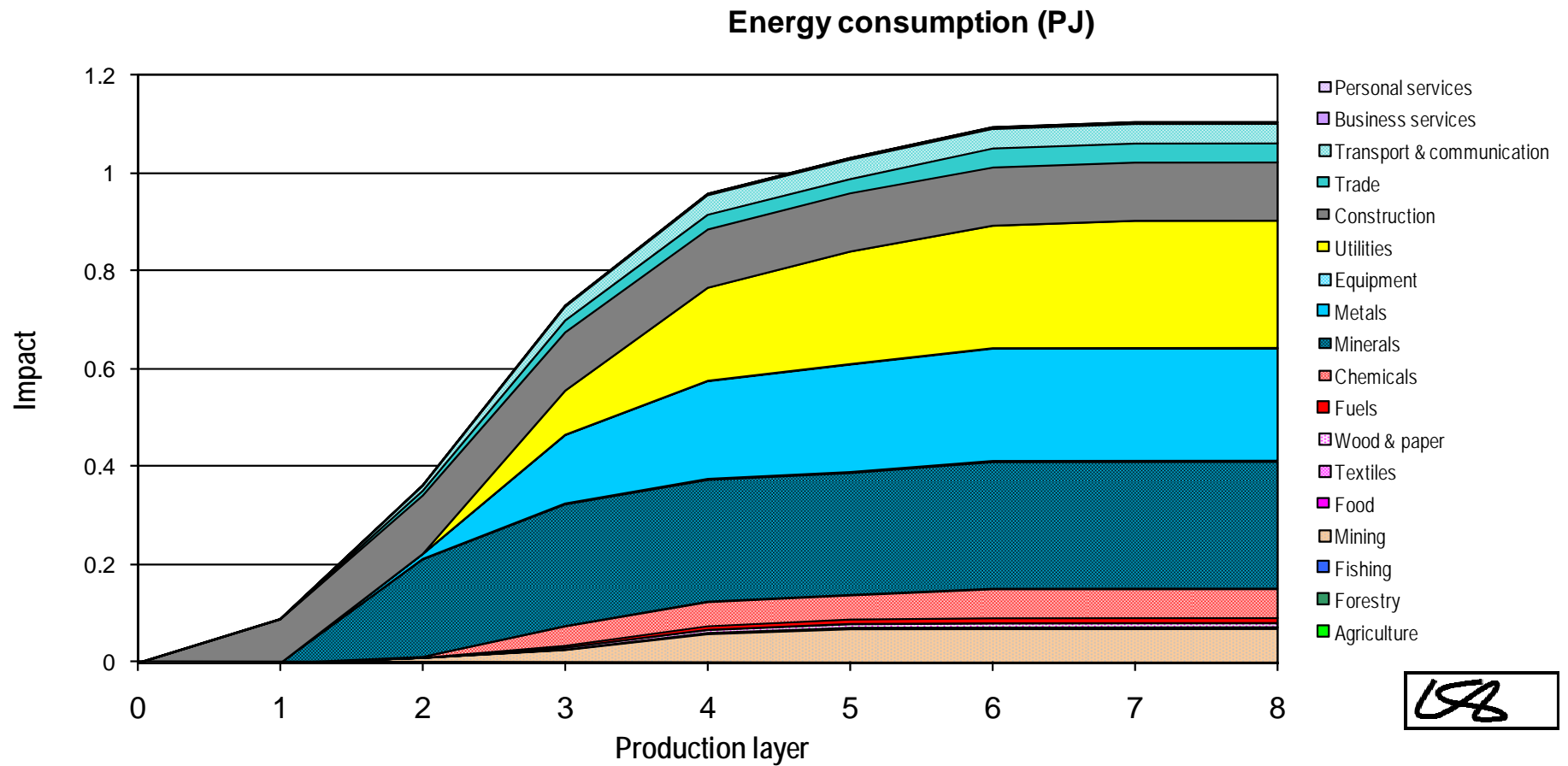


Figure 8: Cumulative Impact by layer – WSS Capital – Lachlan, Energy Consumption

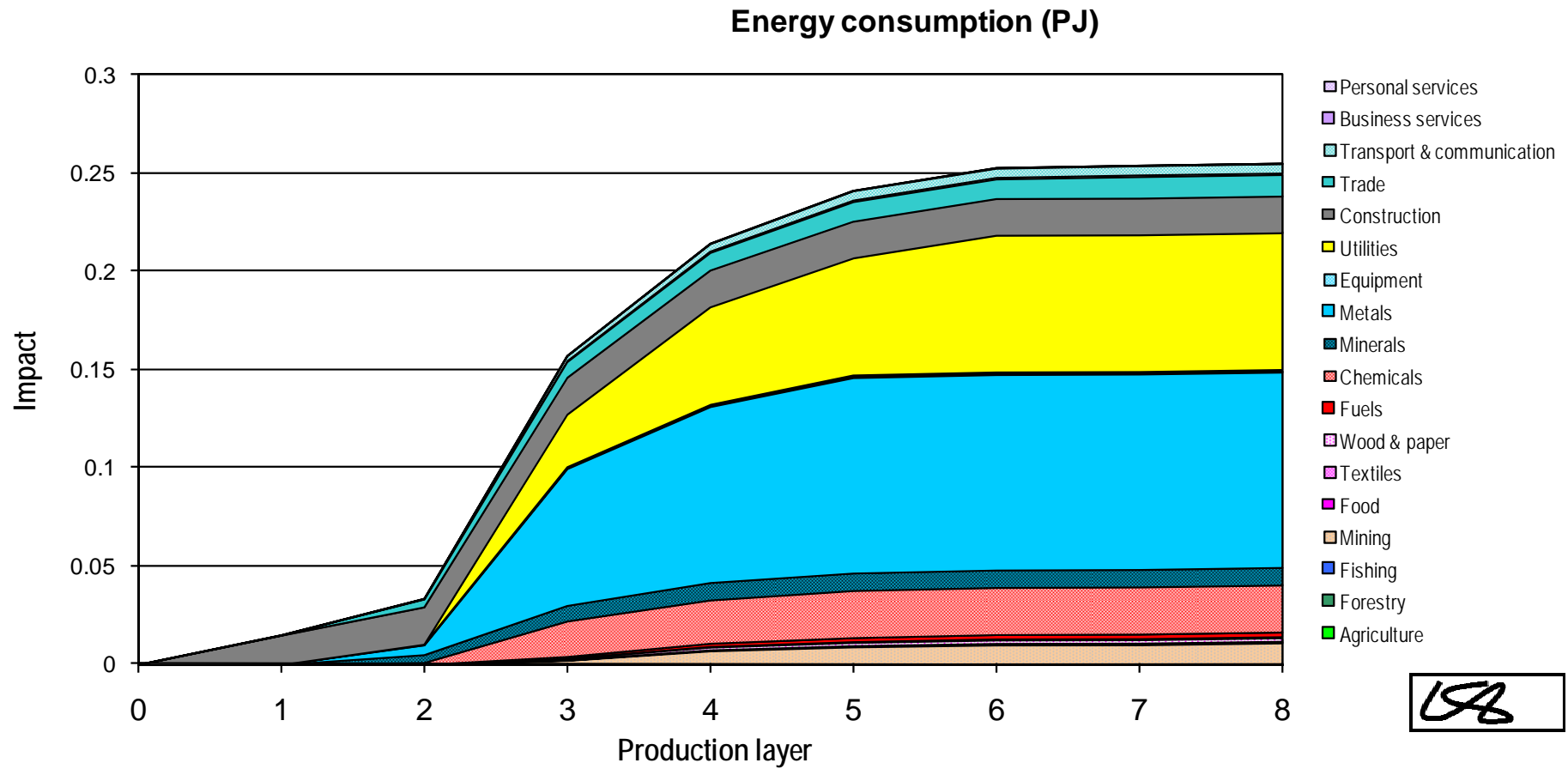


Figure 9: Cumulative Impact by layer – WSS Capital – Macquarie, Energy Consumption

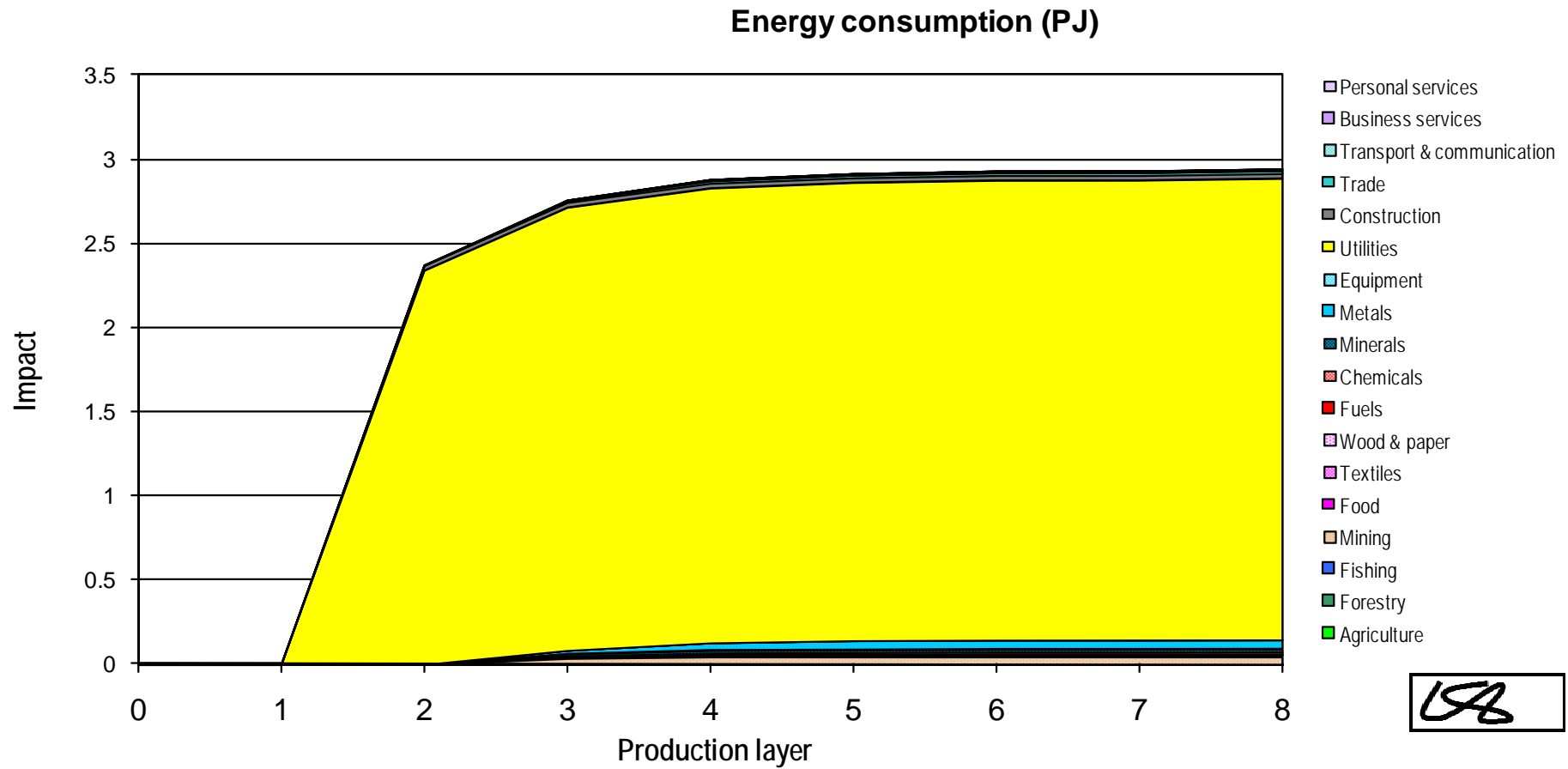


Figure 10: Cumulative Impact by layer – WSS Opex – Lachlan, Energy Consumption

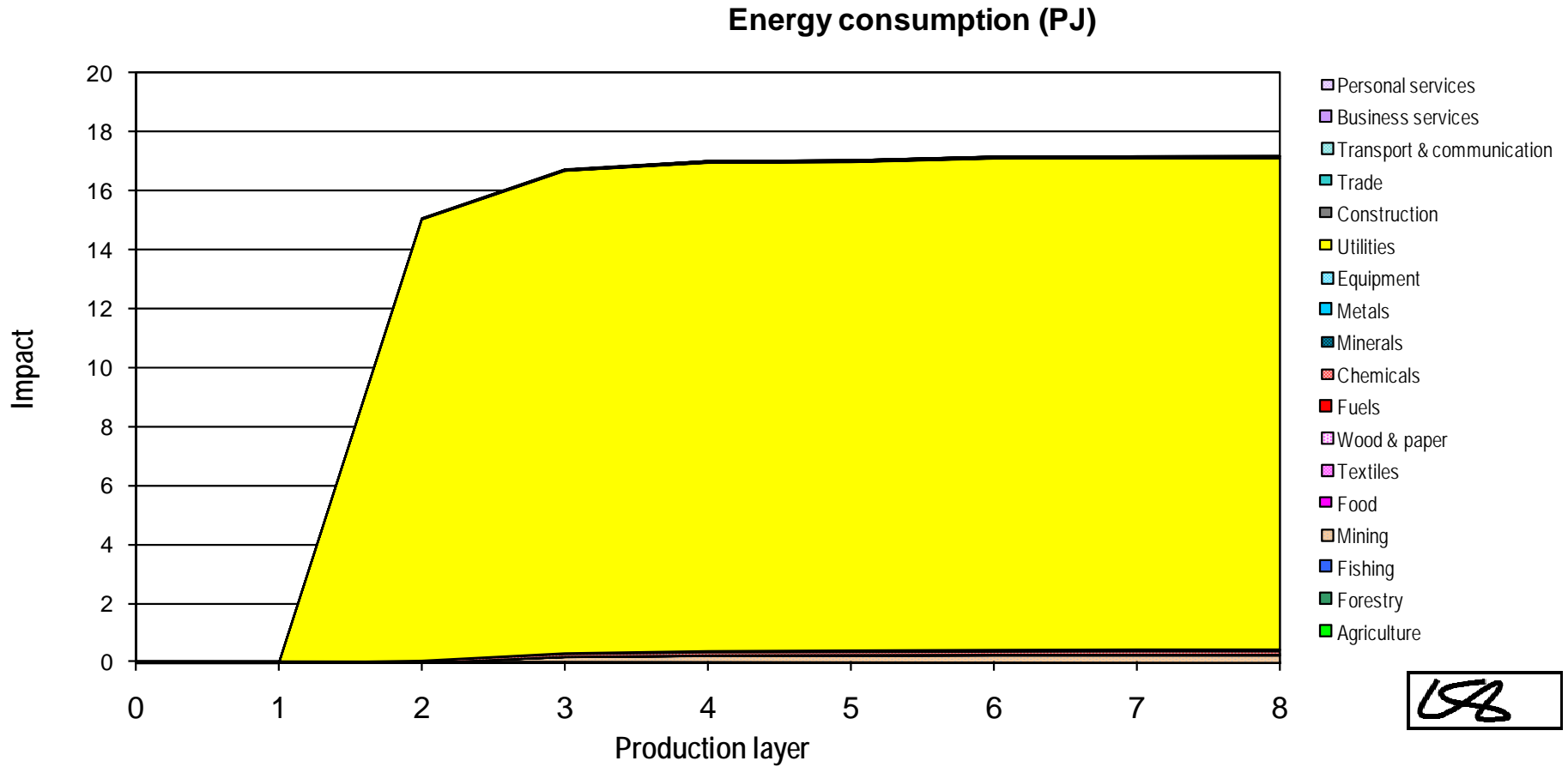


Figure 11: Cumulative Impact by layer – WSS Opex – Macquarie, Energy Consumption

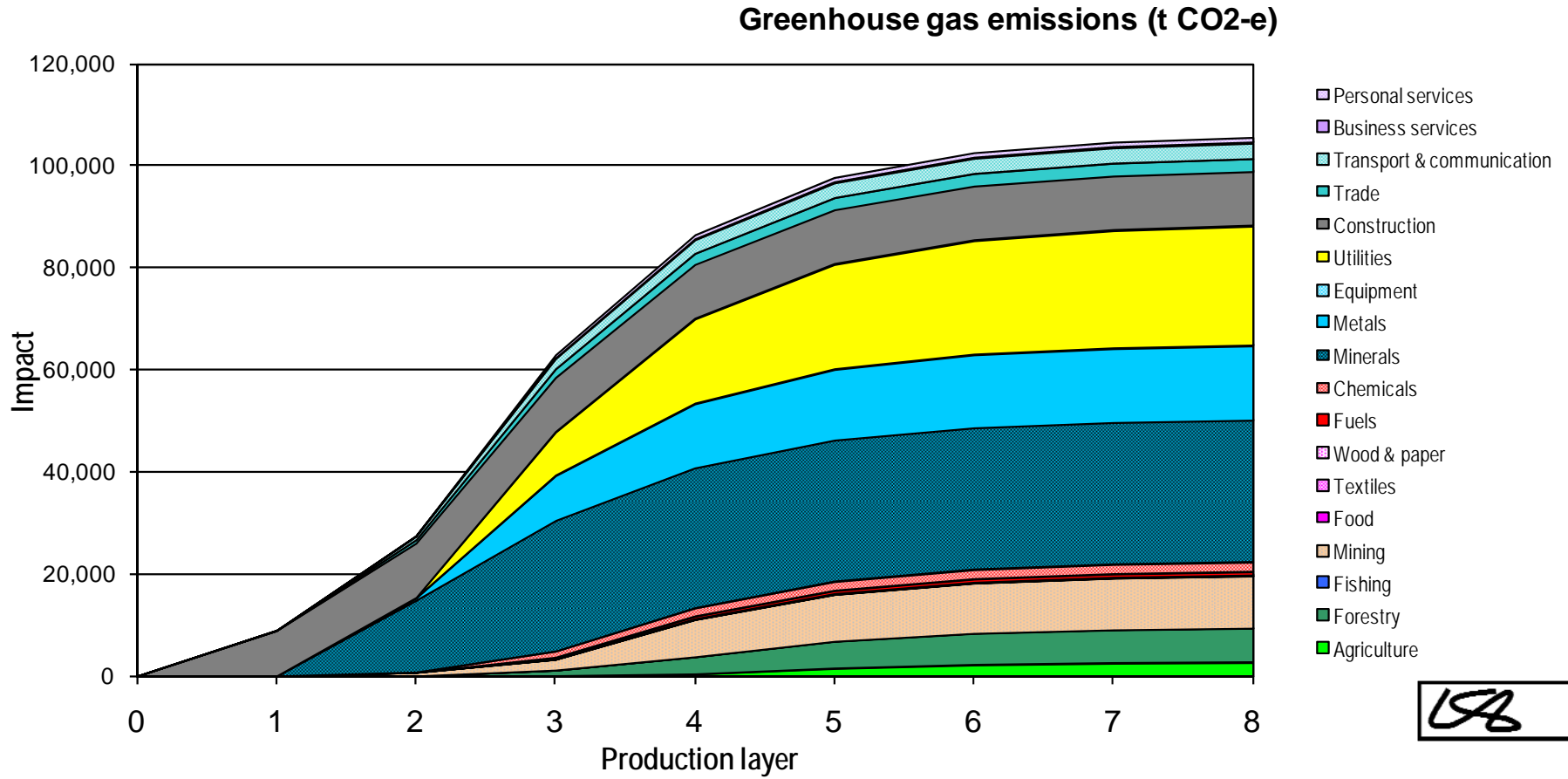


Figure 12: Cumulative Impact by layer – WSS Capital – Lachlan, Greenhouse Gas Emissions

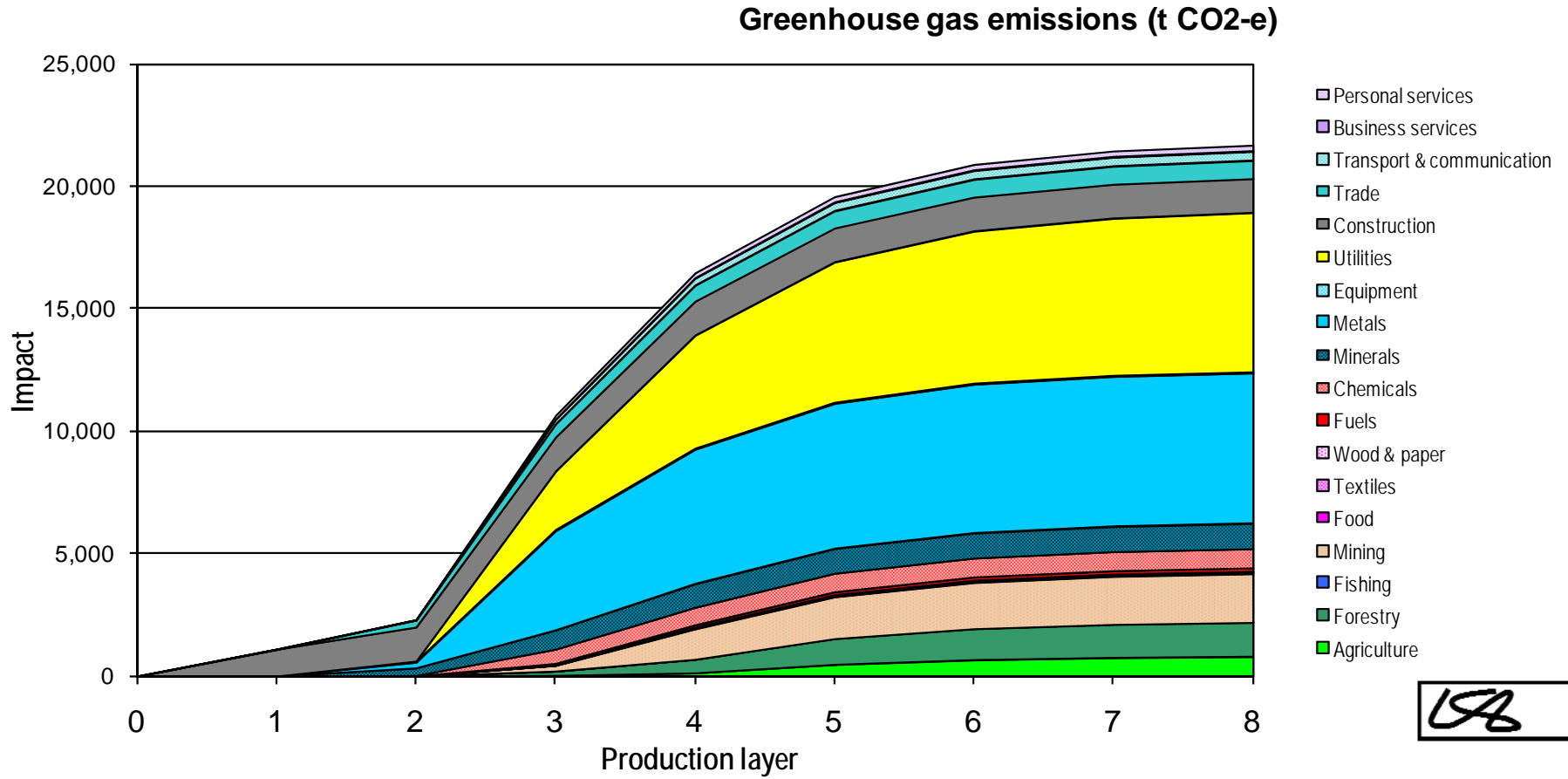



Figure 13: Cumulative Impact by layer – WSS Capital - Macquarie, Greenhouse Gas Emissions

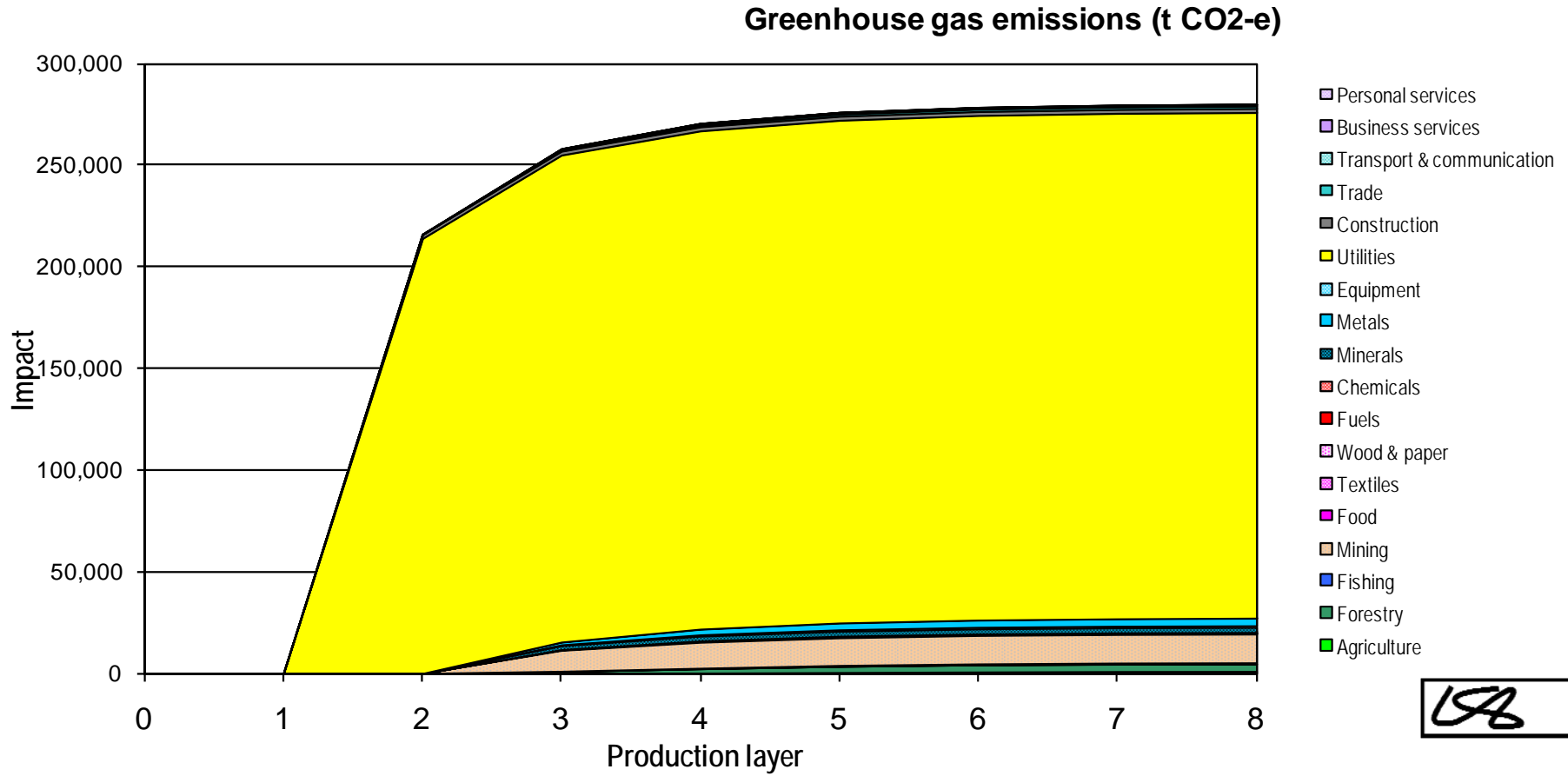


Figure 14: Cumulative Impact by layer – WSS Opex - Lachlan, Greenhouse Gas Emissions

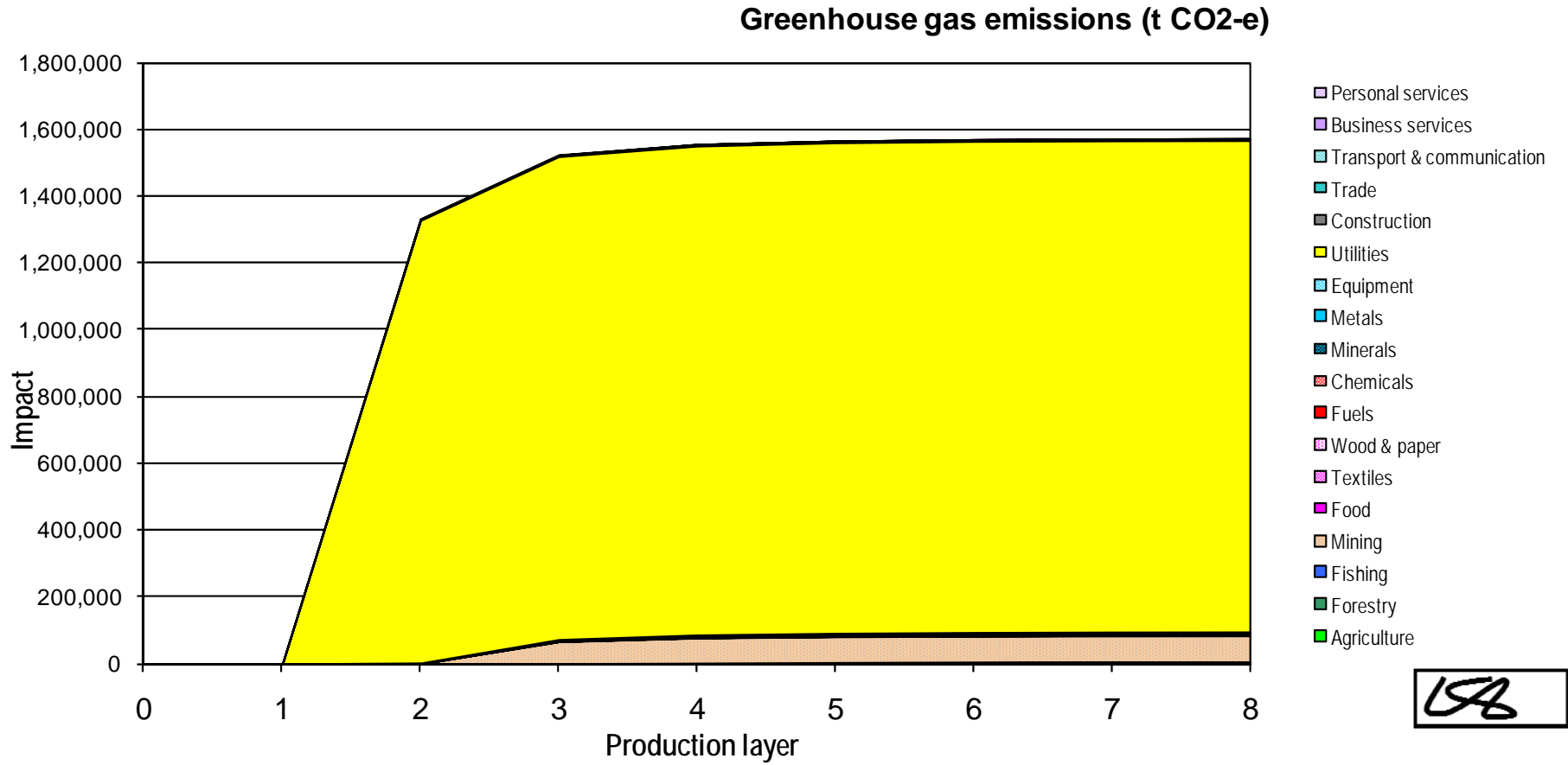


Figure 15: Cumulative Impact by layer – WSS Opex – Macquarie, Greenhouse Gas Emissions

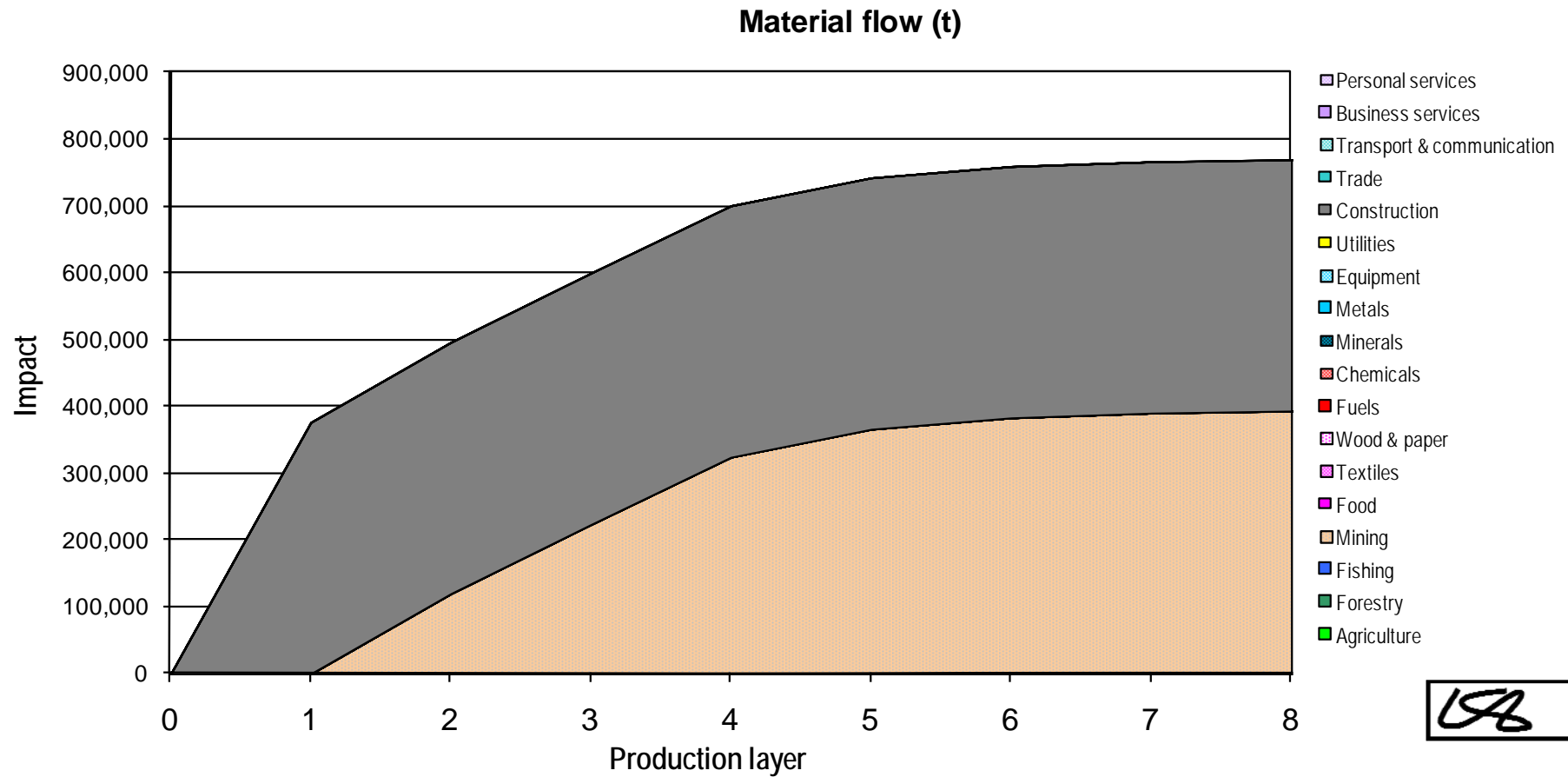


Figure 16: Cumulative Impact by layer – WSS Capital – Lachlan, Material Flow

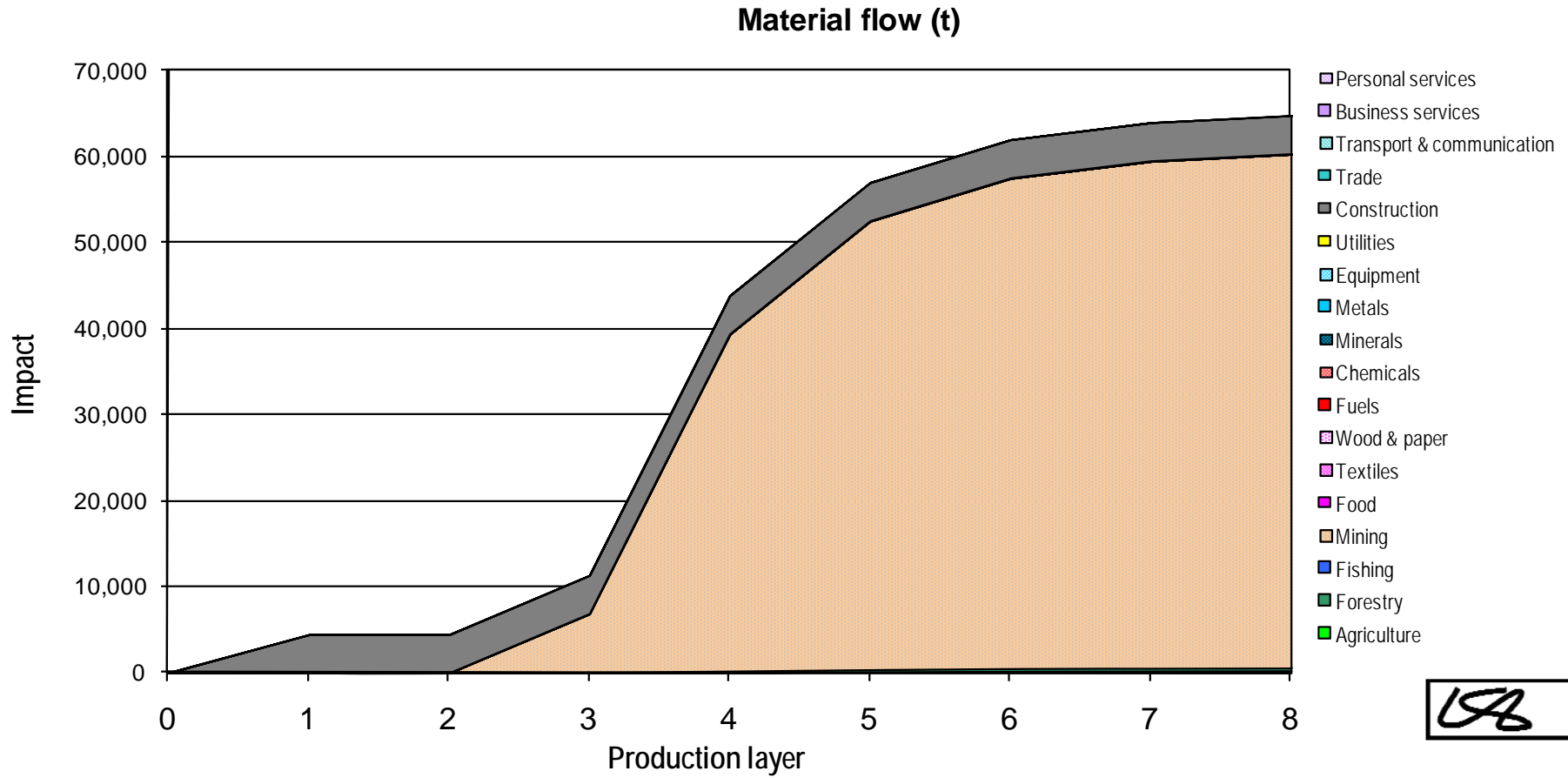


Figure 17: Cumulative Impact by layer – WSS Capital – Macquarie, Material Flow

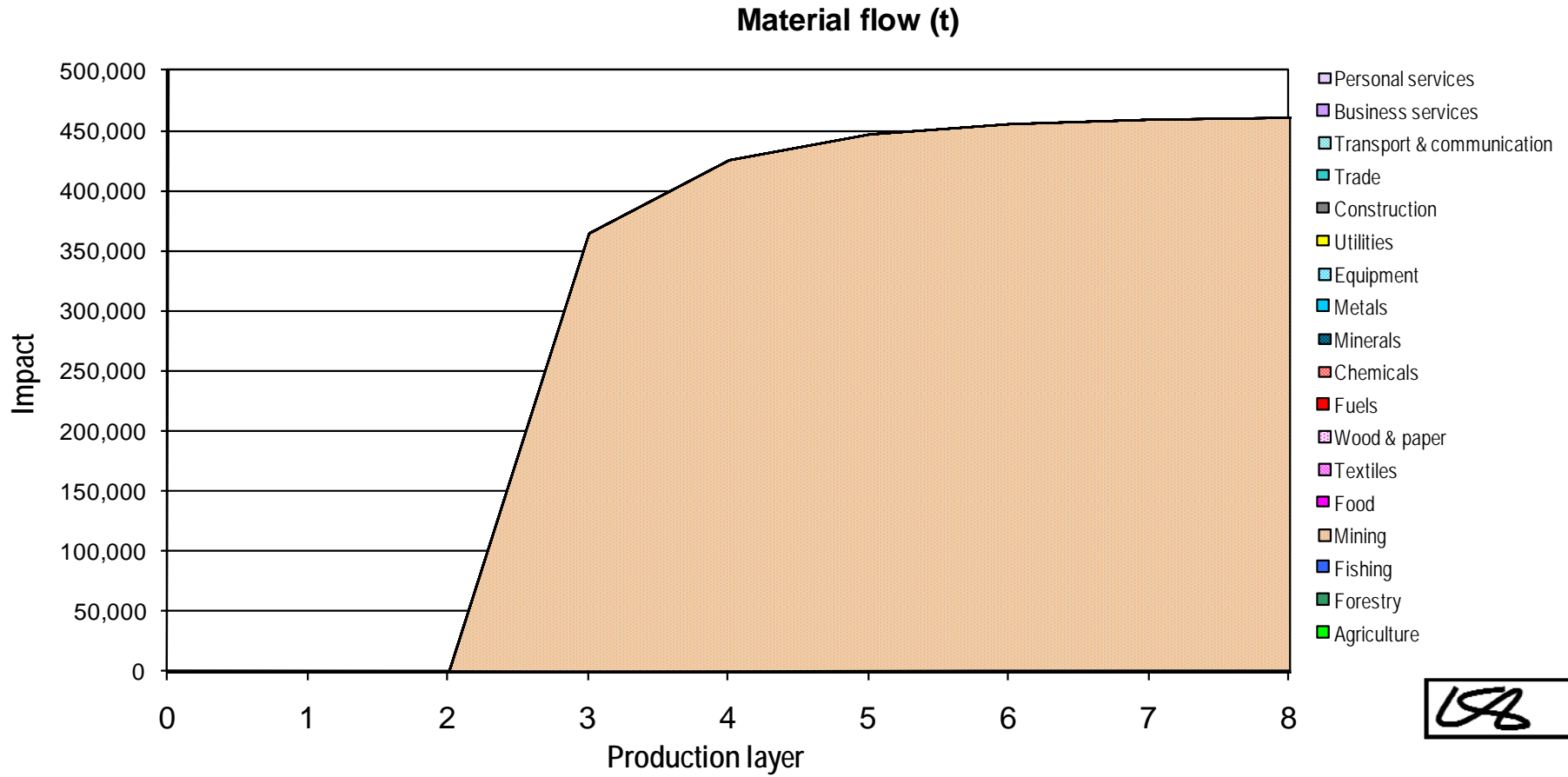


Figure 18: Cumulative Impact by layer – WSS Opex - Lachlan, Material Flow

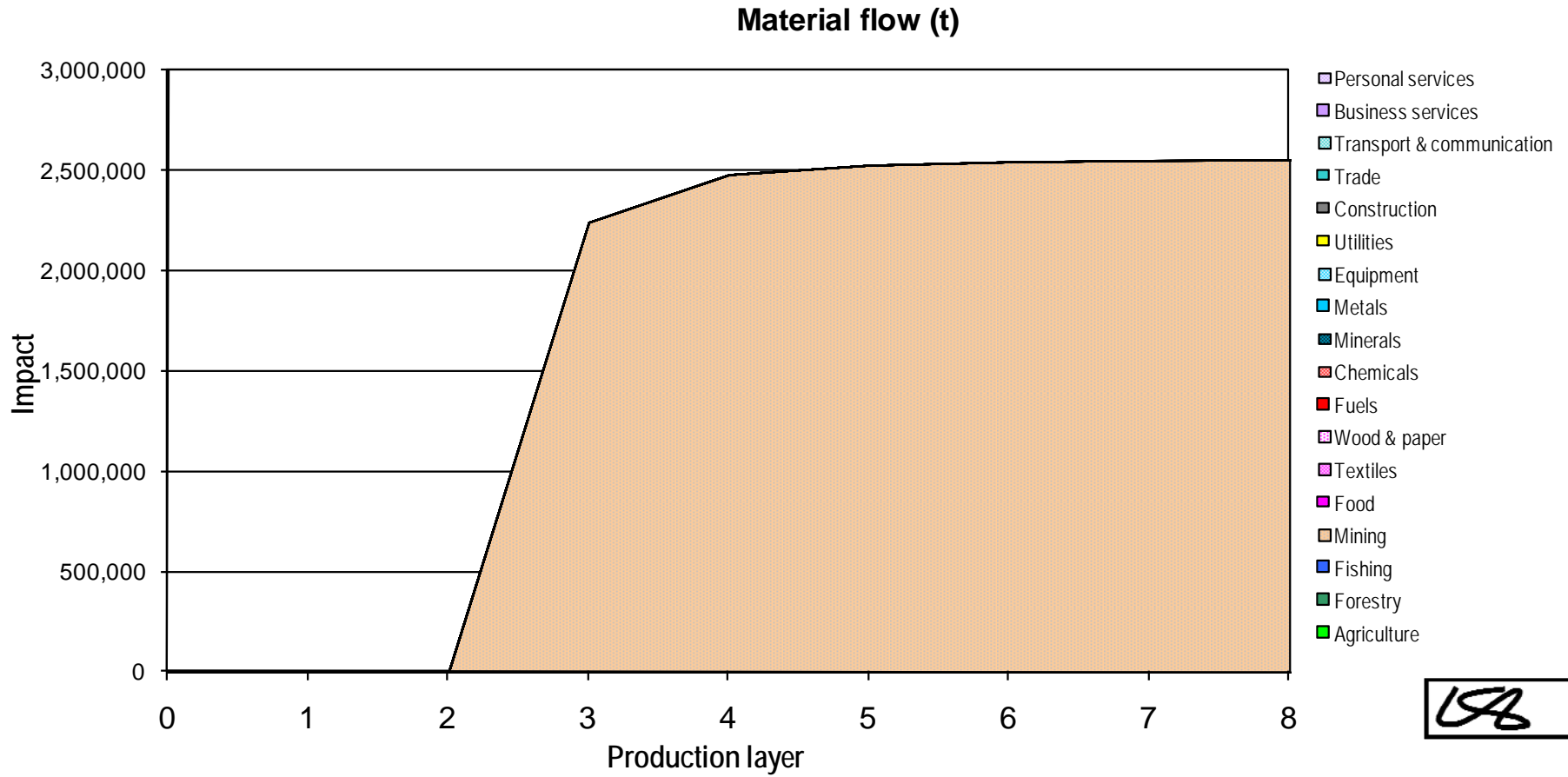


Figure 19: Cumulative Impact by layer – WSS Opex - Macquarie, Material Flow

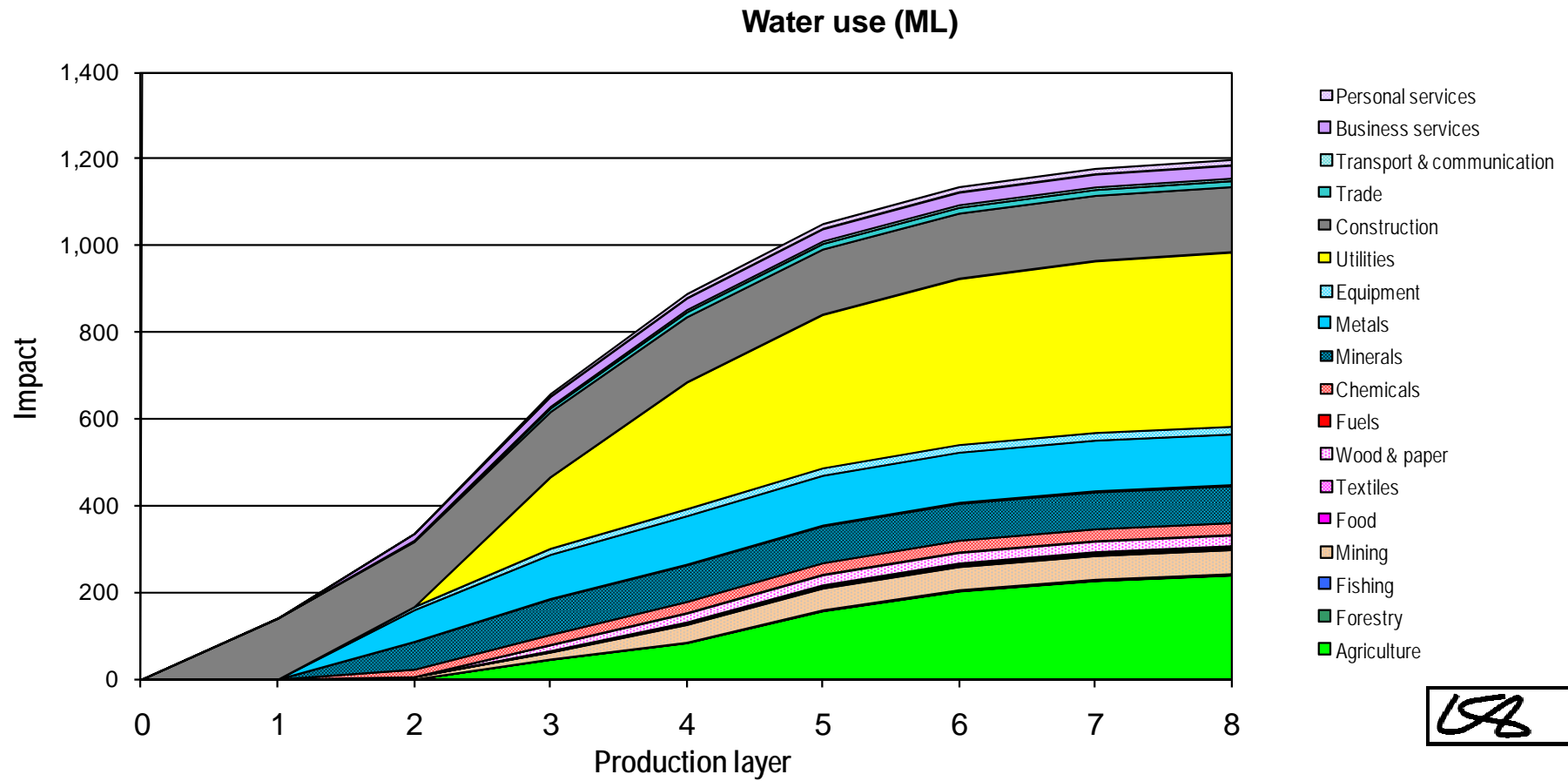


Figure 20: Cumulative Impact by layer – WSS Capital – Lachlan, Water Consumption

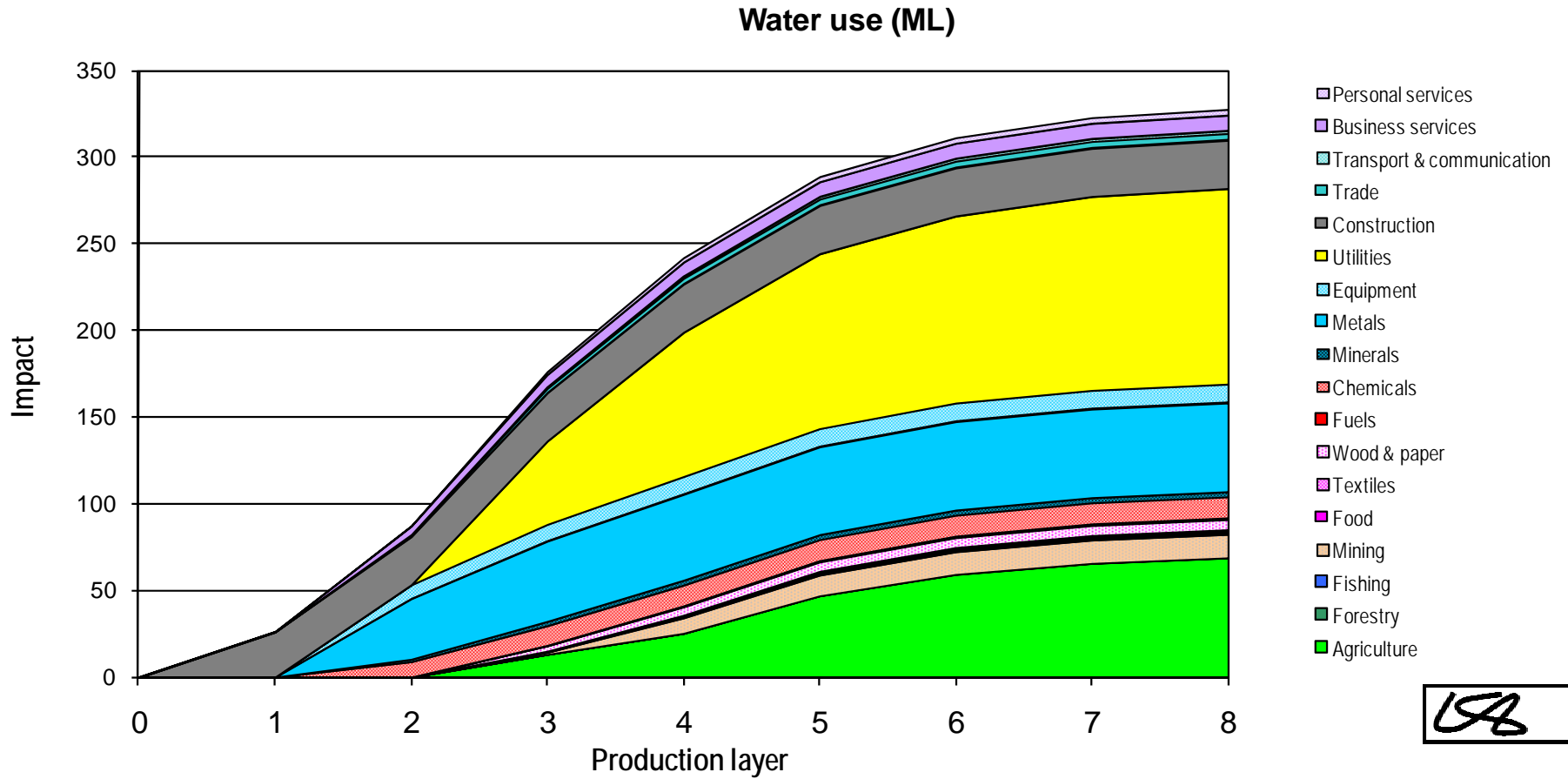


Figure 21: Cumulative Impact by layer – WSS Capital – Macquarie, Water Consumption

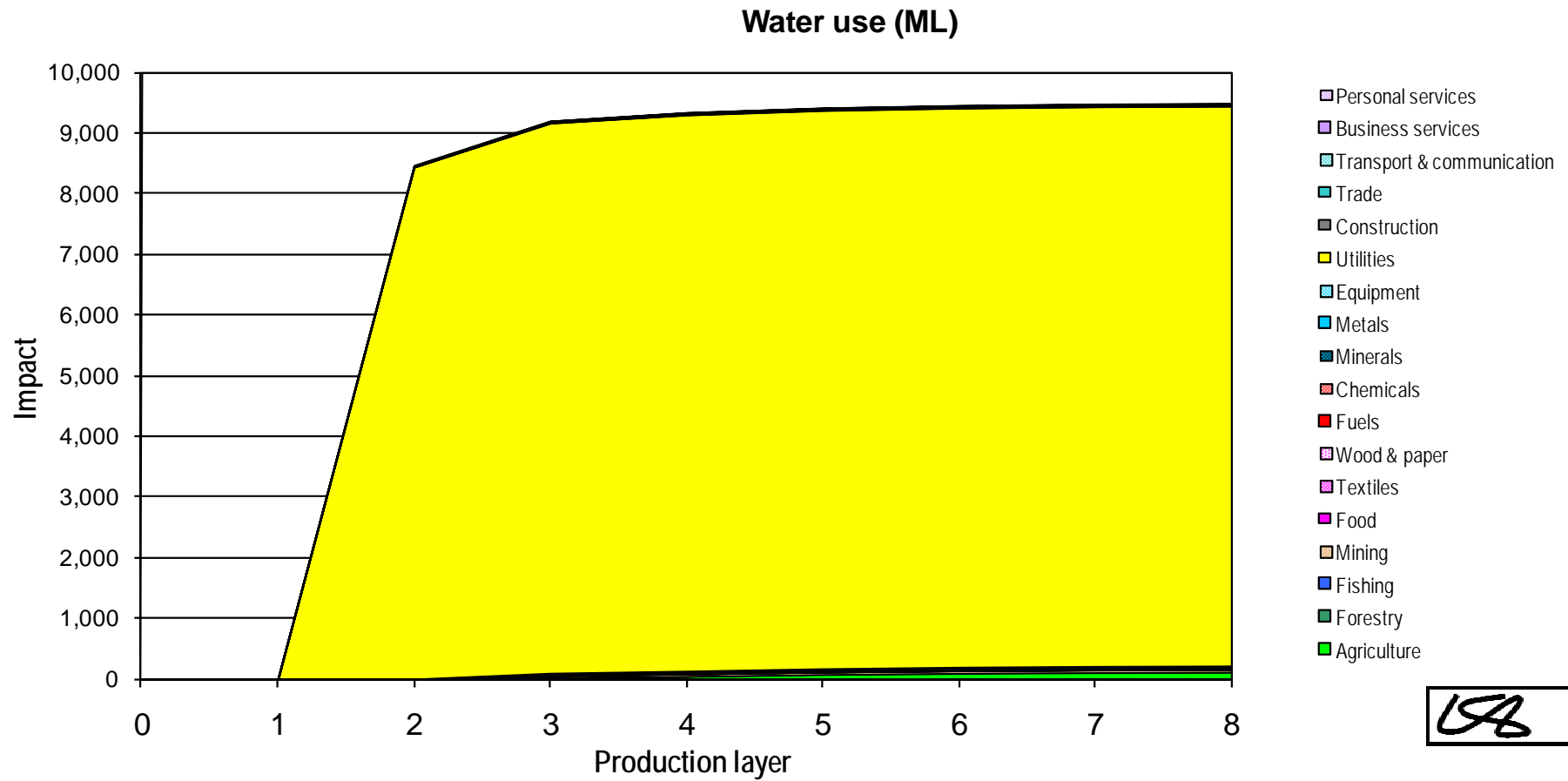


Figure 22: Cumulative Impact by layer – WSS Opex - Lachlan, Water Consumption

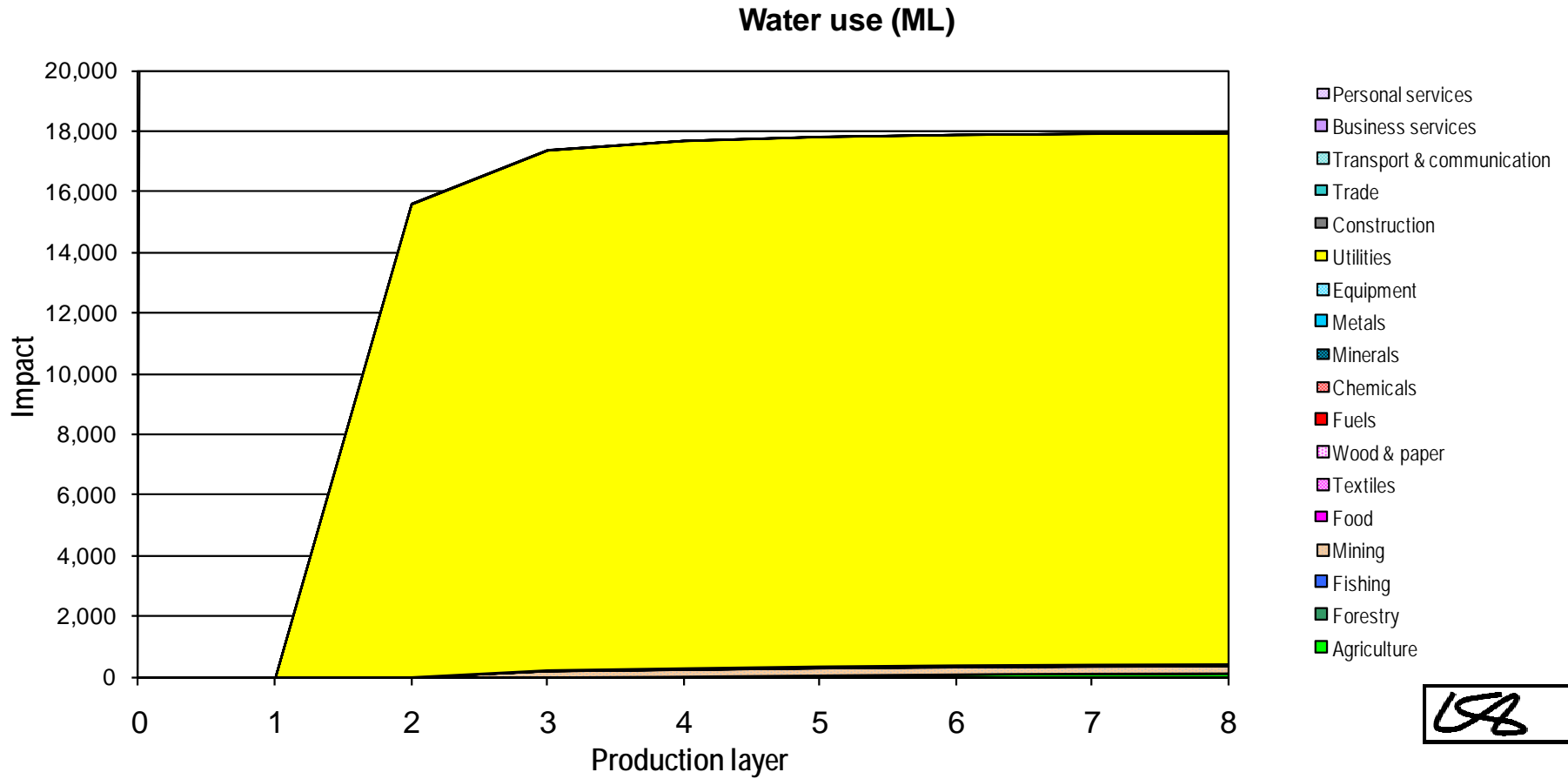


Figure 23: Cumulative Impact by layer – WSS Opex – Macquarie, Water Consumption

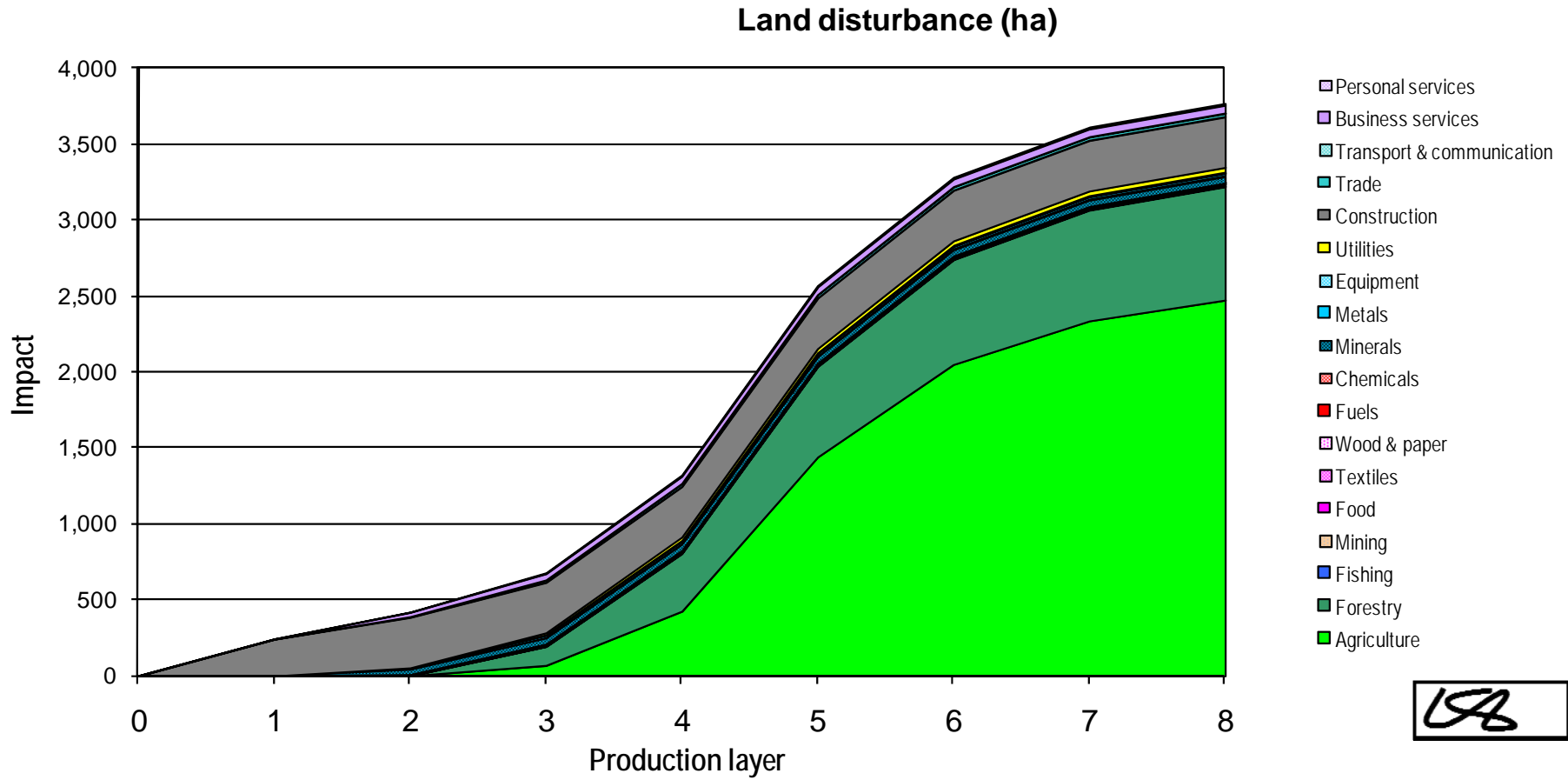



Figure 24: Cumulative Impact by layer – WSS Capital – Lachlan, Land Disturbance

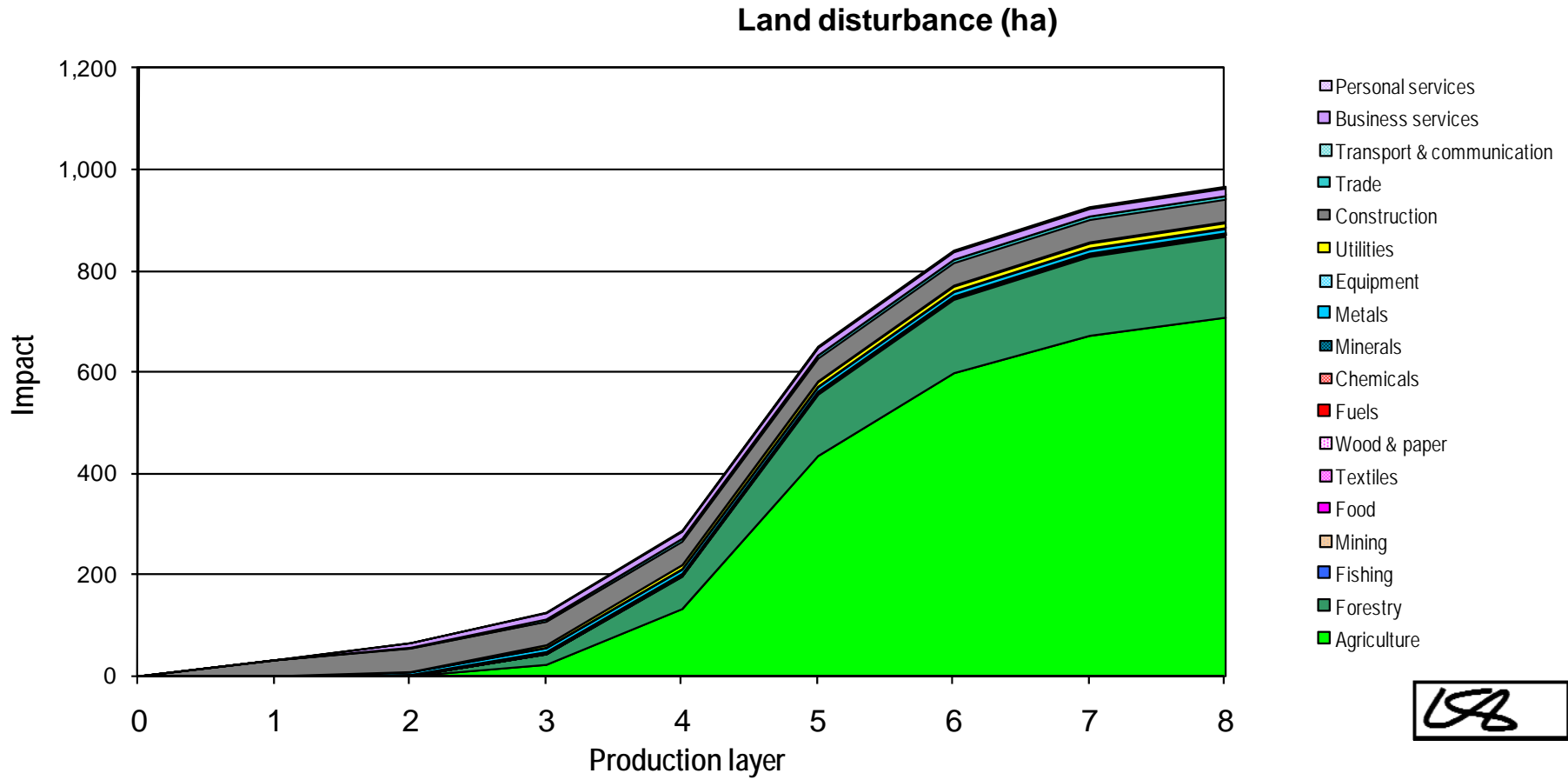


Figure 25: Cumulative Impact by layer – WSS Capital – Macquarie, Land Disturbance

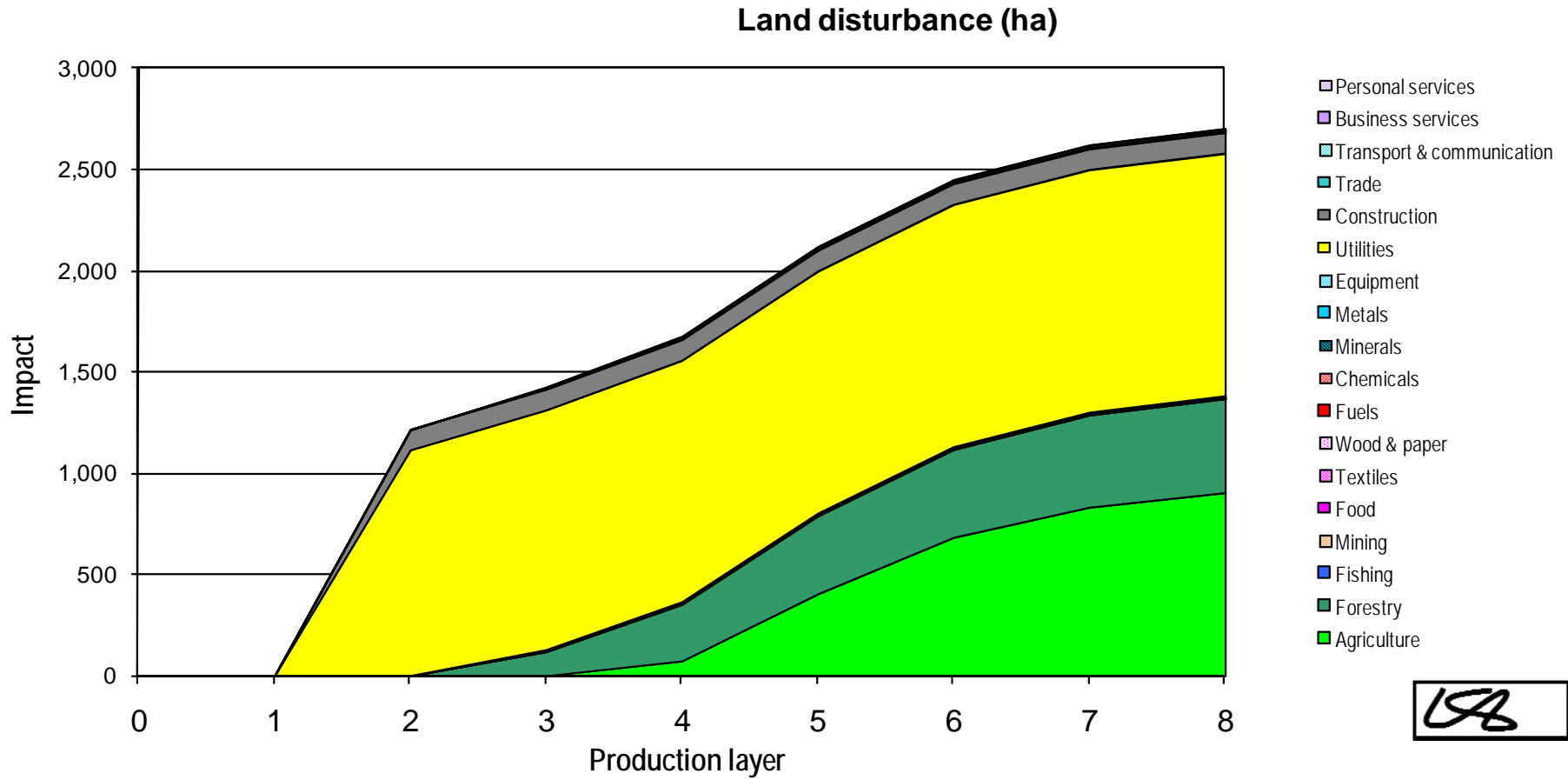


Figure 26: Cumulative Impact by layer – WSS Opex - Lachlan, Land Disturbance

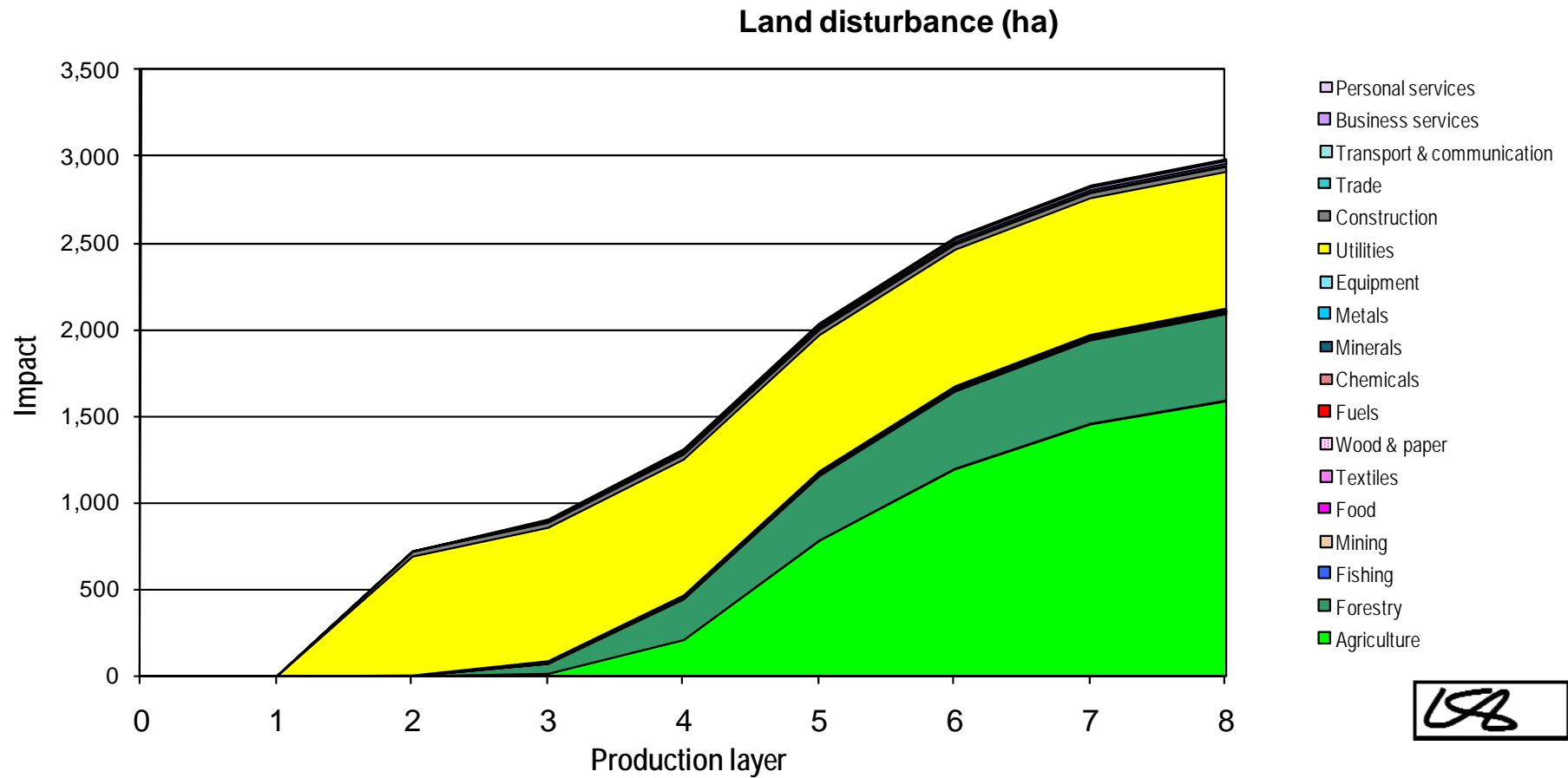


Figure 27: Cumulative Impact by layer – WSS Opex – Macquarie, Land Disturbance

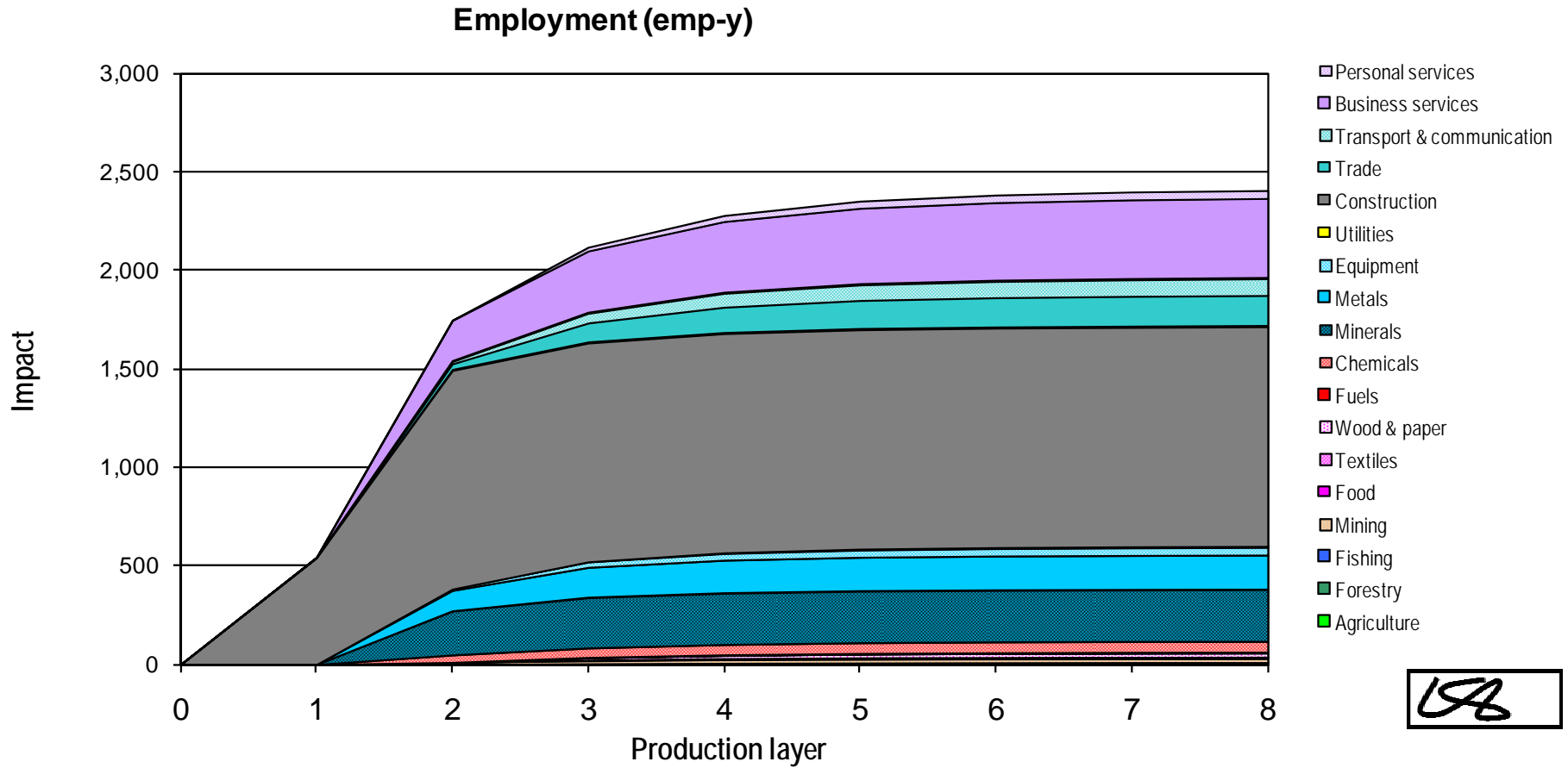


Figure 28: Cumulative Impact by layer – WSS Capital – Lachlan, Employment

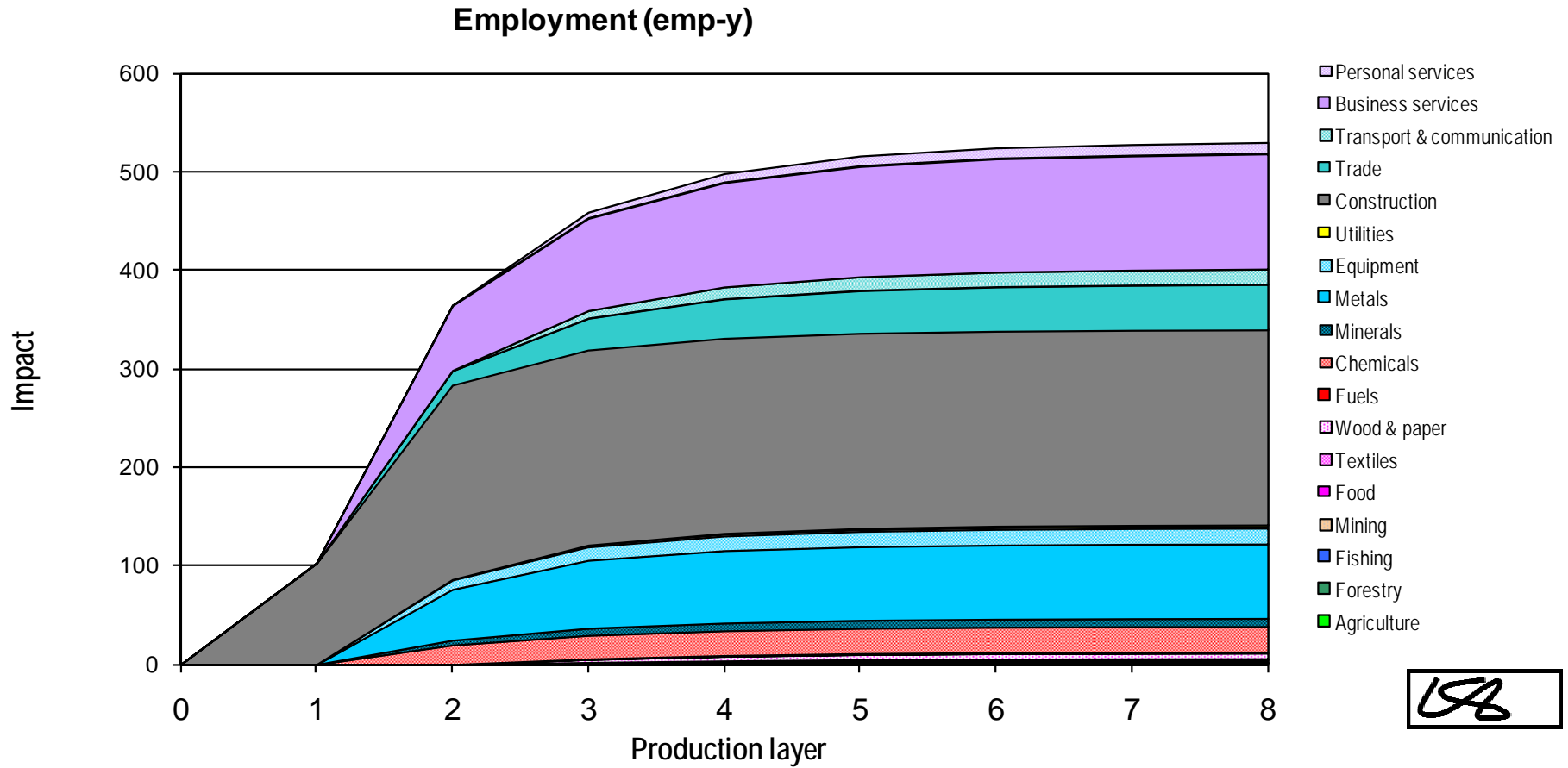


Figure 29: Cumulative Impact by layer – WSS Capital – Macquarie, Employment

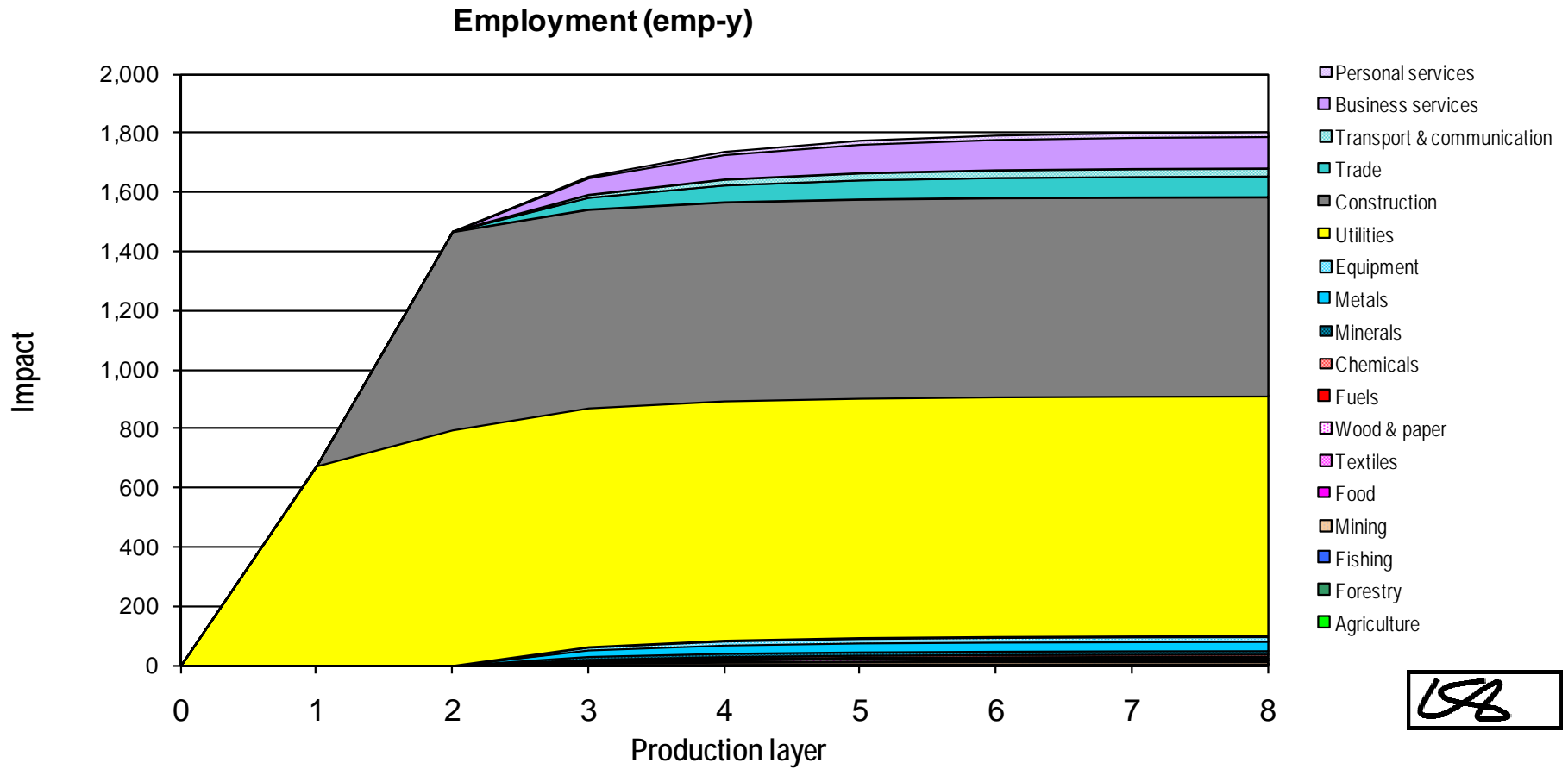


Figure 30: Cumulative Impact by layer – WSS Opex – Lachlan, Employment

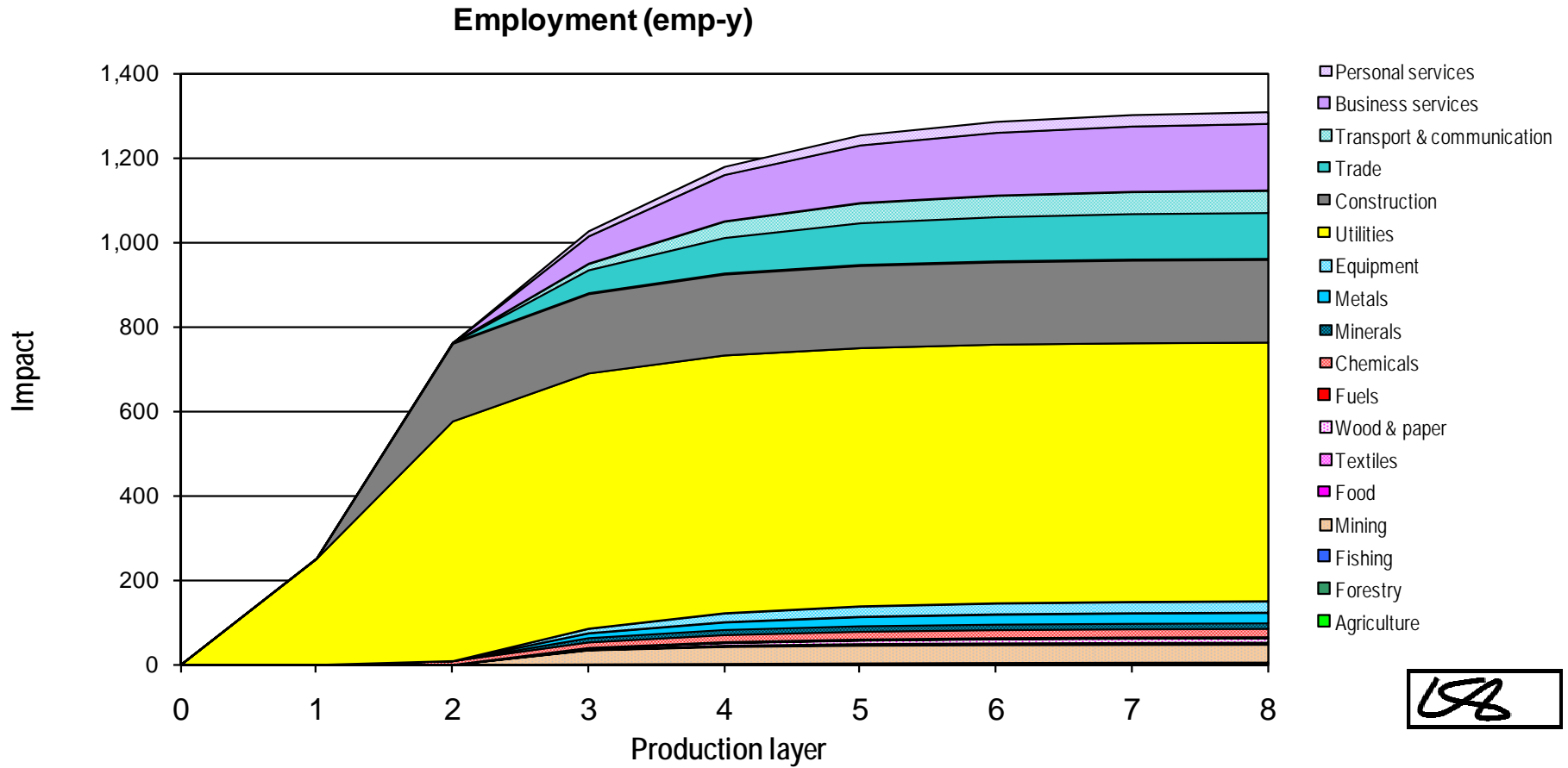


Figure 31: Cumulative Impact by layer – WSS Opex – Macquarie, Employment

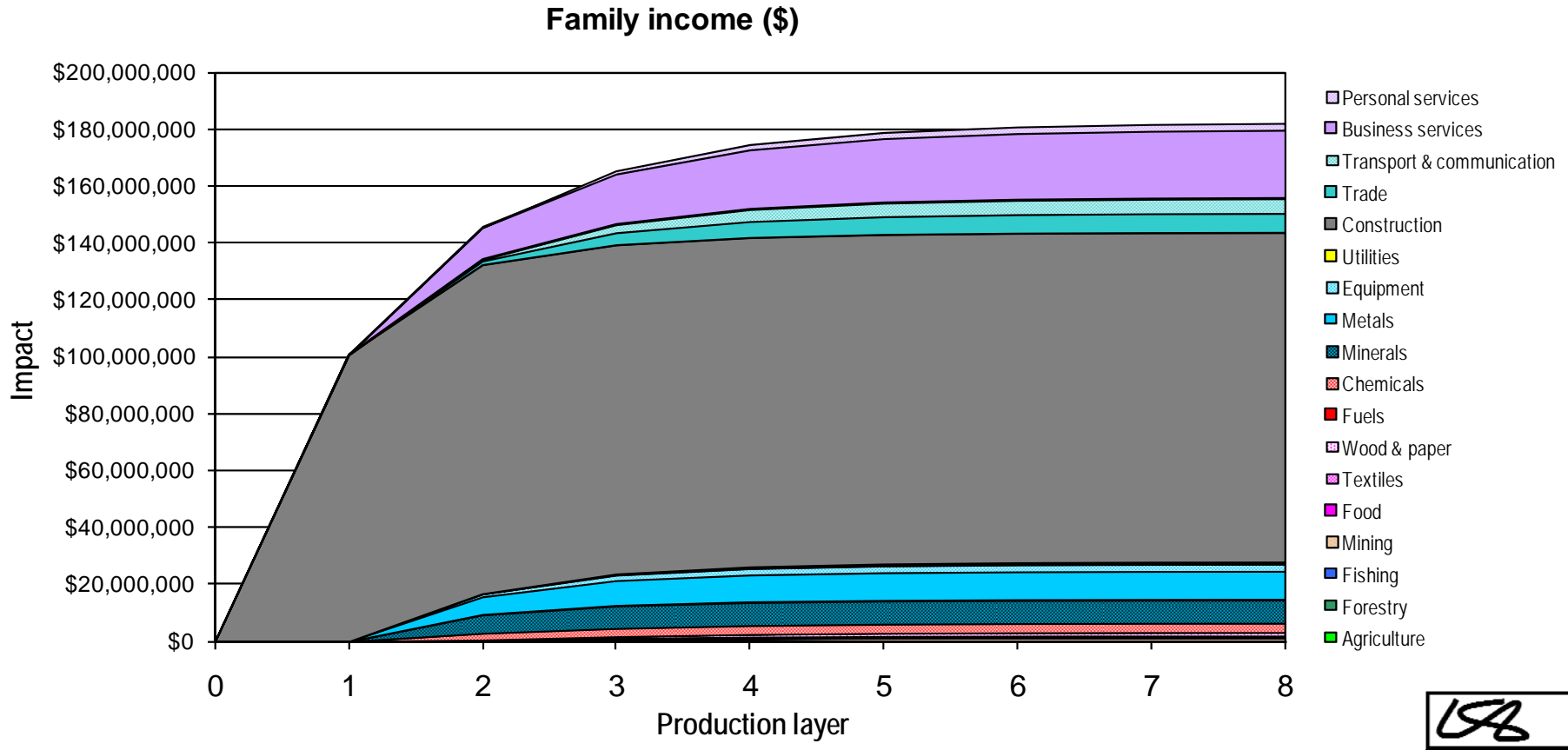


Figure 32: Cumulative Impact by layer – WSS Capital – Lachlan, Family Income

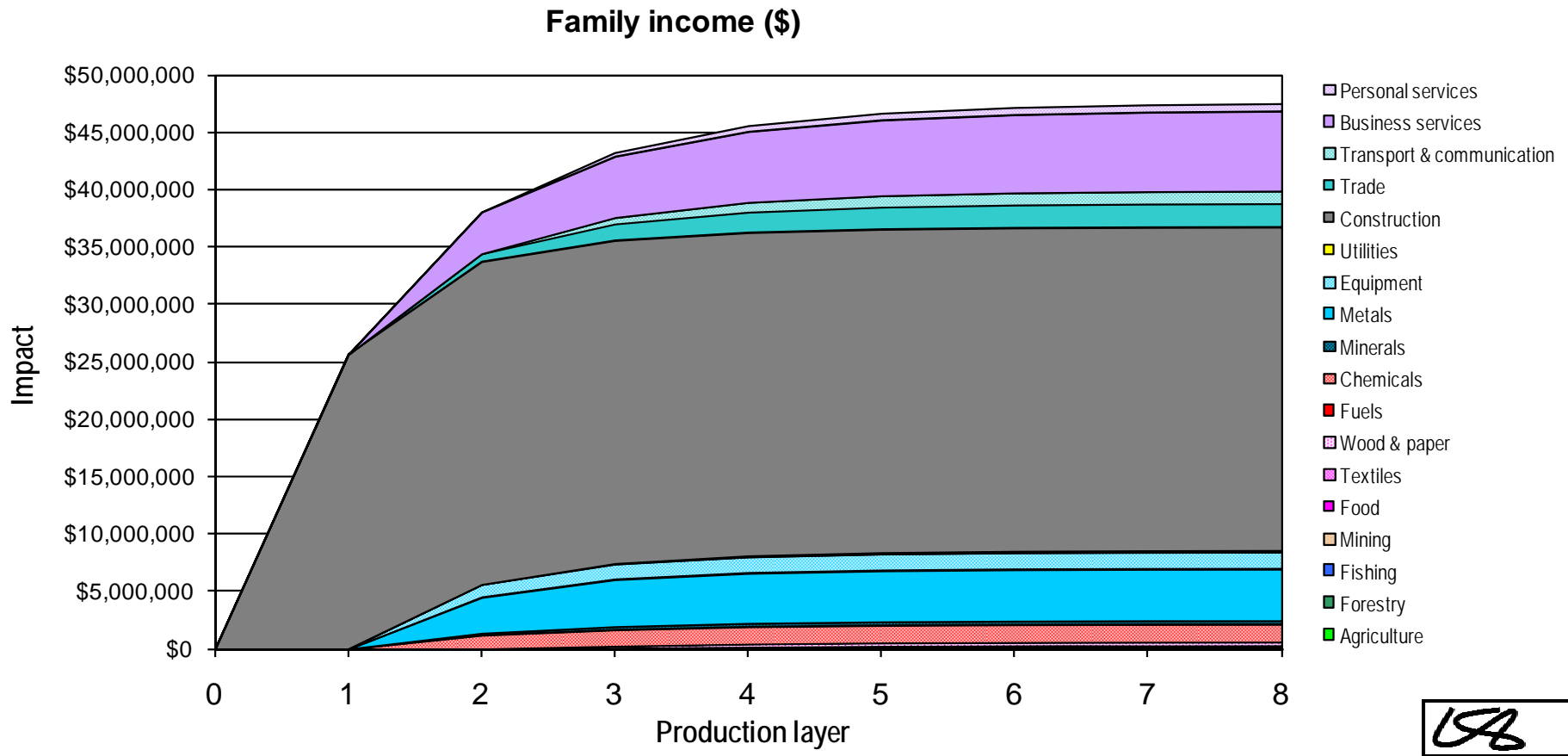


Figure 33: Cumulative Impact by layer – WSS Capital - Macquarie, Family Income

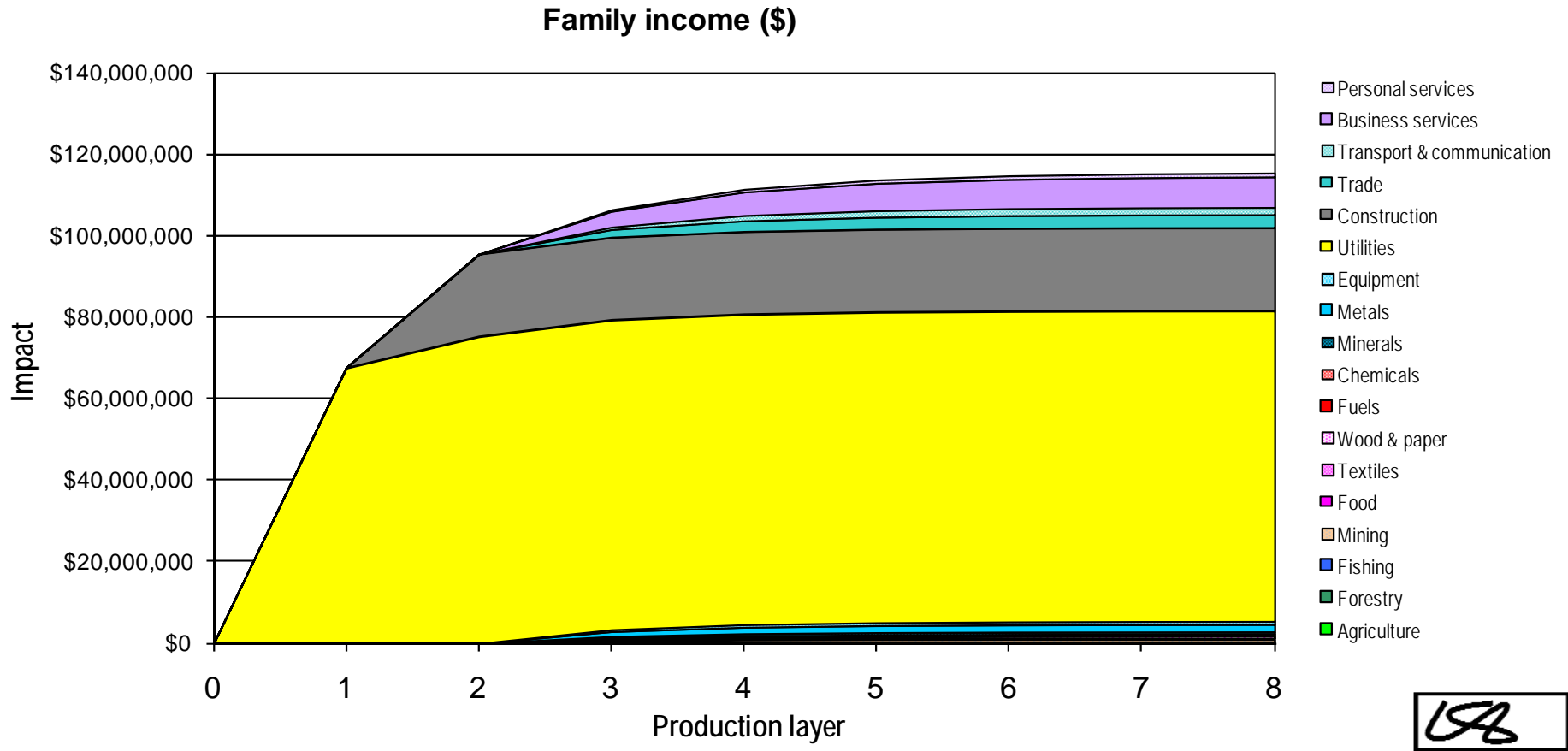


Figure 34: Cumulative Impact by layer – WSS Opex - Lachlan, Family Income

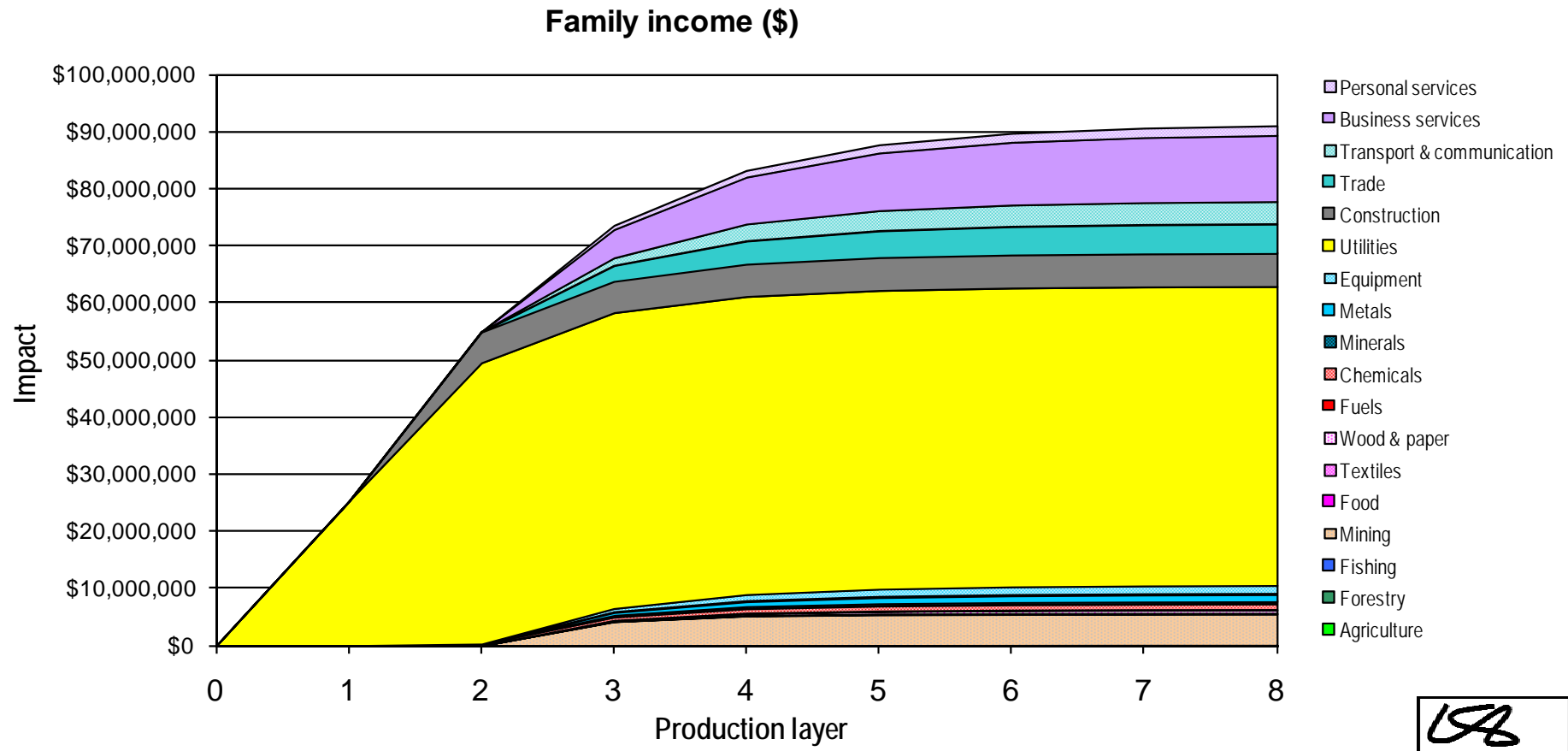



Figure 35: Cumulative Impact by layer – WSS Opex – Macquarie, Family Income

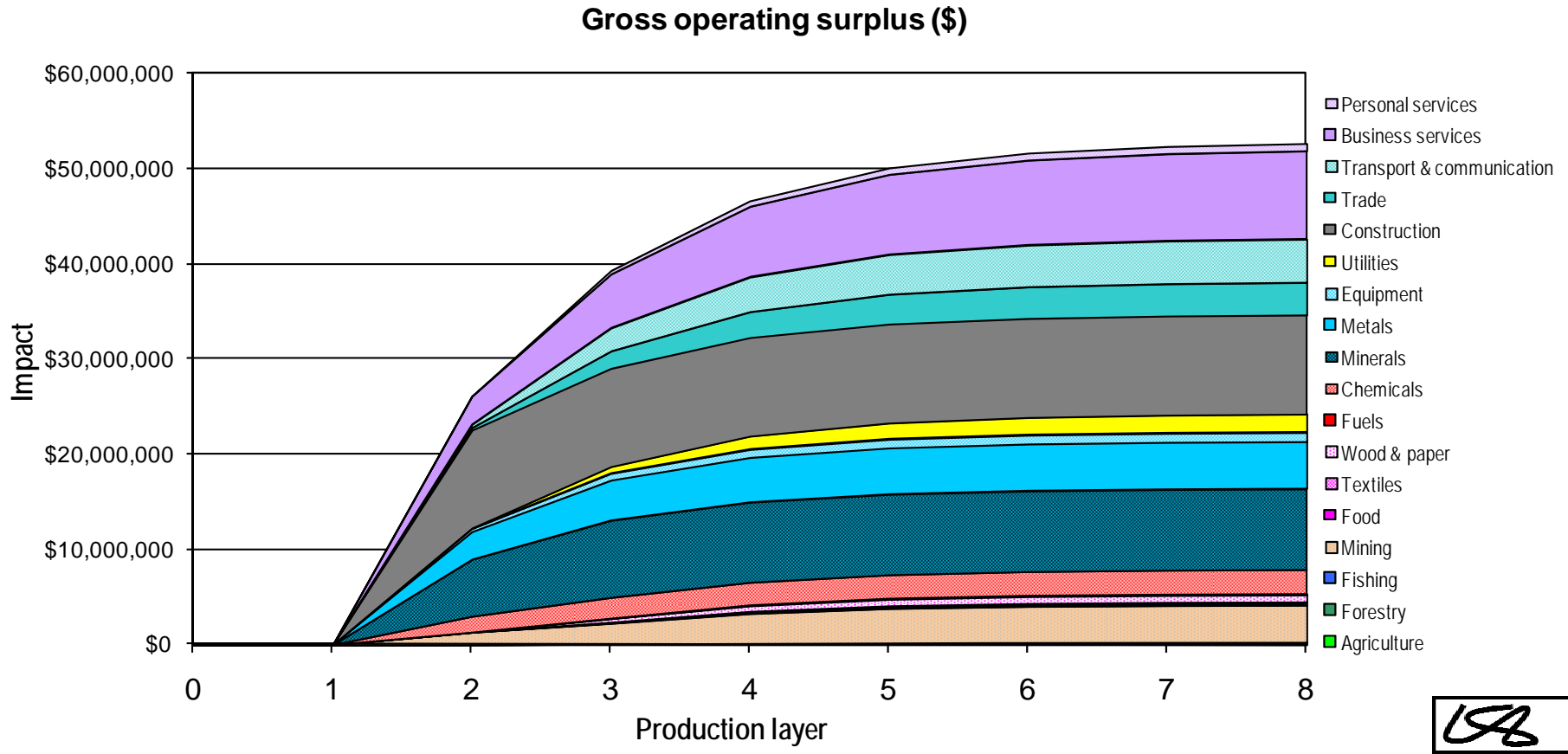


Figure 36: Cumulative Impact by layer – WSS Capital – Lachlan, Gross Operating Surplus

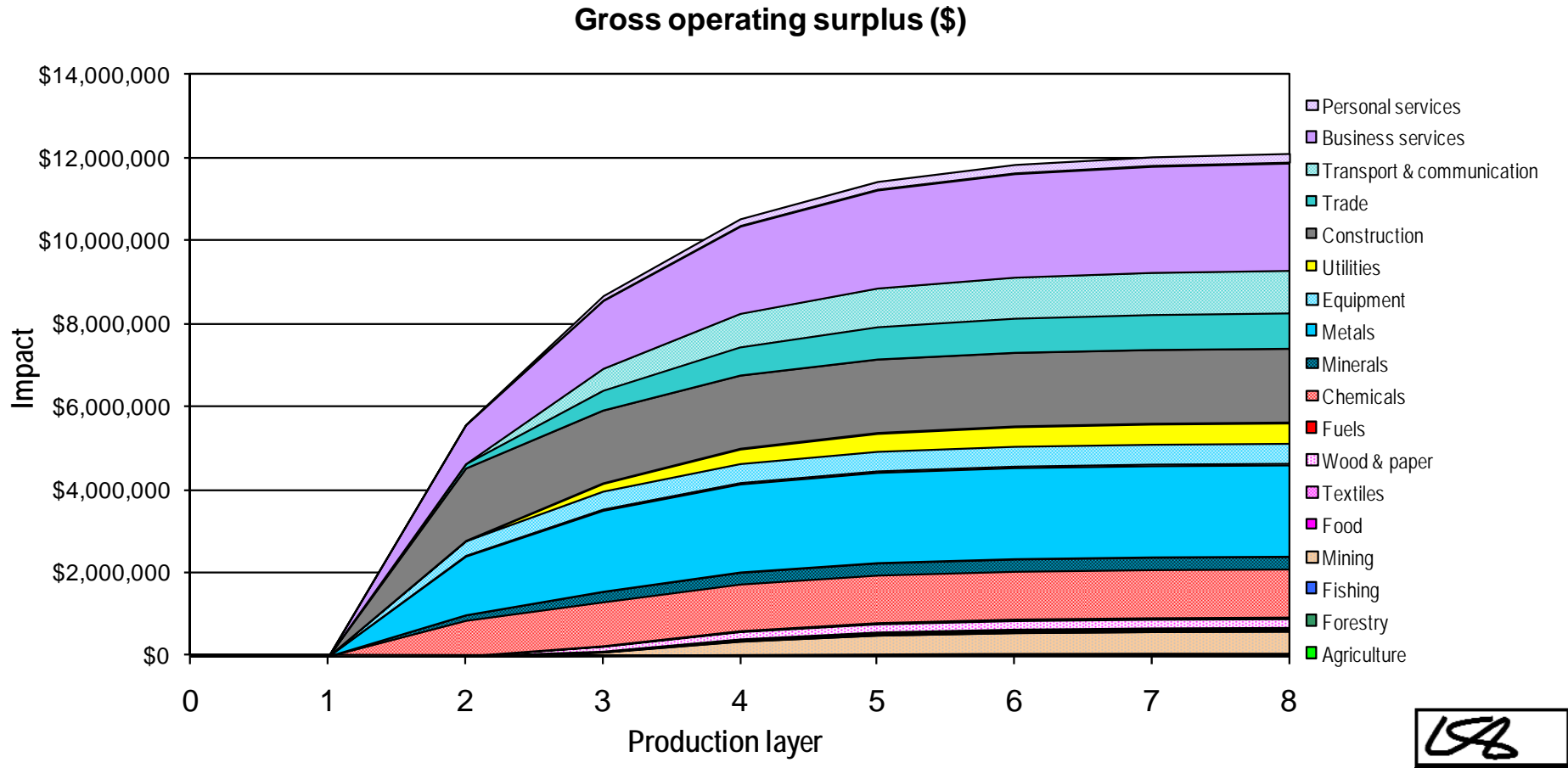


Figure 37: Cumulative Impact by layer – WSS Capital - Macquarie, Gross Operating Surplus

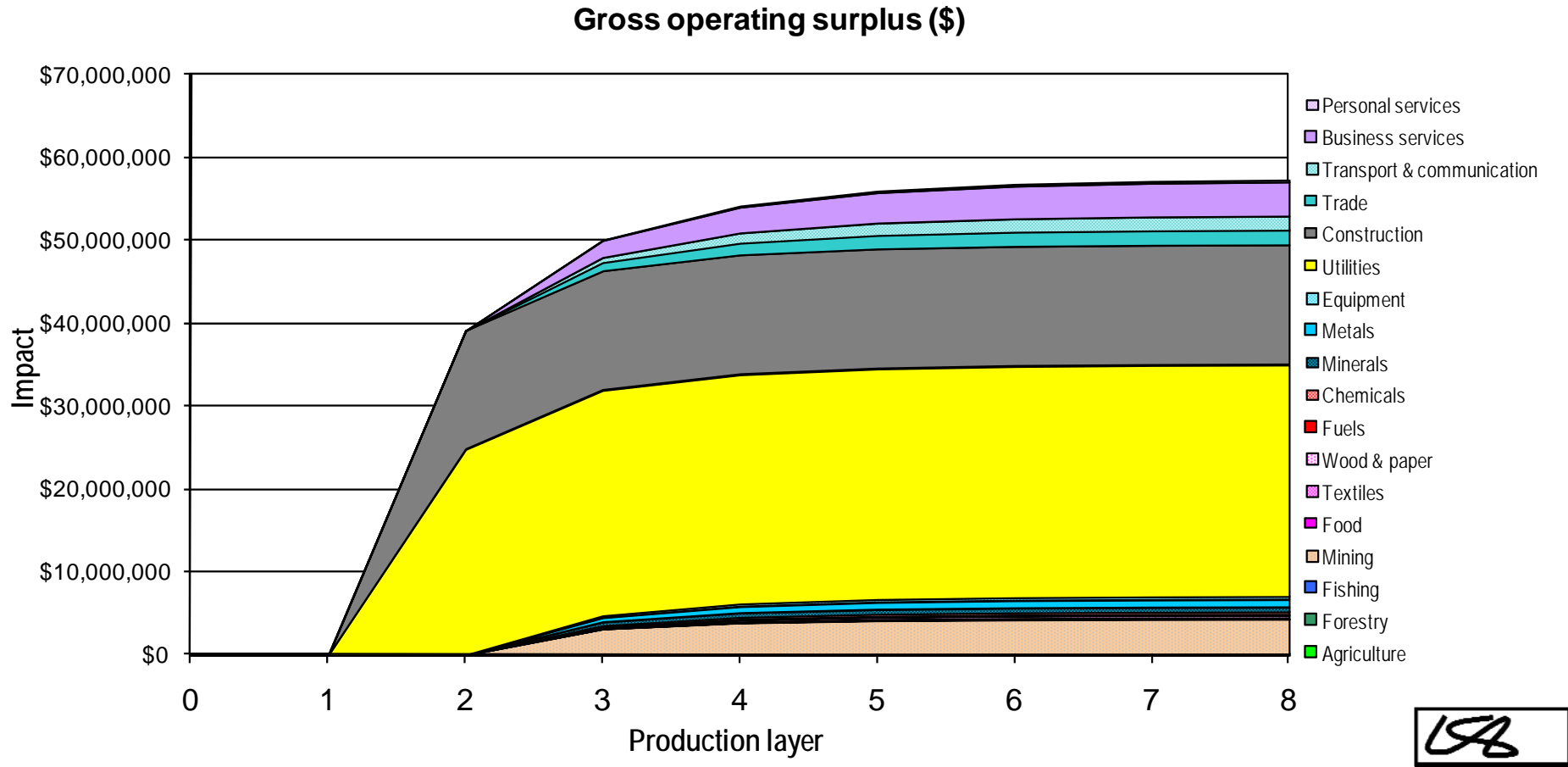


Figure 38: Cumulative Impact by layer – WSS Opex - Lachlan, Gross Operating Surplus

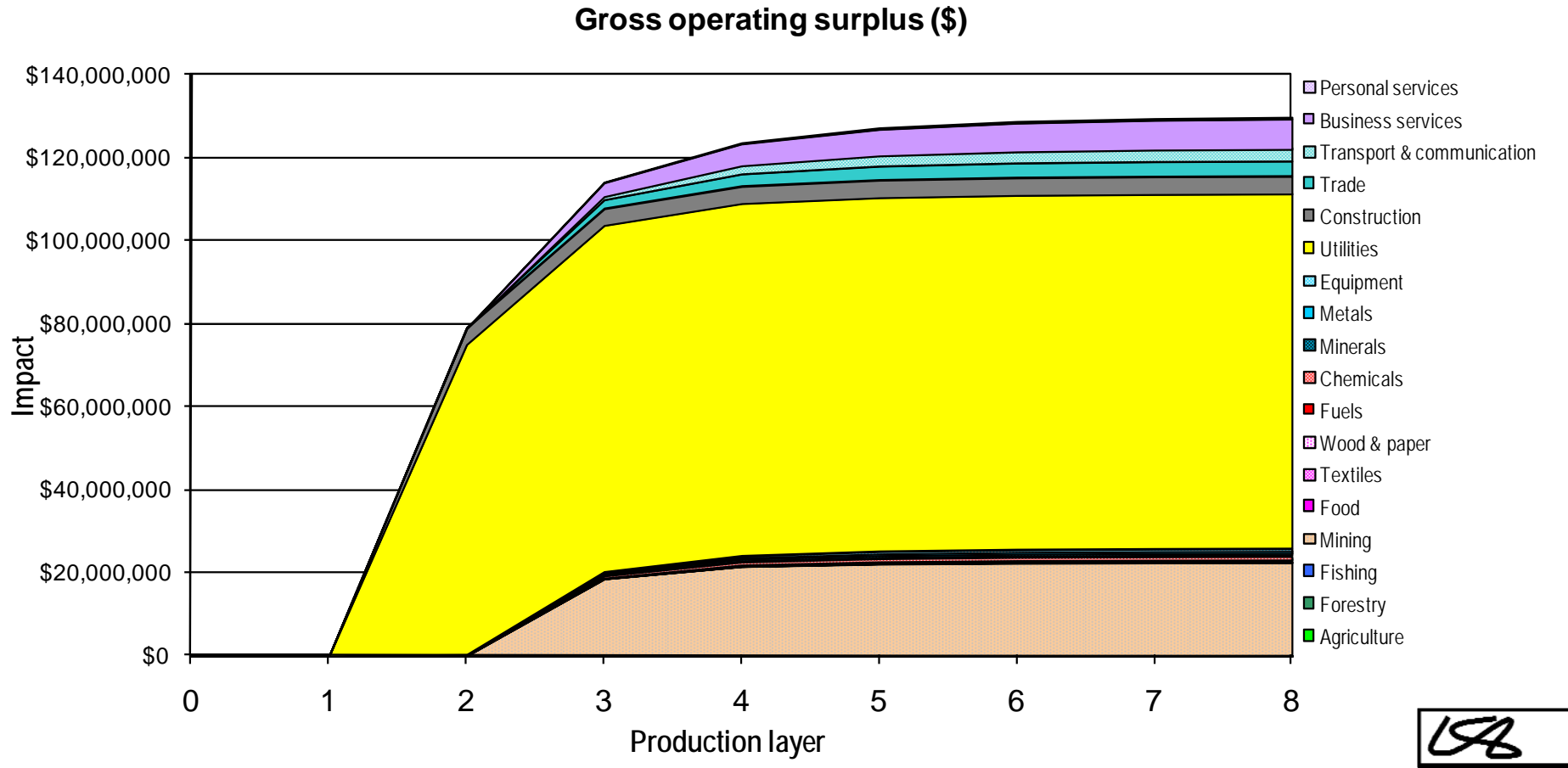


Figure 39: Cumulative Impact by layer – WSS Opex - Macquarie, Gross Operating Surplus

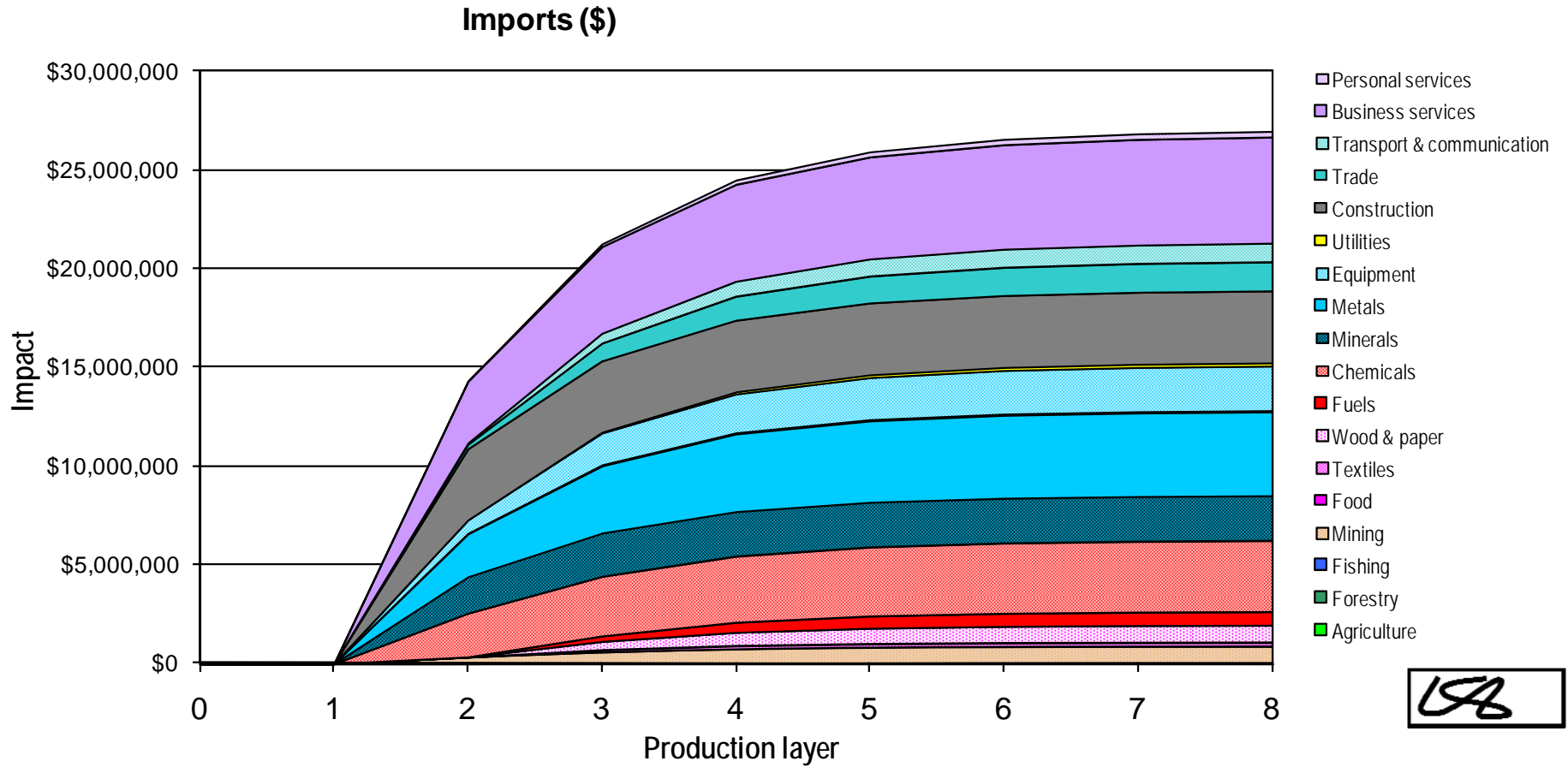


Figure 40: Cumulative Impact by layer – WSS Capital – Lachlan, Imports

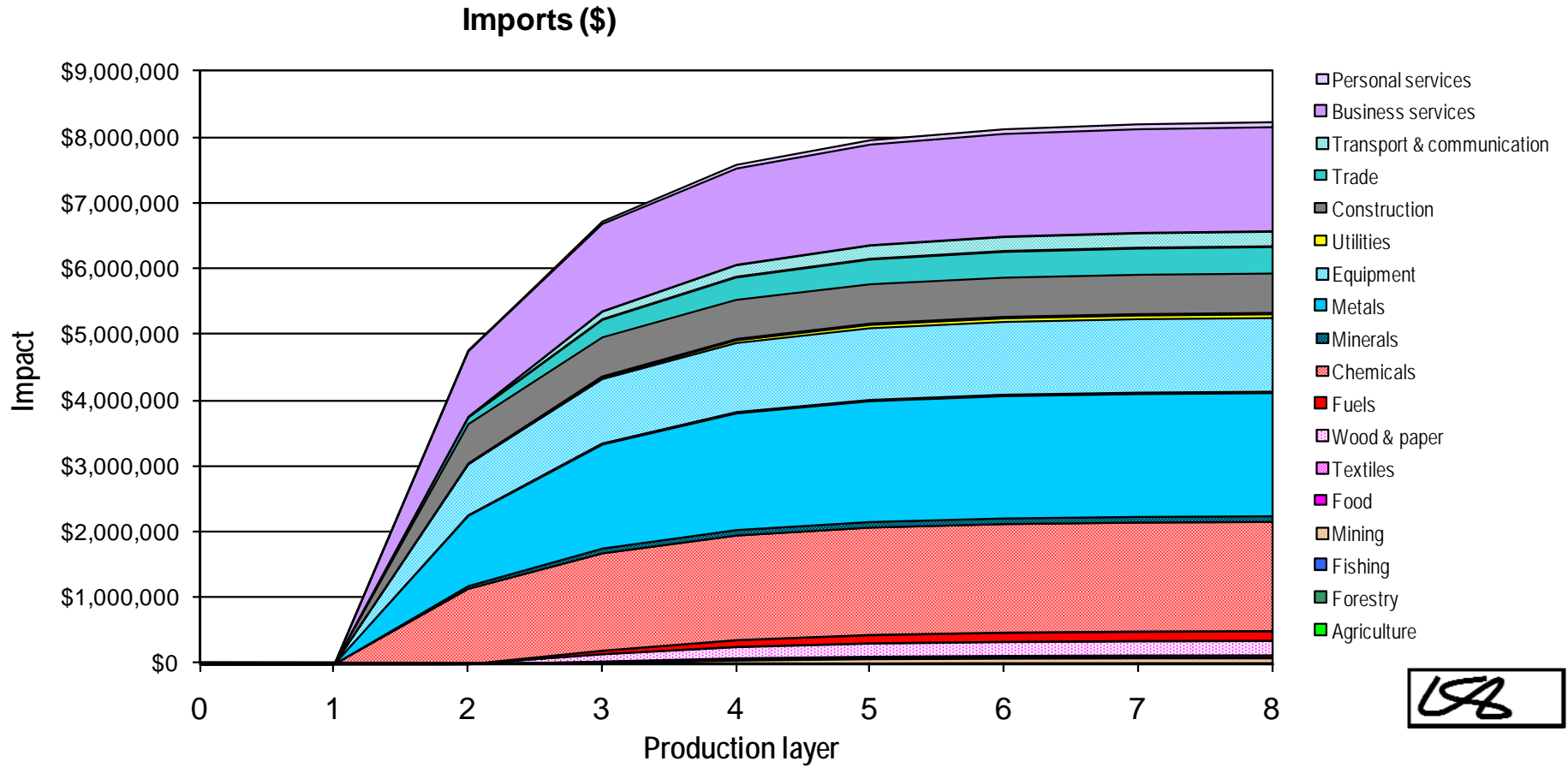
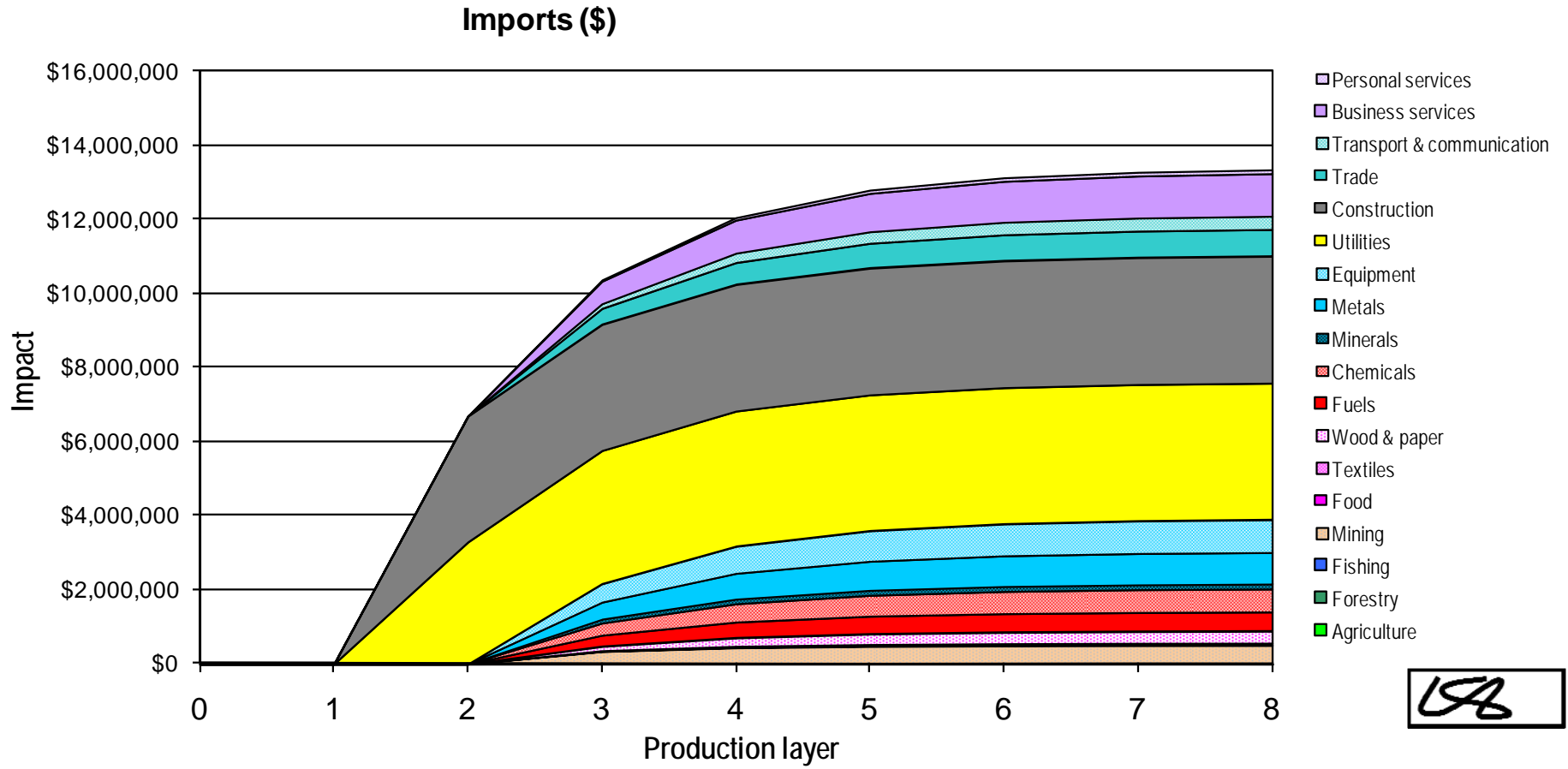


Figure 41: Cumulative Impact by layer – WSS Capital – Macquarie, Imports



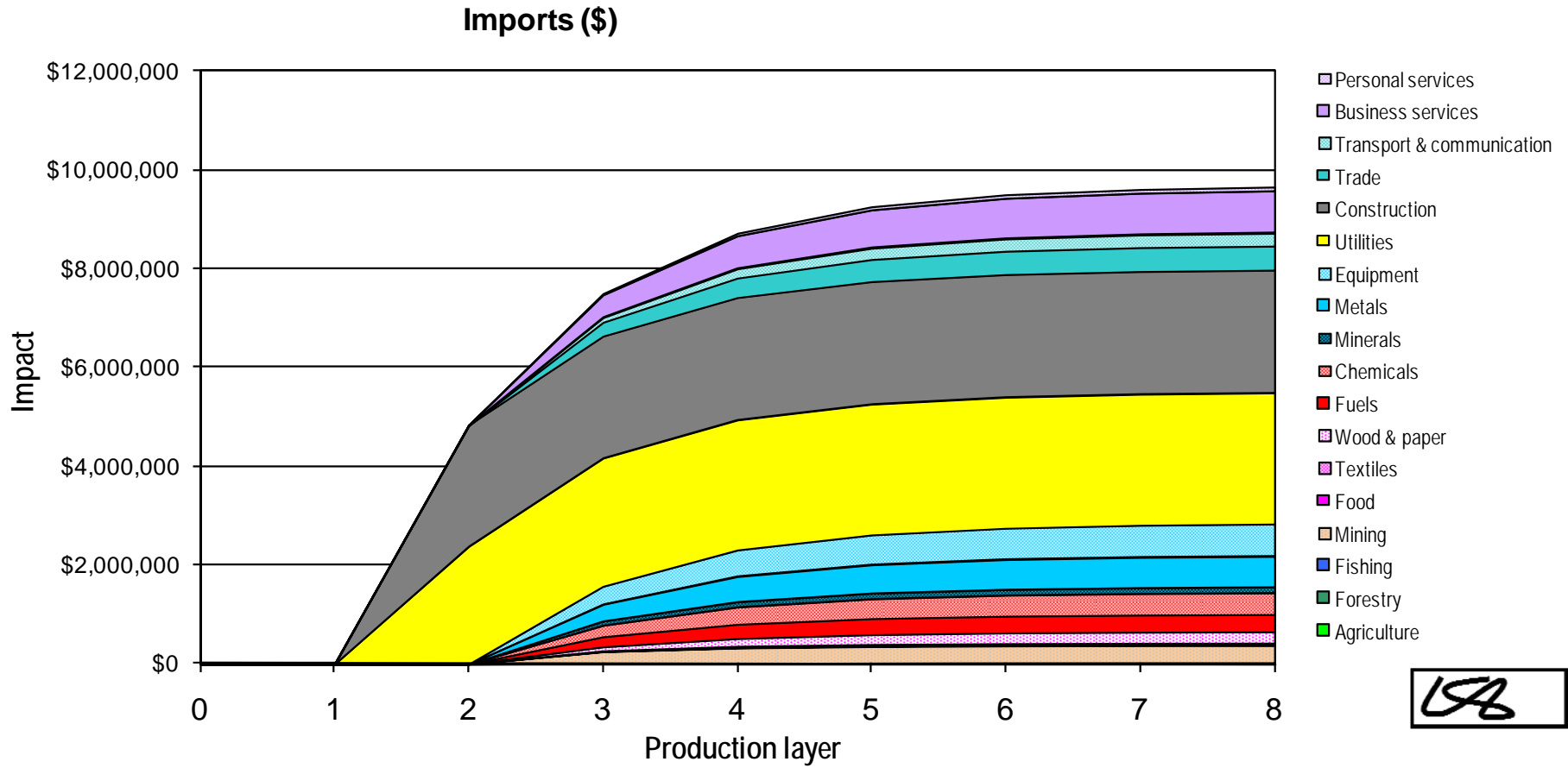


Figure 42: Cumulative Impact by layer – WSS Opex - Lachlan, Imports

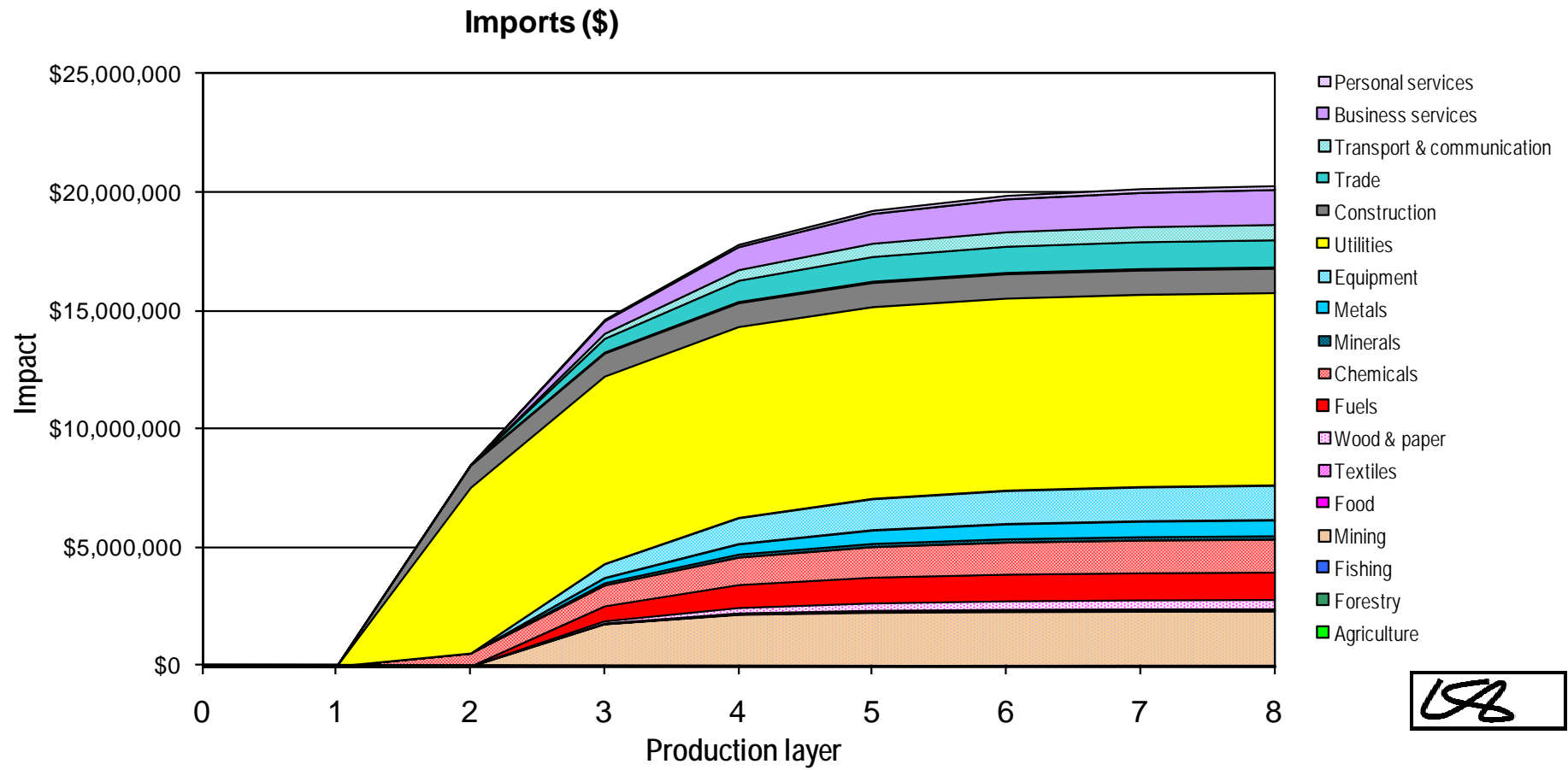


Figure 43: Cumulative Impact by layer – WSS Opex - Macquarie, Imports

## APPENDIX 3: RANKED STRUCTURAL PATHS

**Table 16: Ranked structural paths for WSS Capital: Total – Lachlan, Energy Consumption**

ENERGY CONSUMPTION				
RANK	PATH DESCRIPTION	PATH VALUE (PJ)	PATH ORDER	% OF TOTAL IMPACT
1	Concrete products > WSS Capital: Total – Lachlan	0.20	2	17.80%
2	Iron and steel semi-manufactures > Fabricated construction steel > WSS Capital: Total - Lachlan	0.11	3	9.42%
3	WSS Capital: Total - Lachlan	0.09	1	8.51%
4	Electricity supply > Concrete products > WSS Capital: Total - Lachlan	0.03	3	2.84%
5	Non-building construction > WSS Capital: Total - Lachlan	0.026	2	2.33%
6	Basic chemicals > Plastic products > WSS Capital: Total - Lachlan	0.026	3	2.29%
7	Iron and steel semi-manufactures > Iron and steel semi-manufactures > Fabricated construction steel > WSS Capital: Total - Lachlan	0.023	4	2.09%
8	Electricity supply > Computer and technical services > WSS Capital: Total - Lachlan	0.020	3	1.81%
9	Cement, lime > Concrete products > WSS Capital: Total - Lachlan	0.018	3	1.58%
10	Electricity supply > Iron and steel semi-manufactures > Fabricated construction steel > WSS Capital: Total - Lachlan	0.014	4	1.24%
11	Iron and steel semi-manufactures > Non-building construction > WSS Capital: Total - Lachlan	0.013	3	1.21%
12	Natural gas > Cement, lime > Concrete products > WSS Capital: Total - Lachlan	0.013	4	1.20%
13	Electricity supply > Fabricated construction steel > WSS Capital: Total - Lachlan	0.013	3	1.16%
14	Electricity supply > Plastic products > WSS Capital: Total - Lachlan	0.013	3	1.14%
15	Construction materials > WSS Capital: Total - Lachlan	0.011	2	0.97%
16	Electricity supply > Non-building construction > WSS Capital: Total - Lachlan	0.011	3	0.97%
17	Concrete products > Concrete products > WSS Capital: Total - Lachlan	0.011	3	0.96%
18	Electricity supply > Cement, lime > Concrete products > WSS Capital: Total - Lachlan	0.010	4	0.94%

ENERGY CONSUMPTION				
RANK	PATH DESCRIPTION	PATH VALUE (PJ)	PATH ORDER	% OF TOTAL IMPACT
19	Fabricated construction steel > WSS Capital: Total - Lachlan	0.010	2	0.90%
20	Road freight > Concrete products > WSS Capital: Total - Lachlan	0.010	3	0.89%
21	Road freight > WSS Capital: Total - Lachlan	0.010	2	0.87%
22	Wholesale trade > WSS Capital: Total - Lachlan	0.010	2	0.85%
23	Sand > Concrete products > WSS Capital: Total - Lachlan	0.006	3	0.56%
24	Iron and steel semi-manufactures > Pumps > WSS Capital: Total - Lachlan	0.005	3	0.47%
25	Iron and steel semi-manufactures > Iron and steel semi-manufactures > Iron and steel semi-manufactures > Fabricated construction steel > WSS Capital: Total - Lachlan	0.005	5	0.46%

**Table 17: Ranked structural paths for WSS Capital: Total – Macquarie, Energy Consumption**

ENERGY CONSUMPTION				
RANK	PATH DESCRIPTION	PATH VALUE (PJ)	PATH ORDER	% OF TOTAL IMPACT
1	Iron and steel semi-manufactures > Fabricated construction steel > WSS Capital: Total - Macquarie	0.05	3	18.60%
2	WSS Capital: Total - Macquarie	0.015	1	5.70%
3	Basic chemicals > Plastic products > WSS Capital: Total - Macquarie	0.013	3	5.12%
4	Iron and steel semi-manufactures > Iron and steel semi-manufactures > Fabricated construction steel > WSS Capital: Total - Macquarie	0.011	4	4.11%
5	Electricity supply > Plastic products > WSS Capital: Total - Macquarie	0.007	3	2.55%
6	Electricity supply > Computer and technical services > WSS Capital: Total - Macquarie	0.006	3	2.49%
7	Electricity supply > Iron and steel semi-manufactures > Fabricated construction steel > WSS Capital: Total - Macquarie	0.006	4	2.44%
8	Electricity supply > Fabricated construction steel > WSS Capital: Total - Macquarie	0.006	3	2.28%
9	Iron and steel semi-manufactures > Pumps > WSS Capital: Total - Macquarie	0.005	3	2.04%
10	Fabricated construction steel > WSS Capital: Total - Macquarie	0.005	2	1.76%

ENERGY CONSUMPTION				
RANK	PATH DESCRIPTION	PATH VALUE (PJ)	PATH ORDER	% OF TOTAL IMPACT
11	Concrete products > WSS Capital: Total - Macquarie	0.004	2	1.69%
12	Non-building construction > WSS Capital: Total - Macquarie	0.004	2	1.68%
13	Wholesale trade > WSS Capital: Total - Macquarie	0.004	2	1.58%
14	Iron and steel semi-manufactures > Fabricated metal products > WSS Capital: Total - Macquarie	0.0026	3	1.00%
15	Iron and steel semi-manufactures > Iron and steel semi-manufactures > Iron and steel semi-manufactures > Fabricated construction steel > WSS Capital: Total - Macquarie	0.0024	5	0.91%
16	Electricity supply > Pumps > WSS Capital: Total - Macquarie	0.0023	3	0.89%
17	Iron and steel semi-manufactures > Non-building construction > WSS Capital: Total - Macquarie	0.0023	3	0.87%
18	Iron and steel semi-manufactures > Fabricated construction steel > Fabricated construction steel > WSS Capital: Total - Macquarie	0.0020	4	0.77%
19	Electricity supply > Non-building construction > WSS Capital: Total - Macquarie	0.0018	3	0.70%
20	Basic chemicals > Basic chemicals > Plastic products > WSS Capital: Total - Macquarie	0.0015	4	0.57%
21	Gases > Fabricated construction steel > WSS Capital: Total - Macquarie	0.0014	3	0.55%
22	Electricity supply > Iron and steel semi-manufactures > Iron and steel semi-manufactures > Fabricated construction steel > WSS Capital: Total - Macquarie	0.0014	5	0.54%
23	Iron and steel semi-manufactures > Iron and steel semi-manufactures > Pumps > WSS Capital: Total - Macquarie	0.0012	4	0.45%
24	Precious metals > Iron and steel semi-manufactures > Fabricated construction steel > WSS Capital: Total - Macquarie	0.0011	4	0.43%
25	Electricity supply > Fabricated metal products > WSS Capital: Total - Macquarie	0.0011	3	0.42%

**Table 18: Ranked structural paths for WSS Opex: Total – Lachlan, Energy Consumption**

ENERGY CONSUMPTION				
RANK	PATH DESCRIPTION	PATH VALUE (PJ)	PATH ORDER	% OF TOTAL IMPACT
1	Electricity supply > WSS Opex: Total - Lachlan	2.34	2	79.30%
2	Electricity supply > Electricity supply > WSS Opex: Total - Lachlan	0.21	3	6.98%

ENERGY CONSUMPTION				
RANK	PATH DESCRIPTION	PATH VALUE (PJ)	PATH ORDER	% OF TOTAL IMPACT
3	Electricity supply > Water supply; sewerage and drainage services > WSS Opex: Total - Lachlan	0.07	3	2.25%
4	Non-building repair > WSS Opex: Total - Lachlan	0.031	2	1.06%
5	Natural gas > Electricity supply > WSS Opex: Total - Lachlan	0.020	3	0.67%
6	Electricity supply > Electricity supply > Electricity supply > WSS Opex: Total - Lachlan	0.018	4	0.61%
7	Iron and steel semi-manufactures > Non-building repair > WSS Opex: Total - Lachlan	0.015	3	0.51%
8	Electricity supply > Non-building repair > WSS Opex: Total - Lachlan	0.012	3	0.40%
9	Brown coal > Electricity supply > WSS Opex: Total - Lachlan	0.009	3	0.30%
10	Electricity supply > Electricity supply > Water supply; sewerage and drainage services > WSS Opex: Total - Lachlan	0.006	4	0.20%
11	Concrete products > Non-building repair > WSS Opex: Total - Lachlan	0.005	3	0.17%
12	Electricity supply > Black coal > Electricity supply > WSS Opex: Total - Lachlan	0.005	4	0.16%
13	Basic chemicals > Water supply; sewerage and drainage services > WSS Opex: Total - Lachlan	0.004	3	0.15%
14	Water supply; sewerage and drainage services > WSS Opex: Total - Lachlan	0.004	2	0.14%
15	Iron and steel semi-manufactures > Fabricated construction steel > Non-building repair > WSS Opex: Total - Lachlan	0.004	4	0.12%
16	Electricity supply > Water supply; sewerage and drainage services > Water supply; sewerage and drainage services > WSS Opex: Total - Lachlan	0.004	4	0.12%
17	Wholesale trade > Non-building repair > WSS Opex: Total - Lachlan	0.004	3	0.12%
18	Iron and steel semi-manufactures > Iron and steel semi-manufactures > Non-building repair > WSS Opex: Total - Lachlan	0.003	4	0.11%
19	Black coal > Electricity supply > WSS Opex: Total - Lachlan	0.0027	3	0.09%
20	Natural gas > Gas supply > Electricity supply > WSS Opex: Total - Lachlan	0.0027	4	0.09%
21	Gas supply > Electricity supply > WSS Opex: Total - Lachlan	0.0026	3	0.09%

ENERGY CONSUMPTION				
RANK	PATH DESCRIPTION	PATH VALUE (PJ)	PATH ORDER	% OF TOTAL IMPACT
22	Iron and steel semi-manufactures > Fabricated metal products > Non-building repair > WSS Opex: Total - Lachlan	0.0021	4	0.07%
23	Road freight > Non-building repair > WSS Opex: Total - Lachlan	0.0021	3	0.07%
24	Electricity supply > Iron and steel semi-manufactures > Non-building repair > WSS Opex: Total - Lachlan	0.0020	4	0.07%
25	Motor vehicle and lawn mower repairs > Non-building repair > WSS Opex: Total - Lachlan	0.0019	3	0.07%

**Table 19: Ranked structural paths for WSS Opex: Total – Macquarie, Energy Consumption**

ENERGY CONSUMPTION				
RANK	PATH DESCRIPTION	PATH VALUE (PJ)	PATH ORDER	% OF TOTAL IMPACT
1	Electricity supply > WSS Opex: Total - Macquarie	15.0	2	87.30%
2	Electricity supply > Electricity supply > WSS Opex: Total - Macquarie	1.32	3	7.68%
3	Natural gas > Electricity supply > WSS Opex: Total - Macquarie	0.13	3	0.74%
4	Electricity supply > Electricity supply > Electricity supply > WSS Opex: Total - Macquarie	0.12	4	0.68%
5	Basic chemicals > WSS Opex: Total - Macquarie	0.08	2	0.44%
6	Brown coal > Electricity supply > WSS Opex: Total - Macquarie	0.06	3	0.33%
7	Electricity supply > Black coal > Electricity supply > WSS Opex: Total - Macquarie	0.029	4	0.17%
8	Electricity supply > Water supply; sewerage and drainage services > WSS Opex: Total - Macquarie	0.027	3	0.16%
9	Black coal > Electricity supply > WSS Opex: Total - Macquarie	0.017	3	0.10%
10	Natural gas > Gas supply > Electricity supply > WSS Opex: Total - Macquarie	0.017	4	0.10%
11	Gas supply > Electricity supply > WSS Opex: Total - Macquarie	0.017	3	0.10%
12	Electricity supply > LPG, LNG > Electricity supply > WSS Opex: Total - Macquarie	0.012	4	0.07%
13	Natural gas > Electricity supply > Electricity supply > WSS Opex: Total - Macquarie	0.011	4	0.07%

ENERGY CONSUMPTION				
RANK	PATH DESCRIPTION	PATH VALUE (PJ)	PATH ORDER	% OF TOTAL IMPACT
14	Electricity supply > Electricity supply > Electricity supply > Electricity supply > WSS Opex: Total - Macquarie	0.010	5	0.06%
15	Non-building repair > WSS Opex: Total - Macquarie	0.009	2	0.05%
16	Basic chemicals > Basic chemicals > WSS Opex: Total - Macquarie	0.009	3	0.05%
17	Concrete products > Electricity supply > WSS Opex: Total - Macquarie	0.007	3	0.04%
18	LPG, LNG > Electricity supply > WSS Opex: Total - Macquarie	0.007	3	0.04%
19	Kerosene > Electricity supply > WSS Opex: Total - Macquarie	0.006	3	0.04%
20	Wholesale trade > Electricity supply > WSS Opex: Total - Macquarie	0.005	3	0.03%
21	Motor vehicle and lawn mower repairs > Electricity supply > WSS Opex: Total - Macquarie	0.005	3	0.03%
22	Brown coal > Electricity supply > Electricity supply > WSS Opex: Total - Macquarie	0.005	4	0.03%
23	Electricity supply > Railway freight transport services > Black coal > Electricity supply > WSS Opex: Total - Macquarie	0.005	5	0.03%
24	Railway freight transport services > Black coal > Electricity supply > WSS Opex: Total - Macquarie	0.005	4	0.03%
25	Iron and steel semi-manufactures > Non-building repair > WSS Opex: Total - Macquarie	0.004	3	0.02%

**Table 20: Ranked structural paths for WSS Capital: Total – Lachlan, Greenhouse Gas Emissions**

GREENHOUSE GAS EMISSIONS				
RANK	PATH DESCRIPTION	PATH VALUE (T CO2-E)	PATH ORDER	% OF TOTAL IMPACT
1	Concrete products > WSS Capital: Total - Lachlan	14,088	2	13.30%
2	Cement, lime > Concrete products > WSS Capital: Total - Lachlan	9,115	3	8.58%
3	WSS Capital: Total - Lachlan	8,953	1	8.42%
4	Iron and steel semi-manufactures > Fabricated construction steel > WSS Capital: Total - Lachlan	6,199	3	5.83%
5	Electricity supply > Concrete products > WSS Capital: Total - Lachlan	2,798	3	2.63%

GREENHOUSE GAS EMISSIONS				
RANK	PATH DESCRIPTION	PATH VALUE (T CO <sub>2</sub> -E)	PATH ORDER	% OF TOTAL IMPACT
6	Electricity supply > Computer and technical services > WSS Capital: Total - Lachlan	1,783	3	1.68%
7	Non-building construction > WSS Capital: Total - Lachlan	1,773	2	1.67%
8	Natural gas > Cement, lime > Concrete products > WSS Capital: Total - Lachlan	1,728	4	1.63%
9	Iron and steel semi-manufactures > Iron and steel semi-manufactures > Fabricated construction steel > WSS Capital: Total - Lachlan	1,373	4	1.29%
10	Electricity supply > Iron and steel semi-manufactures > Fabricated construction steel > WSS Capital: Total - Lachlan	1,220	4	1.15%
11	Electricity supply > Fabricated construction steel > WSS Capital: Total - Lachlan	1,139	3	1.07%
12	Electricity supply > Plastic products > WSS Capital: Total - Lachlan	1,123	3	1.06%
13	Electricity supply > Non-building construction > WSS Capital: Total - Lachlan	952	3	0.90%
14	Electricity supply > Cement, lime > Concrete products > WSS Capital: Total - Lachlan	924	4	0.87%
15	Basic chemicals > Plastic products > WSS Capital: Total - Lachlan	888	3	0.84%
16	Hardwoods > Non-building construction > WSS Capital: Total - Lachlan	869	3	0.82%
17	Iron and steel semi-manufactures > Non-building construction > WSS Capital: Total - Lachlan	795	3	0.75%
18	Concrete products > Concrete products > WSS Capital: Total - Lachlan	761	3	0.72%
19	Construction materials > WSS Capital: Total - Lachlan	737	2	0.69%
20	Road freight > Concrete products > WSS Capital: Total - Lachlan	703	3	0.66%
21	Road freight > WSS Capital: Total - Lachlan	685	2	0.64%
22	Wholesale trade > WSS Capital: Total - Lachlan	662	2	0.62%
23	Softwoods > Pulp, paper and paperboard > Concrete products > WSS Capital: Total - Lachlan	597	4	0.56%
24	Cement, lime > Concrete products > Concrete products > WSS Capital: Total - Lachlan	492	4	0.46%
25	Fabricated construction steel > WSS Capital: Total - Lachlan	467	2	0.44%

**Table 21: Ranked structural paths for WSS Capital: Total – Macquarie, Greenhouse Gas Emissions**

GREENHOUSE GAS EMISSIONS				
RANK	PATH DESCRIPTION	PATH VALUE (T CO2-E)	PATH ORDER	% OF TOTAL IMPACT
1	Iron and steel semi-manufactures > Fabricated construction steel > WSS Capital: Total - Macquarie	2,846	3	13.00%
2	WSS Capital: Total - Macquarie	1,099	1	5.02%
3	Iron and steel semi-manufactures > Iron and steel semi-manufactures > Fabricated construction steel > WSS Capital: Total - Macquarie	630	4	2.88%
4	Electricity supply > Plastic products > WSS Capital: Total - Macquarie	584	3	2.67%
5	Electricity supply > Computer and technical services > WSS Capital: Total - Macquarie	572	3	2.62%
6	Electricity supply > Iron and steel semi-manufactures > Fabricated construction steel > WSS Capital: Total - Macquarie	560	4	2.56%
7	Electricity supply > Fabricated construction steel > WSS Capital: Total - Macquarie	523	3	2.39%
8	Basic chemicals > Plastic products > WSS Capital: Total - Macquarie	462	3	2.11%
9	Iron and steel semi-manufactures > Pumps > WSS Capital: Total - Macquarie	314	3	1.43%
10	Concrete products > WSS Capital: Total - Macquarie	312	2	1.43%
11	Non-building construction > WSS Capital: Total - Macquarie	298	2	1.36%
12	Wholesale trade > WSS Capital: Total - Macquarie	286	2	1.31%
13	Fabricated construction steel > WSS Capital: Total - Macquarie	214	2	0.98%
14	Electricity supply > Pumps > WSS Capital: Total - Macquarie	204	3	0.93%
15	Cement, lime > Concrete products > WSS Capital: Total - Macquarie	202	3	0.92%
16	Brown coal > Basic chemicals > Plastic products > WSS Capital: Total - Macquarie	179	4	0.82%
17	Electricity supply > Non-building construction > WSS Capital: Total - Macquarie	160	3	0.73%
18	Iron and steel semi-manufactures > Fabricated metal products > WSS Capital: Total - Macquarie	153	3	0.70%
19	Hardwoods > Non-building construction > WSS Capital: Total - Macquarie	146	3	0.67%

GREENHOUSE GAS EMISSIONS				
RANK	PATH DESCRIPTION	PATH VALUE (T CO2-E)	PATH ORDER	% OF TOTAL IMPACT
20	Iron and steel semi-manufactures > Iron and steel semi-manufactures > Iron and steel semi-manufactures > Fabricated construction steel > WSS Capital: Total - Macquarie	140	5	0.64%
21	Iron and steel semi-manufactures > Non-building construction > WSS Capital: Total - Macquarie	134	3	0.61%
22	Electricity supply > Iron and steel semi-manufactures > Iron and steel semi-manufactures > Fabricated construction steel > WSS Capital: Total - Macquarie	124	5	0.57%
23	Iron and steel semi-manufactures > Fabricated construction steel > Fabricated construction steel > WSS Capital: Total - Macquarie	118	4	0.54%
24	Natural gas > Iron and steel semi-manufactures > Fabricated construction steel > WSS Capital: Total - Macquarie	106	4	0.48%
25	Electricity supply > Fabricated metal products > WSS Capital: Total - Macquarie	96.8	3	0.44%

**Table 22: Ranked structural paths for WSS Opex: Total – Lachlan, Greenhouse Gas Emissions**

GREENHOUSE GAS EMISSIONS				
RANK	PATH DESCRIPTION	PATH VALUE (T CO2-E)	PATH ORDER	% OF TOTAL IMPACT
1	Electricity supply > WSS Opex: Total - Lachlan	206,559	2	73.60%
2	Electricity supply > Electricity supply > WSS Opex: Total - Lachlan	18,168	3	6.48%
3	Water supply; sewerage and drainage services > WSS Opex: Total - Lachlan	7,319	2	2.61%
4	Electricity supply > Water supply; sewerage and drainage services > WSS Opex: Total - Lachlan	5,858	3	2.09%
5	Brown coal > Electricity supply > WSS Opex: Total - Lachlan	4,997	3	1.78%
6	Black coal > Electricity supply > WSS Opex: Total - Lachlan	2,570	3	0.92%
7	Natural gas > Electricity supply > WSS Opex: Total - Lachlan	2,563	3	0.91%
8	Non-building repair > WSS Opex: Total - Lachlan	2,151	2	0.77%
9	Electricity supply > Electricity supply > Electricity supply > WSS Opex: Total - Lachlan	1,598	4	0.57%
10	Electricity supply > Non-building repair > WSS Opex: Total - Lachlan	1,055	3	0.38%

GREENHOUSE GAS EMISSIONS				
RANK	PATH DESCRIPTION	PATH VALUE (T CO2-E)	PATH ORDER	% OF TOTAL IMPACT
11	Hardwoods > Non-building repair > WSS Opex: Total - Lachlan	966	3	0.34%
12	Iron and steel semi-manufactures > Non-building repair > WSS Opex: Total - Lachlan	883	3	0.31%
13	Cement, lime > Water supply; sewerage and drainage services > WSS Opex: Total - Lachlan	666	3	0.24%
14	Electricity supply > Electricity supply > Water supply; sewerage and drainage services > WSS Opex: Total - Lachlan	515	4	0.18%
15	Brown coal > Electricity supply > Electricity supply > WSS Opex: Total - Lachlan	440	4	0.16%
16	Cement, lime > Non-building repair > WSS Opex: Total - Lachlan	427	3	0.15%
17	Electricity supply > Black coal > Electricity supply > WSS Opex: Total - Lachlan	405	4	0.14%
18	Water supply; sewerage and drainage services > Water supply; sewerage and drainage services > WSS Opex: Total - Lachlan	389	3	0.14%
19	Aluminium doors > Non-building repair > WSS Opex: Total - Lachlan	376	3	0.13%
20	Concrete products > Non-building repair > WSS Opex: Total - Lachlan	360	3	0.13%
21	Natural gas > Gas supply > Electricity supply > WSS Opex: Total - Lachlan	348	4	0.12%
22	Electricity supply > Water supply; sewerage and drainage services > Water supply; sewerage and drainage services > WSS Opex: Total - Lachlan	312	4	0.11%
23	Softwoods > Undressed sawn timber > Non-building repair > WSS Opex: Total - Lachlan	295	4	0.11%
24	Wholesale trade > Non-building repair > WSS Opex: Total - Lachlan	245	3	0.09%
25	Cement, lime > Concrete products > Non-building repair > WSS Opex: Total - Lachlan	233	4	0.08%

**Table 23: Ranked structural paths for WSS Opex: Total – Macquarie, Greenhouse Gas Emissions**

GREENHOUSE GAS EMISSIONS				
RANK	PATH DESCRIPTION	PATH VALUE (T CO2-E)	PATH ORDER	% OF TOTAL IMPACT
1	Electricity supply > WSS Opex: Total - Macquarie	1,324,637	2	84.10%

GREENHOUSE GAS EMISSIONS				
RANK	PATH DESCRIPTION	PATH VALUE (T CO <sub>2</sub> -E)	PATH ORDER	% OF TOTAL IMPACT
2	Electricity supply > Electricity supply > WSS Opex: Total - Macquarie	116,510	3	7.40%
3	Brown coal > Electricity supply > WSS Opex: Total - Macquarie	32,044	3	2.03%
4	Black coal > Electricity supply > WSS Opex: Total - Macquarie	16,483	3	1.05%
5	Natural gas > Electricity supply > WSS Opex: Total - Macquarie	16,437	3	1.04%
6	Electricity supply > Electricity supply > Electricity supply > WSS Opex: Total - Macquarie	10,248	4	0.65%
7	Water supply; sewerage and drainage services > WSS Opex: Total - Macquarie	3,007	2	0.19%
8	Brown coal > Electricity supply > Electricity supply > WSS Opex: Total - Macquarie	2,818	4	0.18%
9	Basic chemicals > WSS Opex: Total - Macquarie	2,653	2	0.17%
10	Electricity supply > Black coal > Electricity supply > WSS Opex: Total - Macquarie	2,597	4	0.16%
11	Electricity supply > Water supply; sewerage and drainage services > WSS Opex: Total - Macquarie	2,407	3	0.15%
12	Natural gas > Gas supply > Electricity supply > WSS Opex: Total - Macquarie	2,232	4	0.14%
13	Black coal > Electricity supply > Electricity supply > WSS Opex: Total - Macquarie	1,450	4	0.09%
14	Natural gas > Electricity supply > Electricity supply > WSS Opex: Total - Macquarie	1,446	4	0.09%
15	Electricity supply > LPG, LNG > Electricity supply > WSS Opex: Total - Macquarie	1,040	4	0.07%
16	Brown coal > Basic chemicals > WSS Opex: Total - Macquarie	1,026	3	0.07%
17	Electricity supply > Electricity supply > Electricity supply > Electricity supply > WSS Opex: Total - Macquarie	901	5	0.06%
18	Gas supply > Electricity supply > WSS Opex: Total - Macquarie	692	3	0.04%
19	Non-building repair > WSS Opex: Total - Macquarie	591	2	0.04%
20	Hardwoods > Black coal > Electricity supply > WSS Opex: Total - Macquarie	574	4	0.04%

GREENHOUSE GAS EMISSIONS				
RANK	PATH DESCRIPTION	PATH VALUE (T CO <sub>2</sub> -E)	PATH ORDER	% OF TOTAL IMPACT
21	LPG, LNG > Electricity supply > WSS Opex: Total - Macquarie	527	3	0.03%
22	Concrete products > Electricity supply > WSS Opex: Total - Macquarie	509	3	0.03%
23	Cement, lime > Electricity supply > WSS Opex: Total - Macquarie	487	3	0.03%
24	Electricity supply > Railway freight transport services > Black coal > Electricity supply > WSS Opex: Total - Macquarie	413	5	0.03%
25	Wholesale trade > Electricity supply > WSS Opex: Total - Macquarie	378	3	0.02%

**Table 24: Ranked structural paths for WSS Capital: Total – Lachlan, Material Flow**

MATERIAL FLOW				
RANK	PATH DESCRIPTION	PATH VALUE (T)	PATH ORDER	% OF TOTAL IMPACT
1	WSS Capital: Total - Lachlan	376,054	1	48.80%
2	Construction materials > WSS Capital: Total - Lachlan	119,813	2	15.50%
3	Sand > Concrete products > WSS Capital: Total - Lachlan	46,235	3	6.00%
4	Construction materials > Concrete products > WSS Capital: Total - Lachlan	31,030	3	4.02%
5	Brown coal > Basic chemicals > Plastic products > WSS Capital: Total - Lachlan	18,416	4	2.39%
6	Construction materials > Non-building construction > WSS Capital: Total - Lachlan	9,769	3	1.27%
7	Brown coal > Chemical fertilisers > Plastic products > WSS Capital: Total - Lachlan	9,008	4	1.17%
8	Iron ores > Iron and steel semi-manufactures > Fabricated construction steel > WSS Capital: Total - Lachlan	6,423	4	0.83%
9	Gravel > Non-building construction > WSS Capital: Total - Lachlan	4,383	3	0.57%
10	Limestone > Cement, lime > Concrete products > WSS Capital: Total - Lachlan	4,309	4	0.56%
11	Brown coal > Electricity supply > Concrete products > WSS Capital: Total - Lachlan	3,632	4	0.47%
12	Sand > Non-building construction > WSS Capital: Total - Lachlan	3,445	3	0.45%

MATERIAL FLOW				
RANK	PATH DESCRIPTION	PATH VALUE (T)	PATH ORDER	% OF TOTAL IMPACT
13	Brown coal > Gases > Concrete products > WSS Capital: Total - Lachlan	3,241	4	0.42%
14	Brown coal > Gases > Fabricated construction steel > WSS Capital: Total - Lachlan	3,216	4	0.42%
15	Black coal > Iron and steel semi-manufactures > Fabricated construction steel > WSS Capital: Total - Lachlan	2,929	4	0.38%
16	Sand > Concrete products > Concrete products > WSS Capital: Total - Lachlan	2,498	4	0.32%
17	Sand > Ready-mixed concrete > Concrete products > WSS Capital: Total - Lachlan	2,442	4	0.32%
18	Brown coal > Electricity supply > Computer and technical services > WSS Capital: Total - Lachlan	2,314	4	0.30%
19	Natural gas > Cement, lime > Concrete products > WSS Capital: Total - Lachlan	2,313	4	0.30%
20	Construction materials > Iron and steel semi-manufactures > Fabricated construction steel > WSS Capital: Total - Lachlan	2,132	4	0.28%
21	Brown coal > Basic chemicals > Basic chemicals > Plastic products > WSS Capital: Total - Lachlan	2,063	5	0.27%
22	Sand > Fabricated construction steel > WSS Capital: Total - Lachlan	1,844	3	0.24%
23	Construction materials > Concrete products > Concrete products > WSS Capital: Total - Lachlan	1,676	4	0.22%
24	Brown coal > Electricity supply > Iron and steel semi-manufactures > Fabricated construction steel > WSS Capital: Total - Lachlan	1,583	5	0.21%
25	Brown coal > Chemical fertilisers > Chemical fertilisers > Plastic products > WSS Capital: Total - Lachlan	1,555	5	0.20%

**Table 25: Ranked structural paths for WSS Capital: Total – Macquarie, Material Flow**

MATERIAL FLOW				
RANK	PATH DESCRIPTION	PATH VALUE (T)	PATH ORDER	% OF TOTAL IMPACT
1	Brown coal > Basic chemicals > Plastic products > WSS Capital: Total – Macquarie	9,585	4	14.70%
2	Brown coal > Chemical fertilisers > Plastic products > WSS Capital: Total – Macquarie	4,688	4	7.17%
3	WSS Capital: Total – Macquarie	4,434	1	6.78%
4	Iron ores > Iron and steel semi-manufactures > Fabricated construction steel > WSS Capital: Total – Macquarie	2,949	4	4.51%

<b>MATERIAL FLOW</b>				
<b>RANK</b>	<b>PATH DESCRIPTION</b>	<b>PATH VALUE (T)</b>	<b>PATH ORDER</b>	<b>% OF TOTAL IMPACT</b>
5	Construction materials > Non-building construction > WSS Capital: Total – Macquarie	1,643	3	2.51%
6	Brown coal > Gases > Fabricated construction steel > WSS Capital: Total - Macquarie	1,477	4	2.26%
7	Black coal > Iron and steel semi-manufactures > Fabricated construction steel > WSS Capital: Total - Macquarie	1,345	4	2.06%
8	Brown coal > Basic chemicals > Basic chemicals > Plastic products > WSS Capital: Total - Macquarie	1,073	5	1.64%
9	Sand > Concrete products > WSS Capital: Total - Macquarie	1,024	3	1.57%
10	Construction materials > Iron and steel semi-manufactures > Fabricated construction steel > WSS Capital: Total - Macquarie	979	4	1.50%
11	Sand > Fabricated construction steel > WSS Capital: Total - Macquarie	847	3	1.29%
12	Brown coal > Chemical fertilisers > Chemical fertilisers > Plastic products > WSS Capital: Total - Macquarie	809	5	1.24%
13	Brown coal > Electricity supply > Plastic products > WSS Capital: Total - Macquarie	758	4	1.16%
14	Brown coal > Electricity supply > Computer and technical services > WSS Capital: Total - Macquarie	743	4	1.14%
15	Gravel > Non-building construction > WSS Capital: Total - Macquarie	737	3	1.13%
16	Brown coal > Electricity supply > Iron and steel semi-manufactures > Fabricated construction steel > WSS Capital: Total - Macquarie	727	5	1.11%
17	Construction materials > Concrete products > WSS Capital: Total - Macquarie	687	3	1.05%
18	Brown coal > Electricity supply > Fabricated construction steel > WSS Capital: Total - Macquarie	679	4	1.04%
19	Iron ores > Iron and steel semi-manufactures > Iron and steel semi-manufactures > Fabricated construction steel > WSS Capital: Total - Macquarie	653	5	1.00%
20	Sand > Non-building construction > WSS Capital: Total - Macquarie	580	3	0.89%
21	Brown coal > Basic chemicals > Electrical equipment > WSS Capital: Total - Macquarie	503	4	0.77%
22	Brown coal > Basic chemicals > Plastic products > Plastic products > WSS Capital: Total - Macquarie	476	5	0.73%
23	Iron ores > Fabricated construction steel > WSS Capital: Total – Macquarie	373	3	0.57%

MATERIAL FLOW				
RANK	PATH DESCRIPTION	PATH VALUE (T)	PATH ORDER	% OF TOTAL IMPACT
24	Limestone > Iron and steel semi-manufactures > Fabricated construction steel > WSS Capital: Total - Macquarie	364	4	0.56%
25	Iron ores > Iron and steel semi-manufactures > Pumps > WSS Capital: Total – Macquarie	325	4	0.50%

**Table 26: Ranked structural paths for WSS Opex: Total – Lachlan, Material Flow**

MATERIAL FLOW				
RANK	PATH DESCRIPTION	PATH VALUE (T)	PATH ORDER	% OF TOTAL IMPACT
1	Brown coal > Electricity supply > WSS Opex: Total - Lachlan	268,128	3	58.00%
2	Black coal > Electricity supply > WSS Opex: Total - Lachlan	65,469	3	14.20%
3	Brown coal > Electricity supply > Electricity supply > WSS Opex: Total - Lachlan	23,584	4	5.10%
4	Construction materials > Non-building repair > WSS Opex: Total - Lachlan	10,900	3	2.36%
5	Brown coal > Electricity supply > Water supply; sewerage and drainage services > WSS Opex: Total - Lachlan	7,604	4	1.64%
6	Black coal > Electricity supply > Electricity supply > WSS Opex: Total - Lachlan	5,758	4	1.25%
7	Gravel > Non-building repair > WSS Opex: Total - Lachlan	4,869	3	1.05%
8	Sand > Non-building repair > WSS Opex: Total - Lachlan	3,827	3	0.83%
9	Construction materials > Water supply; sewerage and drainage services > WSS Opex: Total - Lachlan	3,620	3	0.78%
10	Natural gas > Electricity supply > WSS Opex: Total - Lachlan	3,431	3	0.74%
11	Brown coal > Basic chemicals > Water supply; sewerage and drainage services > WSS Opex: Total - Lachlan	3,167	4	0.68%
12	LPG, LNG > Electricity supply > WSS Opex: Total - Lachlan	2,478	3	0.54%
13	Brown coal > Electricity supply > Electricity supply > Electricity supply > WSS Opex: Total - Lachlan	2,074	5	0.45%
14	Black coal > Electricity supply > Water supply; sewerage and drainage services > WSS Opex: Total - Lachlan	1,857	4	0.40%
15	Brown coal > Chemical fertilisers > Water supply; sewerage and drainage services > WSS Opex: Total - Lachlan	1,630	4	0.35%
16	Black coal > Black coal > Electricity supply > WSS Opex: Total - Lachlan	1,411	4	0.31%

MATERIAL FLOW				
RANK	PATH DESCRIPTION	PATH VALUE (T)	PATH ORDER	% OF TOTAL IMPACT
17	Brown coal > Electricity supply > Non-building repair > WSS Opex: Total - Lachlan	1,369	4	0.30%
18	Sand > Concrete products > Non-building repair > WSS Opex: Total - Lachlan	1,181	4	0.26%
19	Iron ores > Iron and steel semi-manufactures > Non-building repair > WSS Opex: Total - Lachlan	915	4	0.20%
20	Construction materials > Concrete products > Non-building repair > WSS Opex: Total - Lachlan	793	4	0.17%
21	Brown coal > Gases > Non-building repair > WSS Opex: Total - Lachlan	719	4	0.16%
22	Brown coal > Petroleum and coal products > Non-building repair > WSS Opex: Total - Lachlan	717	4	0.16%
23	Brown coal > Electricity supply > Electricity supply > Water supply; sewerage and drainage services > WSS Opex: Total - Lachlan	669	5	0.14%
24	Brown coal > Petroleum and coal products > Electricity supply > WSS Opex: Total - Lachlan	625	4	0.14%
25	Brown coal > Basic chemicals > Electrical equipment > Non-building repair > WSS Opex: Total - Lachlan	596	5	0.13%

**Table 27: Ranked structural paths for WSS Opex: Total – Macquarie, Material Flow**

MATERIAL FLOW				
RANK	PATH DESCRIPTION	PATH VALUE (T)	PATH ORDER	% OF TOTAL IMPACT
1	Brown coal > Electricity supply > WSS Opex: Total - Macquarie	1,719,474	3	67.30%
2	Black coal > Electricity supply > WSS Opex: Total - Macquarie	419,845	3	16.40%
3	Brown coal > Electricity supply > Electricity supply > WSS Opex: Total - Macquarie	151,238	4	5.92%
4	Brown coal > Basic chemicals > WSS Opex: Total - Macquarie	55,046	3	2.16%
5	Black coal > Electricity supply > Electricity supply > WSS Opex: Total - Macquarie	36,928	4	1.45%
6	Natural gas > Electricity supply > WSS Opex: Total - Macquarie	22,003	3	0.86%
7	LPG, LNG > Electricity supply > WSS Opex: Total - Macquarie	15,894	3	0.62%

MATERIAL FLOW				
RANK	PATH DESCRIPTION	PATH VALUE (T)	PATH ORDER	% OF TOTAL IMPACT
8	Brown coal > Electricity supply > Electricity supply > Electricity supply > WSS Opex: Total - Macquarie	13,302	5	0.52%
9	Black coal > Black coal > Electricity supply > WSS Opex: Total - Macquarie	9,051	4	0.35%
10	Brown coal > Basic chemicals > Basic chemicals > WSS Opex: Total - Macquarie	6,165	4	0.24%
11	Brown coal > Petroleum and coal products > Electricity supply > WSS Opex: Total - Macquarie	4,007	4	0.16%
12	Brown coal > Electricity supply > Black coal > Electricity supply > WSS Opex: Total - Macquarie	3,371	5	0.13%
13	Black coal > Electricity supply > Electricity supply > Electricity supply > WSS Opex: Total - Macquarie	3,248	5	0.13%
14	Brown coal > Electricity supply > Water supply; sewerage and drainage services > WSS Opex: Total - Macquarie	3,124	4	0.12%
15	Construction materials > Non-building repair > WSS Opex: Total - Macquarie	2,994	3	0.12%
16	Natural gas > Gas supply > Electricity supply > WSS Opex: Total - Macquarie	2,988	4	0.12%
17	Natural gas > Electricity supply > Electricity supply > WSS Opex: Total - Macquarie	1,935	4	0.08%
18	Brown coal > Basic chemicals > Electricity supply > WSS Opex: Total - Macquarie	1,836	4	0.07%
19	Sand > Concrete products > Electricity supply > WSS Opex: Total - Macquarie	1,670	4	0.07%
20	Construction materials > Water supply; sewerage and drainage services > WSS Opex: Total - Macquarie	1,487	3	0.06%
21	LPG, LNG > Electricity supply > Electricity supply > WSS Opex: Total - Macquarie	1,398	4	0.05%
22	Brown coal > Electricity supply > LPG, LNG > Electricity supply > WSS Opex: Total - Macquarie	1,350	5	0.05%
23	Gravel > Non-building repair > WSS Opex: Total - Macquarie	1,337	3	0.05%
24	Brown coal > Basic chemicals > Water supply; sewerage and drainage services > WSS Opex: Total - Macquarie	1,301	4	0.05%
25	Brown coal > Petroleum and coal products > Basic chemicals > WSS Opex: Total - Macquarie	1,248	4	0.05%

**Table 28: Ranked structural paths for WSS Capital: Total – Lachlan, Water Consumption**

WATER USE				
RANK	PATH DESCRIPTION	PATH VALUE (ML)	PATH ORDER	% OF TOTAL IMPACT
1	WSS Capital: Total – Lachlan	141	1	11.60%
2	Fabricated construction steel > WSS Capital: Total - Lachlan	71.1	2	5.85%
3	Concrete products > WSS Capital: Total – Lachlan	63.8	2	5.25%
4	Water supply; sewerage and drainage services > Computer and technical services > WSS Capital: Total – Lachlan	62.3	3	5.12%
5	Electricity supply > Concrete products > WSS Capital: Total - Lachlan	27.4	3	2.26%
6	Plant nurseries > Non-building construction > WSS Capital: Total - Lachlan	25.9	3	2.13%
7	Electricity supply > Computer and technical services > WSS Capital: Total - Lachlan	17.5	3	1.44%
8	Plastic products > WSS Capital: Total - Lachlan	17.2	2	1.42%
9	Computer and technical services > WSS Capital: Total - Lachlan	15.2	2	1.25%
10	Electricity supply > Iron and steel semi-manufactures > Fabricated construction steel > WSS Capital: Total - Lachlan	12.0	4	0.98%
11	Electricity supply > Fabricated construction steel > WSS Capital: Total - Lachlan	11.2	3	0.92%
12	Electricity supply > Plastic products > WSS Capital: Total - Lachlan	11.0	3	0.90%
13	Iron and steel semi-manufactures > Fabricated construction steel > WSS Capital: Total - Lachlan	10.6	3	0.87%
14	Water supply; sewerage and drainage services > Concrete products > WSS Capital: Total - Lachlan	10.1	3	0.83%
15	Non-building construction > WSS Capital: Total - Lachlan	9.36	2	0.77%
16	Electricity supply > Non-building construction > WSS Capital: Total - Lachlan	9.34	3	0.77%
17	Electricity supply > Cement, lime > Concrete products > WSS Capital: Total - Lachlan	9.06	4	0.74%
18	Cement, lime > Concrete products > WSS Capital: Total - Lachlan	8.31	3	0.68%
19	Iron ores > Iron and steel semi-manufactures > Fabricated construction steel > WSS Capital: Total - Lachlan	8.01	4	0.66%
20	Pumps > WSS Capital: Total - Lachlan	5.96	2	0.49%

WATER USE				
RANK	PATH DESCRIPTION	PATH VALUE (ML)	PATH ORDER	% OF TOTAL IMPACT
21	Flowers > Plastic products > WSS Capital: Total - Lachlan	5.75	3	0.47%
22	Construction materials > WSS Capital: Total - Lachlan	5.64	2	0.46%
23	Vegetables > Plastic products > WSS Capital: Total - Lachlan	5.29	3	0.43%
24	Water supply; sewerage and drainage services > Fabricated construction steel > WSS Capital: Total - Lachlan	4.82	3	0.40%
25	Water supply; sewerage and drainage services > Computer and technical services > Non-building construction > WSS Capital: Total - Lachlan	4.68	4	0.39%

**Table 29: Ranked structural paths for WSS Capital: Total – Macquarie, Water Consumption**

WATER USE				
RANK	PATH DESCRIPTION	PATH VALUE (ML)	PATH ORDER	% OF TOTAL IMPACT
1	Fabricated construction steel > WSS Capital: Total - Macquarie	32.6	2	9.83%
2	WSS Capital: Total - Macquarie	26.2	1	7.90%
3	Water supply; sewerage and drainage services > Computer and technical services > WSS Capital: Total - Macquarie	20.0	3	6.02%
4	Plastic products > WSS Capital: Total - Macquarie	8.97	2	2.70%
5	Pumps > WSS Capital: Total - Macquarie	6.08	2	1.83%
6	Electricity supply > Plastic products > WSS Capital: Total - Macquarie	5.73	3	1.72%
7	Electricity supply > Computer and technical services > WSS Capital: Total - Macquarie	5.61	3	1.69%
8	Electricity supply > Iron and steel semi-manufactures > Fabricated construction steel > WSS Capital: Total - Macquarie	5.49	4	1.65%
9	Electricity supply > Fabricated construction steel > WSS Capital: Total - Macquarie	5.13	3	1.54%
10	Computer and technical services > WSS Capital: Total - Macquarie	4.87	2	1.47%
11	Iron and steel semi-manufactures > Fabricated construction steel > WSS Capital: Total - Macquarie	4.86	3	1.46%
12	Plant nurseries > Non-building construction > WSS Capital: Total - Macquarie	4.36	3	1.31%

WATER USE				
RANK	PATH DESCRIPTION	PATH VALUE (ML)	PATH ORDER	% OF TOTAL IMPACT
13	Iron ores > Iron and steel semi-manufactures > Fabricated construction steel > WSS Capital: Total - Macquarie	3.68	4	1.11%
14	Flowers > Plastic products > WSS Capital: Total - Macquarie	2.99	3	0.90%
15	Vegetables > Plastic products > WSS Capital: Total - Macquarie	2.75	3	0.83%
16	Fabricated metal products > WSS Capital: Total - Macquarie	2.41	2	0.72%
17	Water supply; sewerage and drainage services > Fabricated construction steel > WSS Capital: Total - Macquarie	2.21	3	0.67%
18	Electricity supply > Pumps > WSS Capital: Total - Macquarie	2.00	3	0.60%
19	Electrical equipment > WSS Capital: Total - Macquarie	1.91	2	0.58%
20	Non-building construction > WSS Capital: Total - Macquarie	1.57	2	0.47%
21	Electricity supply > Non-building construction > WSS Capital: Total - Macquarie	1.57	3	0.47%
22	Untreated milk > Dairy products > Computer and technical services > WSS Capital: Total - Macquarie	1.44	4	0.43%
23	Concrete products > WSS Capital: Total - Macquarie	1.41	2	0.43%
24	Untreated milk > Cheese > Computer and technical services > WSS Capital: Total - Macquarie	1.39	4	0.42%
25	Grapes for wine > Wine > Hotels, clubs, restaurants and cafes > Computer and technical services > WSS Capital: Total - Macquarie	1.36	5	0.41%

**Table 30: Ranked structural paths for WSS Opex: Total – Lachlan, Water Consumption**

WATER USE				
RANK	PATH DESCRIPTION	PATH VALUE (ML)	PATH ORDER	% OF TOTAL IMPACT
1	Water supply; sewerage and drainage services > WSS Opex: Total – Lachlan	6,419	2	67.70%
2	Electricity supply > WSS Opex: Total - Lachlan	2,025	2	21.30%
3	Water supply; sewerage and drainage services > Water supply; sewerage and drainage services > WSS Opex: Total - Lachlan	342	3	3.60%
4	Electricity supply > Electricity supply > WSS Opex: Total - Lachlan	178	3	1.88%
5	Electricity supply > Water supply; sewerage and drainage services > WSS Opex: Total - Lachlan	57.4	3	0.61%

WATER USE				
RANK	PATH DESCRIPTION	PATH VALUE (ML)	PATH ORDER	% OF TOTAL IMPACT
6	Water supply; sewerage and drainage services > Electricity supply > WSS Opex: Total - Lachlan	34.8	3	0.37%
7	Plant nurseries > Non-building repair > WSS Opex: Total - Lachlan	28.8	3	0.30%
8	Brown coal > Electricity supply > WSS Opex: Total - Lachlan	22.9	3	0.24%
9	Water supply; sewerage and drainage services > Water supply; sewerage and drainage services > WSS Opex: Total - Lachlan	18.2	4	0.19%
10	Electricity supply > Electricity supply > Electricity supply > WSS Opex: Total - Lachlan	15.7	4	0.17%
11	Non-building repair > WSS Opex: Total - Lachlan	12.5	2	0.13%
12	Electricity supply > Non-building repair > WSS Opex: Total - Lachlan	10.3	3	0.11%
13	Black coal > Electricity supply > WSS Opex: Total - Lachlan	6.08	3	0.06%
14	Water supply; sewerage and drainage services > Computer and technical services > Non-building repair > WSS Opex: Total - Lachlan	5.20	4	0.05%
15	Electricity supply > Electricity supply > Water supply; sewerage and drainage services > WSS Opex: Total - Lachlan	5.05	4	0.05%
16	Joinery products > Non-building repair > WSS Opex: Total - Lachlan	3.97	3	0.04%
17	Electricity supply > Black coal > Electricity supply > WSS Opex: Total - Lachlan	3.97	4	0.04%
18	Unginned cotton > Cotton seed > Plant nurseries > Non-building repair > WSS Opex: Total - Lachlan	3.75	5	0.04%
19	Water supply; sewerage and drainage services > Electricity supply > Electricity supply > WSS Opex: Total - Lachlan	3.06	4	0.03%
20	Electricity supply > Water supply; sewerage and drainage services > Water supply; sewerage and drainage services > WSS Opex: Total - Lachlan	3.06	4	0.03%
21	Water supply; sewerage and drainage services > Non-building repair > WSS Opex: Total - Lachlan	3.03	3	0.03%
22	Untreated milk > Cheese > Water supply; sewerage and drainage services > WSS Opex: Total - Lachlan	2.70	4	0.03%
23	Fabricated construction steel > Non-building repair > WSS Opex: Total - Lachlan	2.40	3	0.03%
24	Electrical equipment > Non-building repair > WSS Opex: Total - Lachlan	2.26	3	0.02%

WATER USE				
RANK	PATH DESCRIPTION	PATH VALUE (ML)	PATH ORDER	% OF TOTAL IMPACT
25	Brown coal > Electricity supply > Electricity supply > WSS Opex: Total - Lachlan	2.02	4	0.02%

**Table 31: Ranked structural paths for WSS Opex: Total – Macquarie, Water Consumption**

WATER USE				
RANK	PATH DESCRIPTION	PATH VALUE (ML)	PATH ORDER	% OF TOTAL IMPACT
1	Electricity supply > WSS Opex: Total - Macquarie	12,984	2	72.10%
2	Water supply; sewerage and drainage services > WSS Opex: Total - Macquarie	2,637	2	14.60%
3	Electricity supply > Electricity supply > WSS Opex: Total - Macquarie	1,142	3	6.34%
4	Water supply; sewerage and drainage services > Electricity supply > WSS Opex: Total - Macquarie	223	3	1.24%
5	Brown coal > Electricity supply > WSS Opex: Total - Macquarie	147	3	0.82%
6	Water supply; sewerage and drainage services > Water supply; sewerage and drainage services > WSS Opex: Total - Macquarie	140	3	0.78%
7	Electricity supply > Electricity supply > Electricity supply > WSS Opex: Total - Macquarie	100	4	0.56%
8	Black coal > Electricity supply > WSS Opex: Total - Macquarie	39.0	3	0.22%
9	Electricity supply > Black coal > Electricity supply > WSS Opex: Total - Macquarie	25.5	4	0.14%
10	Electricity supply > Water supply; sewerage and drainage services > WSS Opex: Total - Macquarie	23.6	3	0.13%
11	Water supply; sewerage and drainage services > Electricity supply > Electricity supply > WSS Opex: Total - Macquarie	19.7	4	0.11%
12	Brown coal > Electricity supply > Electricity supply > WSS Opex: Total - Macquarie	12.9	4	0.07%
13	Water supply; sewerage and drainage services > Water supply; sewerage and drainage services > Electricity supply > WSS Opex: Total - Macquarie	11.9	4	0.07%
14	Electricity supply > LPG, LNG > Electricity supply > WSS Opex: Total - Macquarie	10.2	4	0.06%
15	Water supply; sewerage and drainage services > Gas supply > Electricity supply > WSS Opex: Total - Macquarie	9.82	4	0.05%
16	Natural gas > Electricity supply > WSS Opex: Total - Macquarie	8.97	3	0.05%

WATER USE				
RANK	PATH DESCRIPTION	PATH VALUE (ML)	PATH ORDER	% OF TOTAL IMPACT
17	Electricity supply > Electricity supply > Electricity supply > Electricity supply > WSS Opex: Total - Macquarie	8.84	5	0.05%
18	Plant nurseries > Non-building repair > WSS Opex: Total - Macquarie	7.91	3	0.04%
19	Grapes for wine > Wine > Hotels, clubs, restaurants and cafes > Electricity supply > WSS Opex: Total - Macquarie	7.63	5	0.04%
20	Water supply; sewerage and drainage services > Water supply; sewerage and drainage services > Water supply; sewerage and drainage services > WSS Opex: Total - Macquarie	7.46	4	0.04%
21	Brown coal > Basic chemicals > WSS Opex: Total - Macquarie	4.70	3	0.03%
22	Basic chemicals > WSS Opex: Total - Macquarie	4.59	2	0.03%
23	Electricity supply > Railway freight transport services > Black coal > Electricity supply > WSS Opex: Total - Macquarie	4.05	5	0.02%
24	Non-building repair > WSS Opex: Total - Macquarie	3.44	2	0.02%
25	Black coal > Electricity supply > Electricity supply > WSS Opex: Total - Macquarie	3.43	4	0.02%

**Table 32: Ranked structural paths for WSS Capital: Total – Lachlan, Land Disturbance**

LAND DISTURBANCE				
RANK	PATH DESCRIPTION	PATH VALUE (HA)	PATH ORDER	% OF TOTAL IMPACT
1	WSS Capital: Total - Lachlan	242	1	6.22%
2	Beef cattle > Fresh meat > Hotels, clubs, restaurants and cafes > Computer and technical services > WSS Capital: Total - Lachlan	154	5	3.96%
3	Hardwoods > Non-building construction > WSS Capital: Total - Lachlan	100	3	2.57%
4	Beef cattle > Fresh meat > Hotels, clubs, restaurants and cafes > Fabricated construction steel > WSS Capital: Total - Lachlan	97.2	5	2.50%
5	Beef cattle > Meat products > Computer and technical services > WSS Capital: Total - Lachlan	96.6	4	2.48%
6	Non-building construction > WSS Capital: Total - Lachlan	89.8	2	2.31%
7	Softwoods > Pulp, paper and paperboard > Concrete products > WSS Capital: Total - Lachlan	68.4	4	1.76%
8	Shorn wool > Computer and technical services > WSS Capital: Total - Lachlan	64.4	3	1.66%

LAND DISTURBANCE				
RANK	PATH DESCRIPTION	PATH VALUE (HA)	PATH ORDER	% OF TOTAL IMPACT
9	Beef cattle > Fresh meat > Hotels, clubs, restaurants and cafes > Concrete products > WSS Capital: Total - Lachlan	59.4	5	1.53%
10	Beef cattle > Fresh meat > Hotels, clubs, restaurants and cafes > Non-building construction > WSS Capital: Total - Lachlan	52.7	5	1.35%
11	Shorn wool > Wool scouring > Plastic products > WSS Capital: Total - Lachlan	40.1	4	1.03%
12	Shorn wool > Wool scouring > Concrete products > WSS Capital: Total - Lachlan	37.0	4	0.95%
13	Beef cattle > Fresh meat > Retail trade > Non-building construction > WSS Capital: Total - Lachlan	36.4	5	0.94%
14	Concrete products > WSS Capital: Total - Lachlan	35.5	2	0.91%
15	Beef cattle > Meat products > Hotels, clubs, restaurants and cafes > Computer and technical services > WSS Capital: Total - Lachlan	32.9	5	0.85%
16	Shorn wool > Wool scouring > Textile and canvas bags > Concrete products > WSS Capital: Total - Lachlan	31.9	5	0.82%
17	Softwoods > Undressed sawn timber > Non-building construction > WSS Capital: Total - Lachlan	30.4	4	0.78%
18	Beef cattle > Meat products > Non-building construction > WSS Capital: Total - Lachlan	29.7	4	0.76%
19	Computer and technical services > WSS Capital: Total - Lachlan	28.5	2	0.73%
20	Beef cattle > Meat products > Basic chemicals > Plastic products > WSS Capital: Total - Lachlan	24.0	5	0.62%
21	Beef cattle > Offal, hides, skins, blood meal > Basic chemicals > Plastic products > WSS Capital: Total - Lachlan	22.5	5	0.58%
22	Shorn wool > Wool scouring > Fabricated construction steel > WSS Capital: Total - Lachlan	21.0	4	0.54%
23	Beef cattle > Meat products > Hotels, clubs, restaurants and cafes > Fabricated construction steel > WSS Capital: Total - Lachlan	20.7	5	0.53%
24	Softwoods > Sawmill products > Non-building construction > WSS Capital: Total - Lachlan	20.4	4	0.52%
25	Softwoods > Joinery products > Non-building construction > WSS Capital: Total - Lachlan	19.2	4	0.49%

**Table 33: Ranked structural paths for WSS Capital: Total – Macquarie, Land Disturbance**

LAND DISTURBANCE				
RANK	PATH DESCRIPTION	PATH VALUE (HA)	PATH ORDER	% OF TOTAL IMPACT
1	Beef cattle > Fresh meat > Hotels, clubs, restaurants and cafes > Computer and technical services > WSS Capital: Total - Macquarie	49.5	5	4.95%
2	Beef cattle > Fresh meat > Hotels, clubs, restaurants and cafes > Fabricated construction steel > WSS Capital: Total - Macquarie	44.6	5	4.46%
3	WSS Capital: Total - Macquarie	31.5	1	3.15%
4	Beef cattle > Meat products > Computer and technical services > WSS Capital: Total - Macquarie	31.0	4	3.10%
5	Shorn wool > Wool scouring > Plastic products > WSS Capital: Total - Macquarie	20.9	4	2.09%
6	Shorn wool > Computer and technical services > WSS Capital: Total - Macquarie	20.7	3	2.07%
7	Hardwoods > Non-building construction > WSS Capital: Total - Macquarie	16.9	3	1.69%
8	Non-building construction > WSS Capital: Total - Macquarie	15.1	2	1.51%
9	Beef cattle > Meat products > Basic chemicals > Plastic products > WSS Capital: Total - Macquarie	12.5	5	1.25%
10	Beef cattle > Offal, hides, skins, blood meal > Basic chemicals > Plastic products > WSS Capital: Total - Macquarie	11.7	5	1.17%
11	Beef cattle > Meat products > Hotels, clubs, restaurants and cafes > Computer and technical services > WSS Capital: Total - Macquarie	10.6	5	1.06%
12	Shorn wool > Wool scouring > Fabricated construction steel > WSS Capital: Total - Macquarie	9.65	4	0.97%
13	Beef cattle > Meat products > Hotels, clubs, restaurants and cafes > Fabricated construction steel > WSS Capital: Total - Macquarie	9.53	5	0.95%
14	Computer and technical services > WSS Capital: Total - Macquarie	9.15	2	0.92%
15	Beef cattle > Fresh meat > Hotels, clubs, restaurants and cafes > Non-building construction > WSS Capital: Total - Macquarie	8.86	5	0.89%
16	Beef cattle > Fresh meat > Hotels, clubs, restaurants and cafes > Plastic products > WSS Capital: Total - Macquarie	7.03	5	0.70%
17	Beef cattle > Fresh meat > Retail trade > Non-building construction > WSS Capital: Total - Macquarie	6.13	5	0.61%
18	Beef cattle > Meat products > Chemical fertilisers > Plastic products > WSS Capital: Total - Macquarie	6.12	5	0.61%

LAND DISTURBANCE				
RANK	PATH DESCRIPTION	PATH VALUE (HA)	PATH ORDER	% OF TOTAL IMPACT
19	Softwoods > Pulp, paper and paperboard > Printing and stationery > Computer and technical services > WSS Capital: Total - Macquarie	5.76	5	0.58%
20	Beef cattle > Offal, hides, skins, blood meal > Chemical fertilisers > Plastic products > WSS Capital: Total - Macquarie	5.73	5	0.57%
21	Beef cattle > Fresh meat > Computer and technical services > WSS Capital: Total - Macquarie	5.44	4	0.54%
22	Beef cattle > Fresh meat > Hotels, clubs, restaurants and cafes > Market research and other business management services > Computer and technical services > WSS Capital: Total - Macquarie	5.43	6	0.54%
23	Beef cattle > Fresh meat > Hotels, clubs, restaurants and cafes > Wholesale trade > WSS Capital: Total - Macquarie	5.39	5	0.54%
24	Softwoods > Undressed sawn timber > Non-building construction > WSS Capital: Total - Macquarie	5.12	4	0.51%
25	Beef cattle > Meat products > Non-building construction > WSS Capital: Total - Macquarie	5.00	4	0.50%

**Table 34: Ranked structural paths for WSS Opex: Total – Lachlan, Land Disturbance**

LAND DISTURBANCE				
RANK	PATH DESCRIPTION	PATH VALUE (HA)	PATH ORDER	% OF TOTAL IMPACT
1	Water supply; sewerage and drainage services > WSS Opex: Total - Lachlan	1,077	2	38.80%
2	Hardwoods > Non-building repair > WSS Opex: Total - Lachlan	111	3	4.01%
3	Non-building repair > WSS Opex: Total - Lachlan	101	2	3.66%
4	Beef cattle > Fresh meat > Hotels, clubs, restaurants and cafes > Non-building repair > WSS Opex: Total - Lachlan	59.3	5	2.14%
5	Water supply; sewerage and drainage services > Water supply; sewerage and drainage services > WSS Opex: Total - Lachlan	57.3	3	2.07%
6	Beef cattle > Fresh meat > Hotels, clubs, restaurants and cafes > Electricity supply > WSS Opex: Total - Lachlan	43.2	5	1.56%
7	Beef cattle > Fresh meat > Retail trade > Non-building repair > WSS Opex: Total - Lachlan	40.5	5	1.46%
8	Electricity supply > WSS Opex: Total - Lachlan	38.3	2	1.38%
9	Softwoods > Undressed sawn timber > Non-building repair > WSS Opex: Total - Lachlan	33.8	4	1.22%

LAND DISTURBANCE				
RANK	PATH DESCRIPTION	PATH VALUE (HA)	PATH ORDER	% OF TOTAL IMPACT
10	Beef cattle > Meat products > Non-building repair > WSS Opex: Total - Lachlan	32.9	4	1.19%
11	Beef cattle > Fresh meat > Hotels, clubs, restaurants and cafes > Water supply; sewerage and drainage services > WSS Opex: Total - Lachlan	25.7	5	0.93%
12	Softwoods > Sawmill products > Non-building repair > WSS Opex: Total - Lachlan	22.6	4	0.82%
13	Softwoods > Joinery products > Non-building repair > WSS Opex: Total - Lachlan	21.3	4	0.77%
14	Beef cattle > Fresh meat > Hotels, clubs, restaurants and cafes > Computer and technical services > Non-building repair > WSS Opex: Total - Lachlan	12.9	6	0.46%
15	Beef cattle > Meat products > Hotels, clubs, restaurants and cafes > Non-building repair > WSS Opex: Total - Lachlan	12.7	5	0.46%
16	Softwoods > Manufactured wood > Non-building repair > WSS Opex: Total - Lachlan	11.2	4	0.40%
17	Softwoods > Undressed sawn timber > Joinery products > Non-building repair > WSS Opex: Total - Lachlan	11.2	5	0.40%
18	Hardwoods > Black coal > Electricity supply > WSS Opex: Total - Lachlan	10.3	4	0.37%
19	Shorn wool > Wool scouring > Non-building repair > WSS Opex: Total - Lachlan	9.49	4	0.34%
20	Hardwoods > Joinery products > Non-building repair > WSS Opex: Total - Lachlan	9.38	4	0.34%
21	Beef cattle > Fresh meat > Hotels, clubs, restaurants and cafes > Market research and other business management services > Water supply; sewerage and drainage services > WSS Opex: Total - Lachlan	9.29	6	0.33%
22	Beef cattle > Meat products > Hotels, clubs, restaurants and cafes > Electricity supply > WSS Opex: Total - Lachlan	9.23	5	0.33%
23	Hardwoods > Undressed sawn timber > Non-building repair > WSS Opex: Total - Lachlan	8.96	4	0.32%
24	Beef cattle > Meat products > Computer and technical services > Non-building repair > WSS Opex: Total - Lachlan	8.07	5	0.29%
25	Softwoods > Sawmill products > Joinery products > Non-building repair > WSS Opex: Total - Lachlan	7.54	5	0.27%

**Table 35: Ranked structural paths for WSS Opex: Total – Macquarie, Land Disturbance**

LAND DISTURBANCE				
RANK	PATH DESCRIPTION	PATH VALUE (HA)	PATH ORDER	% OF TOTAL IMPACT
1	Water supply; sewerage and drainage services > WSS Opex: Total - Macquarie	443	2	14.20%
2	Beef cattle > Fresh meat > Hotels, clubs, restaurants and cafes > Electricity supply > WSS Opex: Total - Macquarie	277	5	8.90%
3	Electricity supply > WSS Opex: Total - Macquarie	245	2	7.88%
4	Beef cattle > Meat products > Basic chemicals > WSS Opex: Total - Macquarie	71.8	4	2.31%
5	Beef cattle > Offal, hides, skins, blood meal > Basic chemicals > WSS Opex: Total - Macquarie	67.3	4	2.16%
6	Hardwoods > Black coal > Electricity supply > WSS Opex: Total - Macquarie	66.1	4	2.13%
7	Beef cattle > Meat products > Hotels, clubs, restaurants and cafes > Electricity supply > WSS Opex: Total - Macquarie	59.2	5	1.90%
8	Water supply; sewerage and drainage services > Electricity supply > WSS Opex: Total - Macquarie	37.5	3	1.20%
9	Hardwoods > Non-building repair > WSS Opex: Total - Macquarie	30.6	3	0.98%
10	Hardwoods > Railway freight transport services > Black coal > Electricity supply > WSS Opex: Total - Macquarie	29.9	5	0.96%
11	Non-building repair > WSS Opex: Total - Macquarie	27.9	2	0.90%
12	Hardwoods > LPG, LNG > Electricity supply > WSS Opex: Total - Macquarie	26.5	4	0.85%
13	Hardwoods > Electricity supply > WSS Opex: Total - Macquarie	24.8	3	0.80%
14	Beef cattle > Fresh meat > Hotels, clubs, restaurants and cafes > Electricity supply > Electricity supply > WSS Opex: Total - Macquarie	24.4	6	0.78%
15	Water supply; sewerage and drainage services > Water supply; sewerage and drainage services > WSS Opex: Total - Macquarie	23.5	3	0.76%
16	Sheep and lambs > Fresh meat > Hotels, clubs, restaurants and cafes > Electricity supply > WSS Opex: Total - Macquarie	23.5	5	0.76%
17	Electricity supply > Electricity supply > WSS Opex: Total - Macquarie	21.6	3	0.69%
18	Beef cattle > Fresh meat > Hotels, clubs, restaurants and cafes > Black coal > Electricity supply > WSS Opex: Total - Macquarie	20.8	6	0.67%

LAND DISTURBANCE				
RANK	PATH DESCRIPTION	PATH VALUE (HA)	PATH ORDER	% OF TOTAL IMPACT
19	Beef cattle > Fresh meat > Hotels, clubs, restaurants and cafes > Non-building repair > WSS Opex: Total - Macquarie	16.3	5	0.52%
20	Hardwoods > Pipeline transport > Electricity supply > WSS Opex: Total - Macquarie	14.0	4	0.45%
21	Beef cattle > Basic chemicals > WSS Opex: Total - Macquarie	13.9	3	0.45%
22	Beef cattle > Fresh meat > Fresh meat > Hotels, clubs, restaurants and cafes > Electricity supply > WSS Opex: Total - Macquarie	12.7	6	0.41%
23	Beef cattle > Fresh meat > Retail trade > Non-building repair > WSS Opex: Total - Macquarie	11.1	5	0.36%
24	Beef cattle > Fresh meat > Hotels, clubs, restaurants and cafes > Banking > Electricity supply > WSS Opex: Total - Macquarie	10.8	6	0.35%
25	Beef cattle > Fresh meat > Hotels, clubs, restaurants and cafes > Water supply; sewerage and drainage services > WSS Opex: Total - Macquarie	10.6	5	0.34%

**Table 36: Ranked structural paths for WSS Capital: Total – Lachlan, Employment**

EMPLOYMENT				
RANK	PATH DESCRIPTION	PATH VALUE (EMP-Y)	PATH ORDER	% OF TOTAL IMPACT
1	Non-building construction > WSS Capital: Total - Lachlan	568	2	23.60%
2	WSS Capital: Total - Lachlan	543	1	22.60%
3	Concrete products > WSS Capital: Total - Lachlan	223	2	9.27%
4	Computer and technical services > WSS Capital: Total - Lachlan	205	2	8.50%
5	Fabricated construction steel > WSS Capital: Total - Lachlan	96.2	2	4.00%
6	Plastic products > WSS Capital: Total - Lachlan	38.1	2	1.58%
7	Wholesale trade > WSS Capital: Total - Lachlan	33.9	2	1.41%
8	Computer and technical services > Non-building construction > WSS Capital: Total - Lachlan	15.4	3	0.64%
9	Iron and steel semi-manufactures > Fabricated construction steel > WSS Capital: Total - Lachlan	12.6	3	0.52%
10	Road freight > Concrete products > WSS Capital: Total - Lachlan	12.5	3	0.52%
11	Road freight > WSS Capital: Total - Lachlan	12.1	2	0.50%

EMPLOYMENT				
RANK	PATH DESCRIPTION	PATH VALUE (EMP-Y)	PATH ORDER	% OF TOTAL IMPACT
12	Concrete products > Concrete products > WSS Capital: Total - Lachlan	12.1	3	0.50%
13	Wholesale trade > Non-building construction > WSS Capital: Total - Lachlan	11.3	3	0.47%
14	Computer and technical services > Computer and technical services > WSS Capital: Total - Lachlan	10.6	3	0.44%
15	Construction materials > WSS Capital: Total - Lachlan	10.4	2	0.43%
16	Market research and other business management services > Computer and technical services > WSS Capital: Total - Lachlan	10.0	3	0.42%
17	Cement, lime > Concrete products > WSS Capital: Total - Lachlan	9.54	3	0.40%
18	Fabricated metal products > WSS Capital: Total - Lachlan	7.20	2	0.30%
19	Wholesale trade > Concrete products > WSS Capital: Total - Lachlan	6.11	3	0.25%
20	Fabricated metal products > Fabricated construction steel > WSS Capital: Total - Lachlan	6.03	3	0.25%
21	Fabricated metal products > Non-building construction > WSS Capital: Total - Lachlan	5.78	3	0.24%
22	Pumps > WSS Capital: Total - Lachlan	5.77	2	0.24%
23	Market research and other business management services > Concrete products > WSS Capital: Total - Lachlan	5.20	3	0.22%
24	Concrete products > Non-building construction > WSS Capital: Total - Lachlan	5.14	3	0.21%
25	Cleaning > Computer and technical services > WSS Capital: Total - Lachlan	4.81	3	0.20%

**Table 37: Ranked structural paths for WSS Capital: Total – Macquarie, Employment**

EMPLOYMENT				
RANK	PATH DESCRIPTION	PATH VALUE (EMP-Y)	PATH ORDER	% OF TOTAL IMPACT
1	WSS Capital: Total - Macquarie	103	1	19.30%
2	Non-building construction > WSS Capital: Total - Macquarie	95.5	2	18.00%
3	Computer and technical services > WSS Capital: Total - Macquarie	65.7	2	12.40%

EMPLOYMENT				
RANK	PATH DESCRIPTION	PATH VALUE (EMP-Y)	PATH ORDER	% OF TOTAL IMPACT
4	Fabricated construction steel > WSS Capital: Total - Macquarie	44.2	2	8.31%
5	Plastic products > WSS Capital: Total - Macquarie	19.8	2	3.73%
6	Wholesale trade > WSS Capital: Total - Macquarie	14.6	2	2.75%
7	Fabricated metal products > WSS Capital: Total - Macquarie	7.76	2	1.46%
8	Pumps > WSS Capital: Total - Macquarie	5.89	2	1.11%
9	Iron and steel semi-manufactures > Fabricated construction steel > WSS Capital: Total - Macquarie	5.77	3	1.08%
10	Concrete products > WSS Capital: Total - Macquarie	4.95	2	0.93%
11	Electrical equipment > WSS Capital: Total - Macquarie	3.66	2	0.69%
12	Computer and technical services > Computer and technical services > WSS Capital: Total - Macquarie	3.4	3	0.64%
13	Market research and other business management services > Computer and technical services > WSS Capital: Total - Macquarie	3.23	3	0.61%
14	Fabricated metal products > Fabricated construction steel > WSS Capital: Total - Macquarie	2.77	3	0.52%
15	Computer and technical services > Non-building construction > WSS Capital: Total - Macquarie	2.59	3	0.49%
16	Wholesale trade > Fabricated construction steel > WSS Capital: Total - Macquarie	1.95	3	0.37%
17	Wholesale trade > Non-building construction > WSS Capital: Total - Macquarie	1.9	3	0.36%
18	Fabricated construction steel > Fabricated construction steel > WSS Capital: Total - Macquarie	1.83	3	0.34%
19	Basic chemicals > Plastic products > WSS Capital: Total - Macquarie	1.56	3	0.29%
20	Cleaning > Computer and technical services > WSS Capital: Total - Macquarie	1.54	3	0.29%
21	Wholesale trade > Computer and technical services > WSS Capital: Total - Macquarie	1.45	3	0.27%
22	Structural metal products > Fabricated construction steel > WSS Capital: Total - Macquarie	1.42	3	0.27%
23	Iron and steel semi-manufactures > Iron and steel semi-manufactures > Fabricated construction steel > WSS Capital: Total - Macquarie	1.28	4	0.24%

EMPLOYMENT				
RANK	PATH DESCRIPTION	PATH VALUE (EMP-Y)	PATH ORDER	% OF TOTAL IMPACT
24	Wholesale trade > Plastic products > WSS Capital: Total - Macquarie	1.17	3	0.22%
25	Hotels, clubs, restaurants and cafes > Computer and technical services > WSS Capital: Total - Macquarie	1.16	3	0.22%

**Table 38: Ranked structural paths for WSS Opex: Total – Lachlan, Employment**

EMPLOYMENT				
RANK	PATH DESCRIPTION	PATH VALUE (EMP-Y)	PATH ORDER	% OF TOTAL IMPACT
1	WSS Opex: Total - Lachlan	676	1	37.40%
2	Non-building repair > WSS Opex: Total - Lachlan	671	2	37.00%
3	Water supply; sewerage and drainage services > WSS Opex: Total - Lachlan	77.0	2	4.25%
4	Electricity supply > WSS Opex: Total - Lachlan	44.5	2	2.46%
5	Computer and technical services > Non-building repair > WSS Opex: Total - Lachlan	17.1	3	0.94%
6	Wholesale trade > Non-building repair > WSS Opex: Total - Lachlan	12.5	3	0.69%
7	Fabricated metal products > Non-building repair > WSS Opex: Total - Lachlan	6.40	3	0.35%
8	Wholesale trade > Water supply; sewerage and drainage services > WSS Opex: Total - Lachlan	5.86	3	0.32%
9	Concrete products > Non-building repair > WSS Opex: Total - Lachlan	5.70	3	0.32%
10	Market research and other business management services > Water supply; sewerage and drainage services > WSS Opex: Total - Lachlan	5.52	3	0.30%
11	Banking > Water supply; sewerage and drainage services > WSS Opex: Total - Lachlan	5.15	3	0.28%
12	Motor vehicle and lawn mower repairs > Non-building repair > WSS Opex: Total - Lachlan	4.86	3	0.27%
13	Retail trade > Non-building repair > WSS Opex: Total - Lachlan	4.86	3	0.27%
14	Black coal > Electricity supply > WSS Opex: Total - Lachlan	4.59	3	0.25%
15	Electrical equipment > Non-building repair > WSS Opex: Total - Lachlan	4.33	3	0.24%

EMPLOYMENT				
RANK	PATH DESCRIPTION	PATH VALUE (EMP-Y)	PATH ORDER	% OF TOTAL IMPACT
16	Water supply; sewerage and drainage services > Water supply; sewerage and drainage services > WSS Opex: Total - Lachlan	4.10	3	0.23%
17	Electricity supply > Electricity supply > WSS Opex: Total - Lachlan	3.91	3	0.22%
18	Market research and other business management services > Non-building repair > WSS Opex: Total - Lachlan	3.85	3	0.21%
19	Fabricated construction steel > Non-building repair > WSS Opex: Total - Lachlan	3.25	3	0.18%
20	Employment placement > Non-building repair > WSS Opex: Total - Lachlan	3.19	3	0.18%
21	Fabricated metal products > Water supply; sewerage and drainage services > WSS Opex: Total - Lachlan	3.15	3	0.17%
22	Banking > Electricity supply > WSS Opex: Total - Lachlan	3.14	3	0.17%
23	Plant nurseries > Non-building repair > WSS Opex: Total - Lachlan	3.09	3	0.17%
24	Wholesale trade > Electricity supply > WSS Opex: Total - Lachlan	3.02	3	0.17%
25	Structural metal products > Non-building repair > WSS Opex: Total - Lachlan	2.83	3	0.16%

**Table 39: Ranked structural paths for WSS Opex: Total – Macquarie, Employment**

EMPLOYMENT				
RANK	PATH DESCRIPTION	PATH VALUE (EMP-Y)	PATH ORDER	% OF TOTAL IMPACT
1	Electricity supply > WSS Opex: Total - Macquarie	285	2	21.70%
2	WSS Opex: Total - Macquarie	252	1	19.20%
3	Non-building repair > WSS Opex: Total - Macquarie	184	2	14.00%
4	Water supply; sewerage and drainage services > WSS Opex: Total - Macquarie	31.6	2	2.40%
5	Black coal > Electricity supply > WSS Opex: Total - Macquarie	29.5	3	2.24%
6	Electricity supply > Electricity supply > WSS Opex: Total - Macquarie	25.1	3	1.91%
7	Banking > Electricity supply > WSS Opex: Total - Macquarie	20.1	3	1.53%

EMPLOYMENT				
RANK	PATH DESCRIPTION	PATH VALUE (EMP-Y)	PATH ORDER	% OF TOTAL IMPACT
8	Wholesale trade > Electricity supply > WSS Opex: Total - Macquarie	19.4	3	1.47%
9	Motor vehicle and lawn mower repairs > Electricity supply > WSS Opex: Total - Macquarie	13.3	3	1.01%
10	Railway freight transport services > Black coal > Electricity supply > WSS Opex: Total - Macquarie	10.8	4	0.82%
11	Basic chemicals > WSS Opex: Total - Macquarie	8.96	2	0.68%
12	Concrete products > Electricity supply > WSS Opex: Total - Macquarie	8.06	3	0.61%
13	Non-bank finance > Electricity supply > WSS Opex: Total - Macquarie	6.87	3	0.52%
14	Education > Electricity supply > WSS Opex: Total - Macquarie	6.60	3	0.50%
15	Hotels, clubs, restaurants and cafes > Electricity supply > WSS Opex: Total - Macquarie	6.52	3	0.50%
16	Gas supply > Electricity supply > WSS Opex: Total - Macquarie	6.34	3	0.48%
17	Electrical equipment > Electricity supply > WSS Opex: Total - Macquarie	5.68	3	0.43%
18	Plant leasing, hiring and renting services > Electricity supply > WSS Opex: Total - Macquarie	5.66	3	0.43%
19	Computer and technical services > Non-building repair > WSS Opex: Total - Macquarie	4.69	3	0.36%
20	Market research and other business management services > Gas supply > Electricity supply > WSS Opex: Total - Macquarie	4.51	4	0.34%
21	Railway freight transport services > Electricity supply > WSS Opex: Total - Macquarie	3.59	3	0.27%
22	Wholesale trade > Non-building repair > WSS Opex: Total - Macquarie	3.44	3	0.26%
23	Wholesale repair and servicing > Electricity supply > WSS Opex: Total - Macquarie	3.22	3	0.25%
24	Domestic telecommunication services > Electricity supply > WSS Opex: Total - Macquarie	3.03	3	0.23%
25	Road freight > Electricity supply > WSS Opex: Total - Macquarie	3.02	3	0.23%

**Table 40: Ranked structural paths for WSS Capital: Total – Lachlan, Family Income**

FAMILY INCOME				
RANK	PATH DESCRIPTION	PATH VALUE (\$'000)	PATH ORDER	% OF TOTAL IMPACT
1	WSS Capital: Total - Lachlan	100,925	1	55.20%
2	Non-building construction > WSS Capital: Total - Lachlan	14,568	2	7.97%
3	Computer and technical services > WSS Capital: Total - Lachlan	11,283	2	6.17%
4	Concrete products > WSS Capital: Total - Lachlan	6,493	2	3.55%
5	Fabricated construction steel > WSS Capital: Total - Lachlan	6,132	2	3.35%
6	Plastic products > WSS Capital: Total - Lachlan	2,381	2	1.30%
7	Wholesale trade > WSS Capital: Total - Lachlan	1,693	2	0.93%
8	Computer and technical services > Non-building construction > WSS Capital: Total - Lachlan	849	3	0.46%
9	Pumps > WSS Capital: Total - Lachlan	830	2	0.45%
10	Iron and steel semi-manufactures > Fabricated construction steel > WSS Capital: Total - Lachlan	828	3	0.45%
11	Computer and technical services > Computer and technical services > WSS Capital: Total - Lachlan	584	3	0.32%
12	Wholesale trade > Non-building construction > WSS Capital: Total - Lachlan	564	3	0.31%
13	Cement, lime > Concrete products > WSS Capital: Total - Lachlan	553	3	0.30%
14	Road freight > Concrete products > WSS Capital: Total - Lachlan	514	3	0.28%
15	Road freight > WSS Capital: Total - Lachlan	500	2	0.27%
16	Construction materials > WSS Capital: Total - Lachlan	498	2	0.27%
17	Market research and other business management services > Computer and technical services > WSS Capital: Total - Lachlan	460	3	0.25%
18	Concrete products > Concrete products > WSS Capital: Total - Lachlan	351	3	0.19%
19	Fabricated metal products > WSS Capital: Total - Lachlan	305	2	0.17%
20	Wholesale trade > Concrete products > WSS Capital: Total - Lachlan	305	3	0.17%

FAMILY INCOME				
RANK	PATH DESCRIPTION	PATH VALUE (\$'000)	PATH ORDER	% OF TOTAL IMPACT
21	Motor vehicle and lawn mower repairs > Non-building construction > WSS Capital: Total - Lachlan	261	3	0.14%
22	Fabricated metal products > Fabricated construction steel > WSS Capital: Total - Lachlan	256	3	0.14%
23	Fabricated construction steel > Fabricated construction steel > WSS Capital: Total - Lachlan	254	3	0.14%
24	Fabricated metal products > Non-building construction > WSS Capital: Total - Lachlan	245	3	0.13%
25	Electrical equipment > Non-building construction > WSS Capital: Total - Lachlan	245	3	0.13%

**Table 41: Ranked structural paths for WSS Capital: Total – Macquarie, Family Income**

FAMILY INCOME				
RANK	PATH DESCRIPTION	PATH VALUE (\$'000)	PATH ORDER	% OF TOTAL IMPACT
1	WSS Capital: Total - Macquarie	25,680	1	53.90%
2	Computer and technical services > WSS Capital: Total - Macquarie	3,623	2	7.61%
3	Fabricated construction steel > WSS Capital: Total - Macquarie	2,815	2	5.91%
4	Non-building construction > WSS Capital: Total - Macquarie	2,451	2	5.15%
5	Plastic products > WSS Capital: Total - Macquarie	1,239	2	2.60%
6	Pumps > WSS Capital: Total - Macquarie	846	2	1.78%
7	Wholesale trade > WSS Capital: Total - Macquarie	731	2	1.53%
8	Iron and steel semi-manufactures > Fabricated construction steel > WSS Capital: Total - Macquarie	380	3	0.80%
9	Fabricated metal products > WSS Capital: Total - Macquarie	329	2	0.69%
10	Electrical equipment > WSS Capital: Total - Macquarie	230	2	0.48%
11	Computer and technical services > Computer and technical services > WSS Capital: Total - Macquarie	188	3	0.39%
12	Market research and other business management services > Computer and technical services > WSS Capital: Total - Macquarie	148	3	0.31%
13	Concrete products > WSS Capital: Total - Macquarie	144	2	0.30%

FAMILY INCOME				
RANK	PATH DESCRIPTION	PATH VALUE (\$'000)	PATH ORDER	% OF TOTAL IMPACT
14	Computer and technical services > Non-building construction > WSS Capital: Total - Macquarie	143	3	0.30%
15	Fabricated metal products > Fabricated construction steel > WSS Capital: Total - Macquarie	117	3	0.25%
16	Fabricated construction steel > Fabricated construction steel > WSS Capital: Total - Macquarie	116	3	0.24%
17	Wholesale trade > Fabricated construction steel > WSS Capital: Total - Macquarie	98	3	0.20%
18	Wholesale trade > Non-building construction > WSS Capital: Total - Macquarie	95	3	0.20%
19	Iron and steel semi-manufactures > Iron and steel semi-manufactures > Fabricated construction steel > WSS Capital: Total - Macquarie	84	4	0.18%
20	Wholesale trade > Computer and technical services > WSS Capital: Total - Macquarie	72	3	0.15%
21	Employment placement > Fabricated construction steel > WSS Capital: Total - Macquarie	67	3	0.14%
22	Education > Computer and technical services > WSS Capital: Total - Macquarie	64	3	0.13%
23	Plastic products > Plastic products > WSS Capital: Total - Macquarie	62	3	0.13%
24	Wholesale trade > Plastic products > WSS Capital: Total - Macquarie	59	3	0.12%
25	Legal services > Computer and technical services > WSS Capital: Total - Macquarie	53	3	0.11%

**Table 42: Ranked structural paths for WSS Opex: Total – Lachlan, Family Income**

FAMILY INCOME				
RANK	PATH DESCRIPTION	PATH VALUE (\$'000)	PATH ORDER	% OF TOTAL IMPACT
1	WSS Opex: Total - Lachlan	67,636	1	58.50%
2	Non-building repair > WSS Opex: Total - Lachlan	20,068	2	17.40%
3	Water supply; sewerage and drainage services > WSS Opex: Total - Lachlan	4,267	2	3.69%
4	Electricity supply > WSS Opex: Total - Lachlan	3,452	2	2.99%
5	Computer and technical services > Non-building repair > WSS Opex: Total - Lachlan	942	3	0.82%

FAMILY INCOME				
RANK	PATH DESCRIPTION	PATH VALUE (\$'000)	PATH ORDER	% OF TOTAL IMPACT
6	Wholesale trade > Non-building repair > WSS Opex: Total - Lachlan	626	3	0.54%
7	Banking > Water supply; sewerage and drainage services > WSS Opex: Total - Lachlan	520	3	0.45%
8	Black coal > Electricity supply > WSS Opex: Total - Lachlan	418	3	0.36%
9	Banking > Electricity supply > WSS Opex: Total - Lachlan	317	3	0.27%
10	Electricity supply > Electricity supply > WSS Opex: Total - Lachlan	304	3	0.26%
11	Wholesale trade > Water supply; sewerage and drainage services > WSS Opex: Total - Lachlan	293	3	0.25%
12	Motor vehicle and lawn mower repairs > Non-building repair > WSS Opex: Total - Lachlan	290	3	0.25%
13	Electrical equipment > Non-building repair > WSS Opex: Total - Lachlan	272	3	0.24%
14	Fabricated metal products > Non-building repair > WSS Opex: Total - Lachlan	271	3	0.23%
15	Employment placement > Non-building repair > WSS Opex: Total - Lachlan	265	3	0.23%
16	Market research and other business management services > Water supply; sewerage and drainage services > WSS Opex: Total - Lachlan	253	3	0.22%
17	Water supply; sewerage and drainage services > Water supply; sewerage and drainage services > WSS Opex: Total - Lachlan	227	3	0.20%
18	Fabricated construction steel > Non-building repair > WSS Opex: Total - Lachlan	207	3	0.18%
19	Market research and other business management services > Non-building repair > WSS Opex: Total - Lachlan	176	3	0.15%
20	Banking > Non-building repair > WSS Opex: Total - Lachlan	168	3	0.15%
21	LPG, LNG > Electricity supply > WSS Opex: Total - Lachlan	168	3	0.14%
22	Concrete products > Non-building repair > WSS Opex: Total - Lachlan	166	3	0.14%
23	Retail trade > Non-building repair > WSS Opex: Total - Lachlan	161	3	0.14%
24	Wholesale trade > Electricity supply > WSS Opex: Total - Lachlan	151	3	0.13%

FAMILY INCOME				
RANK	PATH DESCRIPTION	PATH VALUE (\$'000)	PATH ORDER	% OF TOTAL IMPACT
25	Property services > Non-building repair > WSS Opex: Total - Lachlan	145	3	0.13%

**Table 43: Ranked structural paths for WSS Opex: Total – Macquarie, Family Income**

FAMILY INCOME				
RANK	PATH DESCRIPTION	PATH VALUE (\$'000)	PATH ORDER	% OF TOTAL IMPACT
1	WSS Opex: Total - Macquarie	25,246	1	27.60%
2	Electricity supply > WSS Opex: Total - Macquarie	22,139	2	24.20%
3	Non-building repair > WSS Opex: Total - Macquarie	5,512	2	6.03%
4	Black coal > Electricity supply > WSS Opex: Total - Macquarie	2,683	3	2.94%
5	Banking > Electricity supply > WSS Opex: Total - Macquarie	2,031	3	2.22%
6	Electricity supply > Electricity supply > WSS Opex: Total - Macquarie	1,947	3	2.13%
7	Water supply; sewerage and drainage services > WSS Opex: Total - Macquarie	1,753	2	1.92%
8	LPG, LNG > Electricity supply > WSS Opex: Total - Macquarie	1,074	3	1.18%
9	Wholesale trade > Electricity supply > WSS Opex: Total - Macquarie	967	3	1.06%
10	Motor vehicle and lawn mower repairs > Electricity supply > WSS Opex: Total - Macquarie	794	3	0.87%
11	Railway freight transport services > Black coal > Electricity supply > WSS Opex: Total - Macquarie	674	4	0.74%
12	Education > Electricity supply > WSS Opex: Total - Macquarie	419	3	0.46%
13	Plant leasing, hiring and renting services > Electricity supply > WSS Opex: Total - Macquarie	368	3	0.40%
14	Electrical equipment > Electricity supply > WSS Opex: Total - Macquarie	357	3	0.39%
15	Non-bank finance > Electricity supply > WSS Opex: Total - Macquarie	349	3	0.38%
16	Pipeline transport > Electricity supply > WSS Opex: Total - Macquarie	333	3	0.36%

FAMILY INCOME				
RANK	PATH DESCRIPTION	PATH VALUE (\$'000)	PATH ORDER	% OF TOTAL IMPACT
17	Domestic telecommunication services > Electricity supply > WSS Opex: Total - Macquarie	324	3	0.35%
18	Gas supply > Electricity supply > WSS Opex: Total - Macquarie	317	3	0.35%
19	Basic chemicals > WSS Opex: Total - Macquarie	287	2	0.31%
20	Data processing services > Electricity supply > WSS Opex: Total - Macquarie	270	3	0.30%
21	Computer and technical services > Non-building repair > WSS Opex: Total - Macquarie	259	3	0.28%
22	Natural gas > Electricity supply > WSS Opex: Total - Macquarie	259	3	0.28%
23	Hotels, clubs, restaurants and cafes > Electricity supply > WSS Opex: Total - Macquarie	252	3	0.28%
24	Black coal > Electricity supply > Electricity supply > WSS Opex: Total - Macquarie	236	4	0.26%
25	Concrete products > Electricity supply > WSS Opex: Total - Macquarie	234	3	0.26%

**Table 44: Ranked structural paths for WSS Capital: Total – Lachlan, Gross Operating Surplus**

GROSS OPERATING SURPLUS				
RANK	PATH DESCRIPTION	PATH VALUE (\$'000)	PATH ORDER	% OF TOTAL IMPACT
1	Non-building construction > WSS Capital: Total - Lachlan	10,357	2	19.60%
2	Concrete products > WSS Capital: Total - Lachlan	5,980	2	11.30%
3	Computer and technical services > WSS Capital: Total - Lachlan	2,917	2	5.51%
4	Fabricated construction steel > WSS Capital: Total - Lachlan	2,870	2	5.42%
5	Plastic products > WSS Capital: Total - Lachlan	1,664	2	3.14%
6	Construction materials > WSS Capital: Total - Lachlan	1,318	2	2.49%
7	Cement, lime > Concrete products > WSS Capital: Total - Lachlan	1,171	3	2.21%
8	Iron and steel semi-manufactures > Fabricated construction steel > WSS Capital: Total - Lachlan	560	3	1.06%
9	Motor vehicle and lawn mower repairs > Non-building construction > WSS Capital: Total - Lachlan	401	3	0.76%

GROSS OPERATING SURPLUS				
RANK	PATH DESCRIPTION	PATH VALUE (\$'000)	PATH ORDER	% OF TOTAL IMPACT
10	Construction materials > Concrete products > WSS Capital: Total - Lachlan	341	3	0.64%
11	Road freight > Concrete products > WSS Capital: Total - Lachlan	330	3	0.62%
12	Concrete products > Concrete products > WSS Capital: Total - Lachlan	323	3	0.61%
13	Road freight > WSS Capital: Total - Lachlan	321	2	0.61%
14	Wholesale trade > WSS Capital: Total - Lachlan	269	2	0.51%
15	Pumps > WSS Capital: Total - Lachlan	247	2	0.47%
16	Computer and technical services > Non-building construction > WSS Capital: Total - Lachlan	219	3	0.41%
17	Domestic telecommunication services > Computer and technical services > WSS Capital: Total - Lachlan	204	3	0.39%
18	Sand > Concrete products > WSS Capital: Total - Lachlan	182	3	0.34%
19	Property services > Non-building construction > WSS Capital: Total - Lachlan	177	3	0.33%
20	Radio and television stations > Computer and technical services > WSS Capital: Total - Lachlan	175	3	0.33%
21	Market research and other business management services > Computer and technical services > WSS Capital: Total - Lachlan	170	3	0.32%
22	Computer and technical services > Computer and technical services > WSS Capital: Total - Lachlan	151	3	0.29%
23	Property operator and developer services > Wholesale trade > WSS Capital: Total - Lachlan	151	3	0.28%
24	Iron ores > Iron and steel semi-manufactures > Fabricated construction steel > WSS Capital: Total - Lachlan	147	4	0.28%
25	Electricity supply > Concrete products > WSS Capital: Total - Lachlan	146	3	0.27%

**Table 45: Ranked structural paths for WSS Capital: Total – Macquarie, Gross Operating Surplus**

GROSS OPERATING SURPLUS				
RANK	PATH DESCRIPTION	PATH VALUE (\$'000)	PATH ORDER	% OF TOTAL IMPACT
1	Non-building construction > WSS Capital: Total - Macquarie	1,742	2	14.30%

<b>GROSS OPERATING SURPLUS</b>				
<b>RANK</b>	<b>PATH DESCRIPTION</b>	<b>PATH VALUE (\$'000)</b>	<b>PATH ORDER</b>	<b>% OF TOTAL IMPACT</b>
2	Fabricated construction steel > WSS Capital: Total - Macquarie	1,318	2	10.80%
3	Computer and technical services > WSS Capital: Total - Macquarie	937	2	7.68%
4	Plastic products > WSS Capital: Total - Macquarie	866	2	7.10%
5	Iron and steel semi-manufactures > Fabricated construction steel > WSS Capital: Total - Macquarie	257	3	2.11%
6	Pumps > WSS Capital: Total - Macquarie	252	2	2.07%
7	Concrete products > WSS Capital: Total - Macquarie	132	2	1.09%
8	Wholesale trade > WSS Capital: Total - Macquarie	116	2	0.95%
9	Electrical equipment > WSS Capital: Total - Macquarie	114	2	0.93%
10	Fabricated metal products > WSS Capital: Total - Macquarie	101	2	0.83%
11	Motor vehicle and lawn mower repairs > Non-building construction > WSS Capital: Total - Macquarie	68	3	0.55%
12	Iron ores > Iron and steel semi-manufactures > Fabricated construction steel > WSS Capital: Total - Macquarie	67	4	0.55%
13	Domestic telecommunication services > Computer and technical services > WSS Capital: Total - Macquarie	66	3	0.54%
14	Property operator and developer services > Wholesale trade > WSS Capital: Total - Macquarie	65	3	0.53%
15	Iron and steel semi-manufactures > Iron and steel semi-manufactures > Fabricated construction steel > WSS Capital: Total - Macquarie	57	4	0.47%
16	Radio and television stations > Computer and technical services > WSS Capital: Total - Macquarie	56	3	0.46%
17	Basic chemicals > Plastic products > WSS Capital: Total - Macquarie	56	3	0.46%
18	Fabricated construction steel > Fabricated construction steel > WSS Capital: Total - Macquarie	54	3	0.45%
19	Market research and other business management services > Computer and technical services > WSS Capital: Total - Macquarie	54	3	0.45%
20	Computer and technical services > Computer and technical services > WSS Capital: Total - Macquarie	49	3	0.40%
21	Forwarding agencies > Fabricated construction steel > WSS Capital: Total - Macquarie	47	3	0.39%

GROSS OPERATING SURPLUS				
RANK	PATH DESCRIPTION	PATH VALUE (\$'000)	PATH ORDER	% OF TOTAL IMPACT
22	Water supply; sewerage and drainage services > Computer and technical services > WSS Capital: Total - Macquarie	44	3	0.36%
23	Storage > Wholesale trade > WSS Capital: Total - Macquarie	43	3	0.35%
24	Plastic products > Plastic products > WSS Capital: Total - Macquarie	43	3	0.35%
25	Black coal > Iron and steel semi-manufactures > Fabricated construction steel > WSS Capital: Total - Macquarie	38	4	0.31%

**Table 46: Ranked structural paths for WSS Opex: Total – Lachlan, Gross Operating Surplus**

GROSS OPERATING SURPLUS				
RANK	PATH DESCRIPTION	PATH VALUE (\$'000)	PATH ORDER	% OF TOTAL IMPACT
1	Non-building repair > WSS Opex: Total - Lachlan	14,267	2	24.80%
2	Water supply; sewerage and drainage services > WSS Opex: Total - Lachlan	14,114	2	24.50%
3	Electricity supply > WSS Opex: Total - Lachlan	10,753	2	18.70%
4	Black coal > Electricity supply > WSS Opex: Total - Lachlan	1,852	3	3.22%
5	Electricity supply > Electricity supply > WSS Opex: Total - Lachlan	946	3	1.64%
6	Water supply; sewerage and drainage services > Water supply; sewerage and drainage services > WSS Opex: Total - Lachlan	751	3	1.31%
7	LPG, LNG > Electricity supply > WSS Opex: Total - Lachlan	742	3	1.29%
8	Motor vehicle and lawn mower repairs > Non-building repair > WSS Opex: Total - Lachlan	446	3	0.78%
9	Banking > Water supply; sewerage and drainage services > WSS Opex: Total - Lachlan	361	3	0.63%
10	Electricity supply > Water supply; sewerage and drainage services > WSS Opex: Total - Lachlan	305	3	0.53%
11	Gas supply > Electricity supply > WSS Opex: Total - Lachlan	264	3	0.46%
12	Computer and technical services > Non-building repair > WSS Opex: Total - Lachlan	244	3	0.42%
13	Banking > Electricity supply > WSS Opex: Total - Lachlan	219	3	0.38%

GROSS OPERATING SURPLUS				
RANK	PATH DESCRIPTION	PATH VALUE (\$'000)	PATH ORDER	% OF TOTAL IMPACT
14	Property services > Non-building repair > WSS Opex: Total - Lachlan	196	3	0.34%
15	Motor vehicle and lawn mower repairs > Electricity supply > WSS Opex: Total - Lachlan	190	3	0.33%
16	Natural gas > Electricity supply > WSS Opex: Total - Lachlan	179	3	0.31%
17	Black coal > Electricity supply > Electricity supply > WSS Opex: Total - Lachlan	163	4	0.28%
18	Concrete products > Non-building repair > WSS Opex: Total - Lachlan	153	3	0.27%
19	Electrical equipment > Non-building repair > WSS Opex: Total - Lachlan	135	3	0.23%
20	Brown coal > Electricity supply > WSS Opex: Total - Lachlan	122	3	0.21%
21	Construction materials > Non-building repair > WSS Opex: Total - Lachlan	120	3	0.21%
22	Non-bank finance > Water supply; sewerage and drainage services > WSS Opex: Total - Lachlan	119	3	0.21%
23	Banking > Non-building repair > WSS Opex: Total - Lachlan	117	3	0.20%
24	Plant leasing, hiring and renting services > Non-building repair > WSS Opex: Total - Lachlan	99	3	0.17%
25	Wholesale trade > Non-building repair > WSS Opex: Total - Lachlan	99	3	0.17%

**Table 47: Ranked structural paths for WSS Opex: Total – Macquarie, Gross Operating Surplus**

GROSS OPERATING SURPLUS				
RANK	PATH DESCRIPTION	PATH VALUE (\$'000)	PATH ORDER	% OF TOTAL IMPACT
1	Electricity supply > WSS Opex: Total - Macquarie	68,958	2	52.90%
2	Black coal > Electricity supply > WSS Opex: Total - Macquarie	11,877	3	9.12%
3	Electricity supply > Electricity supply > WSS Opex: Total - Macquarie	6,065	3	4.66%
4	Water supply; sewerage and drainage services > WSS Opex: Total - Macquarie	5,798	2	4.45%
5	LPG, LNG > Electricity supply > WSS Opex: Total - Macquarie	4,755	3	3.65%
6	Non-building repair > WSS Opex: Total - Macquarie	3,918	2	3.01%

<b>GROSS OPERATING SURPLUS</b>				
<b>RANK</b>	<b>PATH DESCRIPTION</b>	<b>PATH VALUE (\$'000)</b>	<b>PATH ORDER</b>	<b>% OF TOTAL IMPACT</b>
7	Gas supply > Electricity supply > WSS Opex: Total - Macquarie	1,690	3	1.30%
8	Banking > Electricity supply > WSS Opex: Total - Macquarie	1,408	3	1.08%
9	Motor vehicle and lawn mower repairs > Electricity supply > WSS Opex: Total - Macquarie	1,221	3	0.94%
10	Natural gas > Electricity supply > WSS Opex: Total - Macquarie	1,146	3	0.88%
11	Black coal > Electricity supply > Electricity supply > WSS Opex: Total - Macquarie	1,045	4	0.80%
12	Brown coal > Electricity supply > WSS Opex: Total - Macquarie	784	3	0.60%
13	Electricity supply > Electricity supply > Electricity supply > WSS Opex: Total - Macquarie	533	4	0.41%
14	Non-bank finance > Electricity supply > WSS Opex: Total - Macquarie	510	3	0.39%
15	Plant leasing, hiring and renting services > Electricity supply > WSS Opex: Total - Macquarie	496	3	0.38%
16	Water supply; sewerage and drainage services > Electricity supply > WSS Opex: Total - Macquarie	491	3	0.38%
17	LPG, LNG > Electricity supply > Electricity supply > WSS Opex: Total - Macquarie	418	4	0.32%
18	Domestic telecommunication services > Electricity supply > WSS Opex: Total - Macquarie	403	3	0.31%
19	Railway freight transport services > Black coal > Electricity supply > WSS Opex: Total - Macquarie	351	4	0.27%
20	Basic chemicals > WSS Opex: Total - Macquarie	322	2	0.25%
21	Water supply; sewerage and drainage services > Water supply; sewerage and drainage services > WSS Opex: Total - Macquarie	309	3	0.24%
22	Black coal > Black coal > Electricity supply > WSS Opex: Total - Macquarie	256	4	0.20%
23	Concrete products > Electricity supply > WSS Opex: Total - Macquarie	216	3	0.17%
24	Wholesale repair and servicing > Electricity supply > WSS Opex: Total - Macquarie	186	3	0.14%
25	Electrical equipment > Electricity supply > WSS Opex: Total - Macquarie	177	3	0.14%

**Table 48: Ranked structural paths for WSS Capital: Total – Lachlan, Imports**

IMPORTS				
RANK	PATH DESCRIPTION	PATH VALUE (\$'000)	PATH ORDER	% OF TOTAL IMPACT
1	Non-building construction > WSS Capital: Total - Lachlan	3,613	2	13.30%
2	Computer and technical services > WSS Capital: Total - Lachlan	3,138	2	11.60%
3	Plastic products > WSS Capital: Total - Lachlan	2,210	2	8.15%
4	Fabricated construction steel > WSS Capital: Total - Lachlan	2,059	2	7.59%
5	Concrete products > WSS Capital: Total - Lachlan	1,859	2	6.85%
6	Pumps > WSS Capital: Total - Lachlan	571	2	2.10%
7	Iron and steel semi-manufactures > Fabricated construction steel > WSS Capital: Total - Lachlan	488	3	1.80%
8	Construction materials > WSS Capital: Total - Lachlan	343	2	1.27%
9	Computer and technical services > Non-building construction > WSS Capital: Total - Lachlan	236	3	0.87%
10	Wholesale trade > WSS Capital: Total - Lachlan	230	2	0.85%
11	Electrical equipment > Non-building construction > WSS Capital: Total - Lachlan	220	3	0.81%
12	Basic chemicals > Plastic products > WSS Capital: Total - Lachlan	183	3	0.68%
13	Computer and technical services > Computer and technical services > WSS Capital: Total - Lachlan	162	3	0.60%
14	Industrial machinery and equipment > Concrete products > WSS Capital: Total - Lachlan	147	3	0.54%
15	Electrical equipment > WSS Capital: Total - Lachlan	135	2	0.50%
16	Chemical fertilisers > Plastic products > WSS Capital: Total - Lachlan	134	3	0.49%
17	Fabricated metal products > WSS Capital: Total - Lachlan	116	2	0.43%
18	Plastic products > Plastic products > WSS Capital: Total - Lachlan	110	3	0.40%
19	Iron and steel semi-manufactures > Iron and steel semi-manufactures > Fabricated construction steel > WSS Capital: Total - Lachlan	108	4	0.40%
20	Market research and other business management services > Computer and technical services > WSS Capital: Total - Lachlan	102	3	0.38%

IMPORTS				
RANK	PATH DESCRIPTION	PATH VALUE (\$'000)	PATH ORDER	% OF TOTAL IMPACT
21	Concrete products > Concrete products > WSS Capital: Total - Lachlan	100	3	0.37%
22	Electronic equipment > Non-building construction > WSS Capital: Total - Lachlan	99	3	0.37%
23	Fabricated metal products > Fabricated construction steel > WSS Capital: Total - Lachlan	97	3	0.36%
24	Cement, lime > Concrete products > WSS Capital: Total - Lachlan	94	3	0.35%
25	Fabricated metal products > Non-building construction > WSS Capital: Total - Lachlan	93	3	0.34%

**Table 49: Ranked structural paths for WSS Capital: Total – Macquarie, Imports**

IMPORTS				
RANK	PATH DESCRIPTION	PATH VALUE (\$'000)	PATH ORDER	% OF TOTAL IMPACT
1	Plastic products > WSS Capital: Total - Macquarie	1,150	2	13.90%
2	Computer and technical services > WSS Capital: Total - Macquarie	1,007	2	12.20%
3	Fabricated construction steel > WSS Capital: Total - Macquarie	945	2	11.40%
4	Non-building construction > WSS Capital: Total - Macquarie	608	2	7.35%
5	Pumps > WSS Capital: Total - Macquarie	582	2	7.03%
6	Iron and steel semi-manufactures > Fabricated construction steel > WSS Capital: Total - Macquarie	224	3	2.71%
7	Electrical equipment > WSS Capital: Total - Macquarie	207	2	2.50%
8	Fabricated metal products > WSS Capital: Total - Macquarie	124	2	1.50%
9	Wholesale trade > WSS Capital: Total - Macquarie	99	2	1.20%
10	Basic chemicals > Plastic products > WSS Capital: Total - Macquarie	95	3	1.15%
11	Chemical fertilisers > Plastic products > WSS Capital: Total - Macquarie	70	3	0.84%
12	Plastic products > Plastic products > WSS Capital: Total - Macquarie	57	3	0.69%
13	Computer and technical services > Computer and technical services > WSS Capital: Total - Macquarie	52	3	0.63%

IMPORTS				
RANK	PATH DESCRIPTION	PATH VALUE (\$'000)	PATH ORDER	% OF TOTAL IMPACT
14	Iron and steel semi-manufactures > Iron and steel semi-manufactures > Fabricated construction steel > WSS Capital: Total - Macquarie	50	4	0.60%
15	Fabricated metal products > Fabricated construction steel > WSS Capital: Total - Macquarie	44	3	0.54%
16	Concrete products > WSS Capital: Total - Macquarie	41	2	0.50%
17	Computer and technical services > Non-building construction > WSS Capital: Total - Macquarie	40	3	0.48%
18	Fabricated construction steel > Fabricated construction steel > WSS Capital: Total - Macquarie	39	3	0.47%
19	Electrical equipment > Non-building construction > WSS Capital: Total - Macquarie	37	3	0.45%
20	Precious metals > Iron and steel semi-manufactures > Fabricated construction steel > WSS Capital: Total - Macquarie	33	4	0.40%
21	Market research and other business management services > Computer and technical services > WSS Capital: Total - Macquarie	33	3	0.40%
22	Precious metals > Electrical equipment > WSS Capital: Total - Macquarie	30	3	0.36%
23	Electronic equipment > Computer and technical services > WSS Capital: Total - Macquarie	29	3	0.35%
24	Iron and steel semi-manufactures > Pumps > WSS Capital: Total - Macquarie	25	3	0.30%
25	Printing and stationery > Computer and technical services > WSS Capital: Total - Macquarie	17	3	0.21%

**Table 50: Ranked structural paths for WSS Opex: Total – Lachlan, Imports**

IMPORTS				
RANK	PATH DESCRIPTION	PATH VALUE (\$'000)	PATH ORDER	% OF TOTAL IMPACT
1	Non-building repair > WSS Opex: Total - Lachlan	3,395	2	25.40%
2	Water supply; sewerage and drainage services > WSS Opex: Total - Lachlan	2,356	2	17.60%
3	Electricity supply > WSS Opex: Total - Lachlan	942	2	7.03%
4	Computer and technical services > Non-building repair > WSS Opex: Total - Lachlan	262	3	1.96%

<b>IMPORTS</b>				
<b>RANK</b>	<b>PATH DESCRIPTION</b>	<b>PATH VALUE (\$'000)</b>	<b>PATH ORDER</b>	<b>% OF TOTAL IMPACT</b>
5	Electrical equipment > Non-building repair > WSS Opex: Total - Lachlan	245	3	1.83%
6	Black coal > Electricity supply > WSS Opex: Total - Lachlan	169	3	1.26%
7	Water supply; sewerage and drainage services > Water supply; sewerage and drainage services > WSS Opex: Total - Lachlan	125	3	0.94%
8	Fabricated metal products > Non-building repair > WSS Opex: Total - Lachlan	103	3	0.77%
9	Gas oil or fuel oil > Water supply; sewerage and drainage services > WSS Opex: Total - Lachlan	103	3	0.77%
10	Wholesale trade > Non-building repair > WSS Opex: Total - Lachlan	85	3	0.63%
11	Electricity supply > Electricity supply > WSS Opex: Total - Lachlan	83	3	0.62%
12	Industrial machinery repairs > Non-building repair > WSS Opex: Total - Lachlan	76	3	0.57%
13	Paints > Non-building repair > WSS Opex: Total - Lachlan	72	3	0.54%
14	LPG, LNG > Electricity supply > WSS Opex: Total - Lachlan	70	3	0.52%
15	Fabricated construction steel > Non-building repair > WSS Opex: Total - Lachlan	70	3	0.52%
16	Iron and steel semi-manufactures > Non-building repair > WSS Opex: Total - Lachlan	70	3	0.52%
17	Motor vehicle and lawn mower repairs > Non-building repair > WSS Opex: Total - Lachlan	66	3	0.49%
18	Bitumen > Non-building repair > WSS Opex: Total - Lachlan	60	3	0.45%
19	Kerosene > Electricity supply > WSS Opex: Total - Lachlan	57	3	0.42%
20	Market research and other business management services > Water supply; sewerage and drainage services > WSS Opex: Total - Lachlan	56	3	0.42%
21	Fabricated metal products > Water supply; sewerage and drainage services > WSS Opex: Total - Lachlan	51	3	0.38%
22	Electrical equipment > Electricity supply > WSS Opex: Total - Lachlan	50	3	0.37%
23	Aluminium doors > Non-building repair > WSS Opex: Total - Lachlan	48	3	0.36%

IMPORTS				
RANK	PATH DESCRIPTION	PATH VALUE (\$'000)	PATH ORDER	% OF TOTAL IMPACT
24	Concrete products > Non-building repair > WSS Opex: Total - Lachlan	48	3	0.35%
25	Electronic equipment > Water supply; sewerage and drainage services > WSS Opex: Total - Lachlan	45	3	0.33%

**Table 51: Ranked structural paths for WSS Opex: Total – Macquarie, Imports**

IMPORTS				
RANK	PATH DESCRIPTION	PATH VALUE (\$'000)	PATH ORDER	% OF TOTAL IMPACT
1	Electricity supply > WSS Opex: Total - Macquarie	6,039	2	29.60%
2	Black coal > Electricity supply > WSS Opex: Total - Macquarie	1,081	3	5.30%
3	Water supply; sewerage and drainage services > WSS Opex: Total - Macquarie	968	2	4.75%
4	Non-building repair > WSS Opex: Total - Macquarie	932	2	4.58%
5	Basic chemicals > WSS Opex: Total - Macquarie	548	2	2.69%
6	Electricity supply > Electricity supply > WSS Opex: Total - Macquarie	531	3	2.61%
7	LPG, LNG > Electricity supply > WSS Opex: Total - Macquarie	448	3	2.20%
8	Kerosene > Electricity supply > WSS Opex: Total - Macquarie	363	3	1.78%
9	Electrical equipment > Electricity supply > WSS Opex: Total - Macquarie	321	3	1.57%
10	Gas supply > Electricity supply > WSS Opex: Total - Macquarie	254	3	1.25%
11	Motor vehicle and lawn mower repairs > Electricity supply > WSS Opex: Total - Macquarie	180	3	0.88%
12	Wholesale trade > Electricity supply > WSS Opex: Total - Macquarie	131	3	0.64%
13	Gas oil or fuel oil > Black coal > Electricity supply > WSS Opex: Total - Macquarie	126	4	0.62%
14	Natural gas > Electricity supply > WSS Opex: Total - Macquarie	113	3	0.56%
15	Brown coal > Electricity supply > WSS Opex: Total - Macquarie	110	3	0.54%

<b>IMPORTS</b>				
<b>RANK</b>	<b>PATH DESCRIPTION</b>	<b>PATH VALUE (\$'000)</b>	<b>PATH ORDER</b>	<b>% OF TOTAL IMPACT</b>
16	Motor vehicle parts > Motor vehicle and lawn mower repairs > Electricity supply > WSS Opex: Total - Macquarie	98	4	0.48%
17	Black coal > Electricity supply > Electricity supply > WSS Opex: Total - Macquarie	95	4	0.47%
18	Domestic telecommunication services > Electricity supply > WSS Opex: Total - Macquarie	95	3	0.47%
19	Water supply; sewerage and drainage services > Electricity supply > WSS Opex: Total - Macquarie	82	3	0.40%
20	Data processing services > Electricity supply > WSS Opex: Total - Macquarie	81	3	0.40%
21	Wholesale repair and servicing > Electricity supply > WSS Opex: Total - Macquarie	79	3	0.39%
22	Petrol and diesel > Electricity supply > WSS Opex: Total - Macquarie	76	3	0.37%
23	Computer and technical services > Non-building repair > WSS Opex: Total - Macquarie	72	3	0.35%
24	Electrical equipment > Non-building repair > WSS Opex: Total - Macquarie	67	3	0.33%
25	Concrete products > Electricity supply > WSS Opex: Total - Macquarie	67	3	0.33%