Ecologically Sustainable Development Report for Catherine Hill Bay

Prepared for

Coal & Allied Industries Limited

By

ENSIGHT

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TABLE OF CONTENTS

1. EXECUTIVE SUMMARY

This report demonstrates that Coal & Allied Industries Limited (Coal & Allied), the current owner of the proposed Catherine Hill Bay project and its existing sustainable development policies are aligned to the successful implementation of ESD design, construction and operation principles of a sustainable land development.

The Coal & Allied is proposing to develop an estate at Catherine Hill Bay, delivering 222 residential lots. This report addresses the Director General's Environmental Assessment Requirements (DGEAR) related to the proponent's commitment to ESD principles in the design, construction and operation phases of the project and the delivery of an Energy Savings Action Plan and the project's capability in achieving the requirements of Basix and other environmental rating tools. The report demonstrates that the project can commit to ESD principles in the design, construction and operational phases of the development. The report Parts 2 and 3 also demonstrates that the project can comply with a Basix Assessment (BA). The project further demonstrates how each householder can reduce greenhouse gas emissions (GHG) by 73% compared to the government target of 40% and water use by 51%, respectively exceeding the NSW government's mandatory reduction target by 40%.

The DGEAR specifically requests that the developer responds to the following requirement:

Ecological Sustainable Development

1. Demonstrate how the development will commit to ESD principles in design, construction and ongoing operation phases.
2. Demonstrate that the development is capable of achieving the requirements of BASIX.

This report demonstrates how the ESD design for the proposed Catherine Hill Bay project has addressed the sustainable development principles of Coal & Allied. The report also demonstrates that the proposed mechanism to achieve ESD outcomes for the proposed project is for the construction and operation of the proposed Catherine Hill Bay development to comply with an Environmental Management System (EMS).

Coal and Allied is committed to the implementation of sustainable design principles in the Catherine Hill Bay Project. This is demonstrated by the development of a project ESD strategy, indicators and targets.

Coal & Allied has also appointed a specialist ESD consultant to oversee the integration of ESD into the project. All consultants in the design team have participated in individual briefings with the ESD consultant and as a group participated in a daylong project sustainable development workshop. All consultants are reporting to the project ESD strategy as part of their contractual obligations. The ESD approach adopted for the project is set out in Part 1 of this report and follows industry and nationally accepted ESD development processes.

The Energy and Water Savings Action Plans prepared for Catherine Hill Bay address both energy and water savings from a householder's perspective, not from a developer's perspective. This approach is consistent with the intent of the Energy Saving Action Plan *(*ESAP) guidelines. Undertaking the cost-effectiveness analysis from a householder perspective ensures all viable energy and water saving measures are identified and included in the ESAP. The analysis has not been undertaken from a developer perspective as this

would result in all proposed energy and water saving measures to be excluded, on the basis that they are not cost-effective. The ESAP decision rule requires all cost effective energy and water saving measures to be included, and to exclude energy saving measures that are not cost-effective. This results in the developer fulfilling the role of a sustainability facilitator, through the provision of design guidelines. Refer to part 1 of this report for a description of how the design guidelines will be implemented.

This report provides two viable energy and water saving approaches; Basix Compliance and Beyond Basix. These approaches align with the project owner's sustainability goals; statutory compliance known as Basix Compliance (BC), and Australian Best Practice known as Beyond Basix.

The Basix Compliance (BC) approach provides compliance with NSW statutory sustainability requirements. The Basix Compliance demonstrates the project can meet the fundamental requirement of the NSW government; that is to achieve a 40% and 51% reduction in energy and water use in the proposed project. Achieving this target results in each lot-purchaser complying with the NSW Basix, a prerequisite to obtaining a building approval, The BC approach also aligns with the Development Control Plan (DCP) requirements of the local council.

The Beyond Basix (BB) approach demonstrates how each future householder can achieve a 73% reduction in greenhouse gas emissions and 67% in water use, at lowest cost, exceeding the NSW government's mandatory reduction target by 40%. The quantifiable outcomes of both approaches are set out below.

Basix Compliance

The Basix Compliance approach to energy use reduction achieves an annual greenhouse gas emission (GHG) saving of an estimated 1,149 kgs per lot. The total GHG saving over the estate is estimated at 255 tonnes per annum. Energy saving measures include; passive building design and electric boosted solar water heating. Incorporating these measures, it is predicted, according to the Basix Assessment Tool, to reduce energy use by 40%.

The Basix Compliance approach to water use reduction achieves an estimated annual water savings of 149 kilolitres per lot. The total water savings over the estate is estimated at 33,078 kilolitres per annum. Water saving measures include; water efficient taps and fittings, collecting stormwater at each lot to supply toilet flushing and landscape watering. Incorporating these measures are predicted to reduce water use by 51%.

Beyond Basix

The Beyond Compliance (BB) approach to energy use reduction achieves an annual greenhouse gas emission (GHG) saving of an estimated 5,743 kilograms per lot. The total GHG saving over the estate is estimated at 1,275 tonnes per annum. Energy saving measures include; a 1.5 kW photovoltaic grid interactive array, gas boosted solar water heating and gas oven and cook tops. Incorporating these measures, it is predicted to reduce greenhouse gas emissions by 73%.

The Beyond Compliance to water use reduction achieves an estimated annual water savings of 198 kilolitres per lot. The total water savings over the estate is estimated at 43,956 kilolitres per annum. Water saving measures include; collecting rainwater at each lot to supply toilet

flushing and the household washing machine. Incorporating these measures, it is predicted to reduce water use by 67%.

2. PROJECT & PLANNING CONTEXT

It is proposed that the entire Coal & Allied Industries Limited (Coal & Allied) owned Catherine Hill Bay (Middle Camp) site be rezoned/listed as a 'State Significant Site' (SSS) in Schedule 3 of State Environmental Planning Policy (Major Development). A draft Schedule 3 listing will be prepared with the Concept Plan Application.

The Concept Plan for a residential subdivision of the Catherine Hill Bay (Middle Camp) site will apply to the entire 569ha Catherine Hill Bay (Middle Camp) site. The key parameters for the future development of the site are as follows:

- Dedication of 526.58ha of conservation land to the New South Wales Government (NSWG) that is identified in the Lower Hunter Regional Strategy and Lower Hunter Regional Conservation Plan, comprising approximately 93% of the Catherine Hill Bay (Middle Camp) site.
- Maximum dwelling yield of 222 dwellings (including 57 integrated housing lots) and 3 super lots over 28.2ha.
- Two developable areas are identified under the Concept Plan located to the north of the Middle Camp heritage township,:
    - Developable area A (northeast) = 7.32ha;
    - Developable area B (northwest) = 20.88ha.
- Indicative development staging. The number of lots and extent of staging for release areas will be largely dictated by the service infrastructure requirements as well as responding to market forces.
- The provision of associated infrastructure.
- Torrens title subdivision of the Catherine Hill Bay (Middle Camp) site. The Torrens title subdivision and boundary realignment of Coal & Allied land will enable the following:
    - transfer of land 526.58ha in area that is owned by Coal & Allied to be excised and to be dedicated to NSWG for conservation land.
    - transfer of land 1.6ha in area that is owned by Coal & Allied, located between the cemetery and the oval and including the adjacent car park to Lake Macquarie City Council.
    - enable land 12.38ha in area that is owned by Coal & Allied comprising four houses north west of Northwood Road and land 0.17ha east of Flowers Drive, to be retained by Coal & Allied post transfer of the conservation land.

Approval will not be sought under the Concept Plan for a specific lot layout. An indicative lot layout will indicate how the dwelling yield of 222 dwellings could be achieved on the site.

Similarly, approval will not be sought under the Concept Plan for subdivision or construction of individual houses. However, the desired future character of the proposed concept plan will be included in Urban Design Guidelines. Urban Design Guidelines will be prepared to inform

the Concept Plan in respect of urban form, built form, open space and landscape, access and movement and visual impact for the site.

It is proposed to dedicate land for conservation purposes as part of the Major Project Application via a Voluntary Planning Agreement (VPA) between Coal & Allied and the NSWG in accordance with s.93F of the Environmental Planning & Assessment Act, 1979 (EP&A Act).

The proposed Concept Plan and a Plan showing the proposed development areas and conservation areas is included in the Preliminary Environmental Assessment (PEA) prepared by Urbis.

The requirement for ESD and Energy Savings Action Plan are detailed below:

Ecological Sustainable Development

1. Demonstrate how the development will commit to ESD principles in design, construction and ongoing operation phases.
2. Demonstrate that the development is capable of achieving the requirements of BASIX.

About the consultants

EnSight is an Australian award winning sustainable design consultancy, completing award winning projects in environmentally sensitive, remote and island communities. These include Bingara Gorge land development by Bovis Lend Lease, Kelvin Grove Urban Village, Couran Cove Island Resort, to name a few. Established since 1996 and working on leading sustainable projects such as Australia's first 4.5 star ABGR building, the William Buck Building, Australia's first 5 star ABGR building, William McCormack Place, Orion Town Centre and Kelvin Grove Urban Village.

EnSight brings to the Catherine Hill Bay project a range of innovative and practical sustainable energy, water and development experience. Reference has been made to sustainable design databases such as Your Development (http://yourdevelopment.org/), Green Building Council, US Leed and UDIA's EnviroDevelopment and other leading projects from around Australia and the world

In addition EnSight has worked with the Queensland EPA Sustainable Industries Division to review policy initiatives and evaluation of programs. "IES (EnSight) have been used as advisors by the EPA's Sustainable Industries Divisions because they bring the complete suite of competencies from a strong understanding of public policy and process to energy engineering and financial packaging." Dr John Cole, Executive Director Queensland Environmental Protection Agency.

PART 1

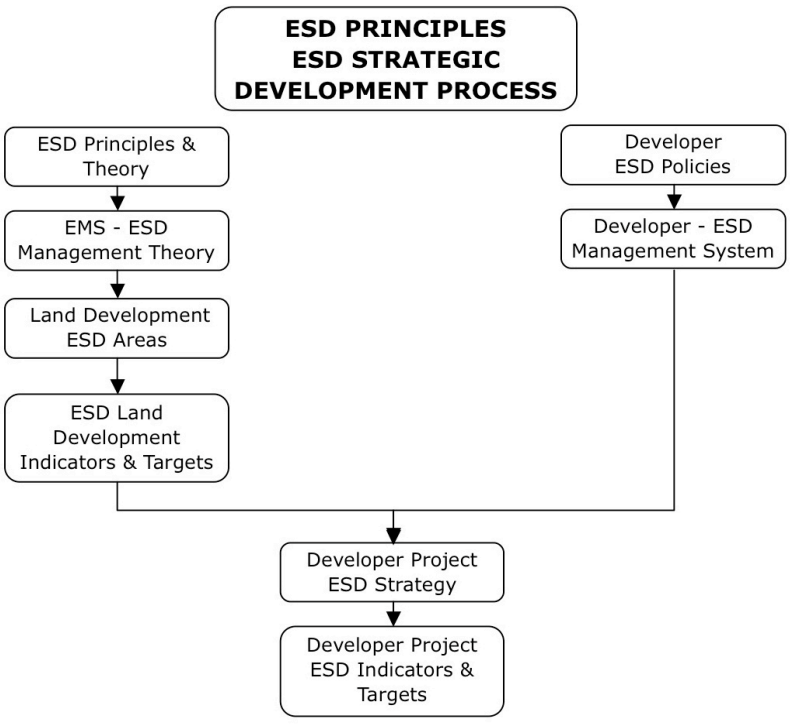
ESD REPORT

1. ESD PRINCIPLES

1.1 INTRODUCTION

ESD principles are based on sustainability theories that have been developed over the many years since the publication of "*The Limits to Growth"* (Meadows et al) in 1972. Edwards, in 'the Sustainability Revolution' (2005) suggests that sustainability seeks a context in which legitimate interests can be satisfied: environmental, economic and social. This premise suggests that an ESD based company will embed ESD principles into their corporate strategies. This section of the report aims to overview foundational ESD theory and summarise the ESD principles and how these principles are implemented. Then it is outlined how ESD principles apply to land development and are qualified through relevant indicators and targets. This will be followed by a summary of the ESD policies and practices to be implemented for the proposed land development.

The process in which ESD principles, translated into an ESD strategy, are overlayed by corporate policies and developed into an integrated and congruent ESD Project Strategy, is shown in the table below.



1.2 ESD PRINCIPLES AND THEORY

Australia's national strategy for Ecologically Sustainable Development (ESD), endorsed by all Australian jurisdictions in 1992, defines the goal of ESD as:

"Using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be increased." (Brundtland, 1992)

It includes three key objectives:

- *To enhance individual and community well-being and welfare by following a path of economic development that safeguards the welfare of future generations;*
- *To provide for equity within and between generations; and*
- *To protect biological diversity and maintain essential ecological processes and life-support systems.*

What are ESD principles? Principles are defined as "a fundamental, primary, or general law or truth from which others are derived"[i]. Thus ESD principles are those principles that are fundamental to the achievement of ESD outcomes. To achieve ESD outcomes consistent with the objectives stated above requires the integration of short and long-term economic, social and environmental effects in all decision-making. Thus, to be consistent with ESD principles, "resources not only need to be used sustainably, but how they are used, who benefits and when, along with the impacts of their use, all need to be evaluated" (Fletcher, 2002).

The National Strategy for Ecologically Sustainable Development (1992) adopted widely accepted principles underpinning the consideration of economic, social and environmental effects are:

a) The precautionary principle - namely, that if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.

b) Inter-generational equity - namely, that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.

c) Conservation of biological diversity and ecological integrity – namely, that a full and diverse range of plant and animal species should be maintained.

d) Improved valuation, pricing and incentive mechanisms – these mechanisms would enable environmental factors to be included in the valuation of assets and services

The four principles are interrelated. For instance, inter-generational equity can only be achieved in instances where biodiversity is conserved for the use and enrichment of future generations. The linkage of the four principles means that they must be considered both individually and collectively when assessing whether a proposed project would contribute to ESD in Australia. Sustainability now has a broader meaning with a strong focus on the

integration of environmental, social and economic goals through societal and economic development activity. This has been expressed in Australian legislation as;

"Decision making processes should effectively integrate both long-term and short-term economic, environmental, social and equitable considerations."

Government and corporate decision-making processes promote adopting ESD principles by considering the effects of;

a) economic,

b) environmental,

c) social and equitable impacts.

These three areas of considerations underpin the ESD decision-making framework used for this project. The system to be established to monitor, manage and report on the implementation of measures to achieve ESD outcomes will be discussed in the next section.

1.3 EMS - ESD IMPLEMENTATION

Successful implementation of ESD principles, which aims to minimise the project's impact and maximise the benefits of the social, economic and environmental resources, requires accurate reporting and monitoring of relevant indicators to determine the projects' intended and actual progress.

One internationally accepted management system for reporting of a business' environmental performance is the Environmental Management System (EMS) Standard ISO14001. It is widely recognised as an effective framework for the monitoring and reporting of environmental management. Whilst many organisations are aligning their environmental management systems with ISO14001, not all seek to have their systems certified due to its rigorous nature. Certification does provide external stakeholders with a high level of assurance that an organisation's EMS is robust, verifiable and functional.

The core of an EMS is the development of indicators that assist an organisation in providing information on how it manages any environmental impacts on its operations, products and services. These EMS indicators demonstrate the organisation's capacity to monitor and control material environmental risks, and to capitalise on market opportunities arising through effective environmental management. It is proposed in this project, and accepted internationally (Global Reporting Initiative www.globalreporting.org), that an EMS can also report on social and economic impacts. It is proposed that this project will use the EMS to report on the project's compliance to the ESD strategy, indicators and targets.

Furthermore, the EMS indicators provide information on how an organisation can identify and assess initiatives and opportunities it has to enhance its environmental performance and demonstrate its commitment to continual improvement. An organisation's willingness to report progress in relation to objectives and targets illustrates an ongoing commitment to such continual improvement. It also demonstrates accountability for environmental performance and a commitment to managing environmental risks and meeting legal and other obligations.

EMS indicators are particularly valuable as they are forward-looking or 'lead' indicators that can provide a basis for future performance forecasts. For example, an organisation that sets environmental objectives and targets is likely to show improvement in relation to environmental performance indicators (e.g. energy, water, waste), as the management process is evidence of planning and resource allocation.

EMS indicators presented below, as they specifically relate to land development, broadly correspond to the report recommendations outlined in the 'Governance Structure and Management Systems', part C, section 3 of the Global Reporting Initiative's (GRI) 2002 Sustainability Reporting Guidelines. The environmental aspects of land development activities are considered at two levels, namely:

- Design related aspects, such as master planning, urban and architectural design, landscaping design and engineering design.
- Construction and operation related aspects, such as civil works and building construction.

A suitable approach to report on ESD project outcomes is to select a small number of relevant indicators and demonstrate performance improvements. Reporting against a large number of indicators does not necessarily enhance or improve overall EMS performance (GRI 2007).

1.4 ESD DESIGN

ESD design is an umbrella term to describe a set of strategies, components and technologies that lower environmental, economic and social impact (Mclennan, 2004). Design related ESD issues are addressed through project-specific ESD design criteria that are based on accepted ESD indicators and targets. There are many ESD design principles applied to the built form, of which some will and some will not apply to land development. Accepted ESD design principles (Green Star, Office) include:-

1. Management
2. Indoor environmental quality
3. Energy
4. Water
5. Transport
6. Ecology & Land use
7. Materials

8. Emissions

This framework ignores economic and social impacts; principally it is an environmental management tool. The GRI provides social and economic performance indicators, which are reported below. The relevant social performance indicators within this (GRI) guide address the following key social issues:

1. Community
2. Public policy
3. Compliance

The general and relevant economic performance indicators within the GRI guide address the following key economic issues:

1. Economic performance
2. Market presence
3. Indirect economic impact

1.5 ESD LAND DEVELOPMENT

This section of the report will adapt and consolidate the general environmental indicators from the built form and relevant and general GRI social and economic indicators to specifically address land development. Urban planning and development can have long-term environmental, economic and social impacts. The priority is to ensure sustainability is incorporated, as early as possible, in the design stage so that the opportunities for sustainable development are not limited or lost in subsequent delivery stages.

The environmental performance indicators for land development that are consistent with the accepted built form tools are:

1. Energy
2. Water
3. Materials, Waste – solid and hazardous
4. Emissions and discharges to air, land and water
5. Biodiversity
6. Compliance

The social performance indicators for land development that are consistent with the GRI guide include:

1. Social and community infrastructure
2. Education access and diversity
3. Retail access and diversity
4. Health Services provision and access
5. Employment opportunities and income levels
6. Cultural identity protection

The economic performance indicators that address land development and that are consistent with the GRI guide include:

1. Economic improvements to the region
2. Affordability, adaptability and staging
3. Profitability of the development

1.6 ESD LAND DEVELOPMENT, INDICATORS AND TARGETS

A number of ESD indicators and areas of consideration flow from the application of ESD principles when applied to a land development. These areas take into account the specific nature of land development and achieving a triple bottom line outcome for the developer. The key indicators of sustainability; economics, social and environment, are subdivided further for reporting and goal setting purposes. The indicators presented below broadly correspond to the report content recommendations outlined in the 'Governance Structure and Management Systems' part C, section 3 of the GRI's Sustainability Reporting Guidelines ('02). The twelve ESD areas of consideration and indicators are listed below:-

CATHERINE HILL BAY ESD INDICATORS BY ESD AREA	
ESD Areas	**ESD Indicators**
1. Social & Community	Community consultation Community facilities Creating community Community education for sustainable living
2. Economics	Regional economic impact Local economic impact
3. Employment	Local employment - construction Local employment – operation
4. Transport	Local transport Regional transport
5. Water Cycle Management	Water use – dwellings/infrastructure Water supply availability Alternative water supplies Pollution control Flow management
6. Energy	Carbon neutral – construction Energy supply – electricity/gas/renewable Energy use – dwelling/infrastructure Energy efficiency - built form/ urban form
7. Ecosystem management	Native vegetation Landscape design

CATHERINE HILL BAY ESD INDICATORS BY ESD AREA	
ESD Areas	**ESD Indicators**
8. Riparian corridor management	Riparian length Environmental corridors Terrestrial and aquatic habitat Bed and bank stability & water quality
9. Conservation of indigenous heritage (including Items, values, and places of cultural significance)	Conserve indigenous heritage Consultation with indigenous peoples Conservation management plans
10. Conservation of European heritage	Conserve significant heritage items and places Conservation management plans.
11. Indoor environmental quality, waste and sustainable materials	IEQ Waste – construction Waste – organic Sustainable materials
12. Number and nature of compliance	Protection of Environment Operation (POEO) Act – Developer POEO Act – contractors Other environment, OH&S and planning legislation – Developer Other environment, OH&S and planning legislation – contractor Environmental audits/ scores

1.7 DEVELOPER ESD PRINCIPLES

As identified in the ESD Strategic Development Process diagram in section 3.1 there are four tiers in which ESD is integrated into the commitments for this project: developer ESD policies, developer ESD management system, developer ESD strategy and developer project ESD indicators and targets. These four tiers flow from a hierarchy of sustainability policies and principles from the developer to the project. The developer's sustainability philosophy is as follows;

> *Sustainable development is about balancing economic, social and environmental priorities.*

A developer needs to explore the opportunity to incorporate sustainable design initiatives into its development projects that are consistent with its sustainability policy. Typical development sustainability policy features six key areas. The six key areas of sustainability policy are listed below:

1. Product Stewardship
2. Asset Use and Resource Efficiency

3. Culture
4. Economic Viability
5. Community Relationships
6. Environmental Stewardship

Coal & Allied is committed to delivering sustainable development outcomes from its business operations. There is a total alignment between the Coal & Allied sustainable development aspirations and the theory and implementation of ESD in general and specifically in land development.

1.8 ESD STRATEGY DEVELOPMENT

Coal & Allied has a sustainable development strategy for the Catherine Hill Bay estate that should, when combined with ESD principles, guide its overall decision-making. The strategy establishes the overall project outcomes sought by Coal & Allied

CATHERINE HILL BAY ESD STRATEGY

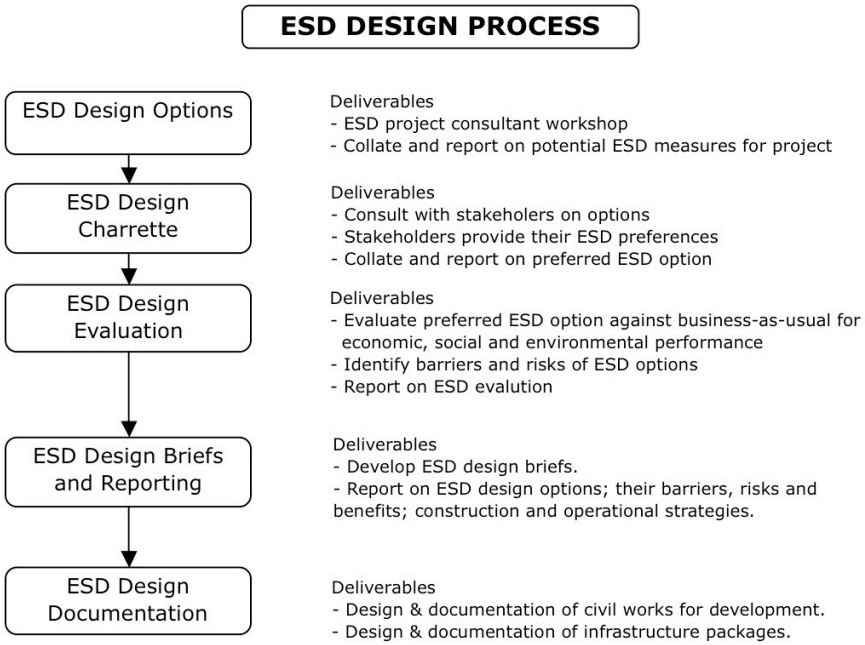
> *Develop the Catherine Hill Bay residential estate to create a social, economic and environmental legacy for the people of the Lower Hunter region as set out in the ESD strategy.*

To achieve the proposed Catherine Hill Bay ESD Strategy, twelve ESD areas have been identified along with an associated ESD goal, set out in the table below.

CATHERINE HILL BAY ESD GOALS BY ESD AREA	
ESD AREAS	**ESD GOALS**
1. Social & Community	Contribute towards the sustainable social and community growth of the Lower Hunter consistent with the Lower Hunter Regional Strategy (LHRS).
2. Economics	Contribute towards the sustainable economic growth of the Lower Hunter consistent with the LHRS
3. Employment	Increase and enhance employment opportunities in the Lower Hunter consistent with the aspiration of the LHRS.
4. Transport	Increase and enhance public transport and efficient transport options to improve mobility and build community consistent with the aspiration of the LHRS.
5. Water Cycle Management	Incorporate and demonstrate best practice whole-of-project water cycle management consistent with the LHRS.
6. Energy	Create a carbon friendly estate with greenhouse gas emission reductions of 60% compared to a standard development reduction of 40%.
7. Ecosystem Management	Identify and conserve significant ecosystems to promote conservation, interpretation and community engagement.
8. Riparian Corridor Management	Identify, conserve and/or create riparian corridors.
9. Conservation of Indigenous Heritage	Identify and conserve indigenous heritage to promote conservation, interpretation and community engagement.
10. Conservation of European Heritage	Identify and conserve European heritage to promote interpretation, tourism, employment and community engagement.
11. Indoor Environmental Quality, Waste and Sustainable Material	Identify and promote the use of low Volatile Organic Compounds (VOC) and reuse of materials in the dwelling and estate infrastructure.
12. Estate Development Compliance	Develop the estates with 100% compliance to government and the developer's environmental policies.

2. ESD DESIGN

The ESD design process followed for the Catherine Hill Bay project is set out below. This process aims to deliver on the ESD principles of Coal and Allied.



2.1 ESD GOAL, INDICATORS & TARGETS

ESD indicators and targets have been developed to allow the measurement of ESD outcomes for the operational phase of the project, inform design and construction methods. The targets for each ESD indicator are shown in the table below.

> ***Develop the Catherine Hill Bay residential estate to create a social, economic and environmental legacy for the people of the Lower Hunter region as out in the sustainable strategy.***

For each of the twelve ESD areas an ESD goal has been developed that sets the direction for the ESD indicators and targets that follow. The indicators and targets have been developed to allow the measurement of ESD outcomes for the operational phase of the project, inform design and construction methods. The targets for each ESD indicator are shown in the table below.

CATHERINE HILL BAY ESD PROJECT GOALS & TARGETS	
ESD AREA	**ESD GOAL**
1. Social & Community	**Contribute towards the sustainable social and community growth of the Lower Hunter consistent with the Lower Hunter Regional Strategy.**
ESD INDICATORS	ESD TARGETS
Community Consultation	(a) A Community Consultation plan is developed and implemented in accordance with

CATHERINE HILL BAY ESD PROJECT GOALS & TARGETS	
ESD AREA	**ESD GOAL**
	the developer's community policy.
	(b) 100% of identified stakeholder groups being engaged through consultation and participation.
Community Facilities	(c) Targets are to be determined on each project based on the community demography and needs.
Creating Community	(d) All estates will have a Creating Community program.
	(e) Where there are Creating Community programs, initial contact to be made within 14 days of completion of each dwelling.
Community Education for Sustainable Living	(f) Develop educational program and materials for the project.
	(g) 80% reduction in carbon emissions through education and promotion to the community via an intranet of energy use and renewable energy targets and actual estate performance.
	(h) 95% reduction in potable water use through education and promotion to the community via an intranet of water use targets and actual estate performance.
	(i) 100% of the estates have marketing material that includes consumer education on sustainable living.
2. Economics	**Contribute towards the sustainable economic growth of the Lower Hunter consistent with the Lower Hunter Regional Strategy.**
Regional Economic Impact	(a) Improved property values, neutral travel costs, regional employment and neutral wage differentials.
Local Economic Impact	(b) Improved property values, neutral travel costs, regional employment and neutral wage differentials.
	(b) Promote the increase in disposable income from reduced expenditure on energy and water from estates promoting integrated energy and water solutions.
3. Employment	**Increase and enhance employment opportunities in the Lower Hunter consistent with the aspiration of the Lower Hunter Regional Strategy.**
Local Employment - Construction	(a) Provide community employment opportunities during project construction by promoting local contractors.
Local Employment – Operation	(b) Provide community employment opportunities with operation of the development through joint ventures with regional training authorities and small business development agencies.
4. Transport	**Increase and enhance public transport and efficient transport options to improve mobility and build community, consistent with the aspiration of the Lower Hunter Regional Strategy.**
Local Transport	(a) Provide accessible pedestrian ways to connect to public domains.
Regional Transport	(b) Provide an integrated bikeway network to existing regional public infrastructure.
	(c) Provide each dwelling with high-speed internet access to encourage home office and work at home professionals to reduce the need for travel.
5. Water Cycle Management	**Incorporate and demonstrate best practice whole-of-project water cycle management consistent with the Lower Hunter Regional Strategy.**
Water Sensitive Urban Design (WSUD)	(a) 100% of the lots to have project-specific WSUD strategies.
Water use – Dwellings	(b) Combination of water efficiency and reuse options – achieve 60% score for COMPLIANCE water index.

CATHERINE HILL BAY ESD PROJECT GOALS & TARGETS	
ESD AREA	**ESD GOAL**
Water Use – Infrastructure	(c) Public domain irrigation shall be from non-potable sources and incorporate water efficient landscaping.
Water supply availability	(d) Eliminate or minimise the need for public water infrastructure upgrades through innovative design.
Alternative water supplies	(e) Provide third pipe solutions to all estates to minimise use of potable water, if commercially viable and meets regulatory requirements.
	(f) Maximise the reuse of water by using water that is fit-for-purpose.
Pollution control	(g) Provide sewer treatment and third pipe access to Catherine Hill Bay to reduce riparian and water table pollution risk, if commercially viable and meets regulatory requirements.
	(h) 45% reduction in the mean annual load of total nitrogen (TN) based on EPA best practice guidelines.
	(i) 45% reduction in the mean annual load of total Phosphorus (TP) based on EPA best practice guidelines.
	(j) 80% reduction in the mean annual load of total suspended solids (TSS).
	(k) 90% reduction in nitrogen and phosphates in the Class A+ reuse water, through community education of environmentally friendly cleaning products and detergents.
Flow management	(l) Post-development storm discharges; pre-development storm discharges for 1.5 year ARI event, to minimise the impact of frequent events on the natural waterways and to minimise bed and bank erosion.
6. Energy	**Reduce greenhouse gas emissions by 60% compared to a standard development.**
Carbon Neutral – Construction	(a) Greenhouse offsets will be purchased for all energy used to construct the Employment Lands by all contractors and consultants. This commitment needs to be reviewed - eg. The developer will participate in an approved Greenhouse offset scheme for construction activities.
Energy Supply – Electricity	(b) Provide an electricity system sufficient to meet maximum power demand and lowest life cycle cost. Investigate the use of co-generation and grid support solutions with Energy Australia for each estate.
Energy Supply – Gas	(c) All dwellings will have access to Natural gas If proven to be financially viable and meet commercial and regulatory requirements to ensure greenhouse friendly energy solutions are adopted. Refer to Energy Management Plan for details.
Energy Supply – Renewable Energy	(d) All dwellings are to be fitted with solar water heaters sufficient to meet 90% of annual hot water requirements. Refer to Energy Saving Action Plan for details.
	(e) All dwellings are to be fitted with photovoltaic solar panels to achieve a greenhouse neutral balance. Refer to Energy Saving Action Plan for details.
Energy Use – Dwelling	(f) All dwellings shall achieve a minimum of 60% score the Basix Assessment Tool. Refer to Energy Saving Action Plan for details.
Energy Use – Infrastructure	(g) All infrastructures shall incorporate energy efficiency principles to reduce energy by 60% over standard practice.
Energy Efficiency - Built Form	(h) 100% of dwellings to have design guidelines to control the siting of dwelling, garages and fencing and incorporate appropriate building elements which contribute to the streetscape quality and promote casual surveillance.
Energy Efficiency - Urban Form	(i) All design guidelines produced for the estate shall include minimum solar access zones in accordance with SEDA's Solar Access for Lots Guidelines for residential subdivision in NSW.
7. Ecosystem management	**Identify and conserve significant ecosystems to promote conservation, interpretation and community engagement.**

CATHERINE HILL BAY ESD PROJECT GOALS & TARGETS	
ESD AREA	**ESD GOAL**
Native vegetation	(a) Preservation of 80% of the land to ensure no net loss for high conservation value vegetation.
Landscape design	(b) Landscape design to integrate into urban form to create community and promote energy efficiency.
8. Riparian corridor management	**Identify and conserve riparian corridors in each of the proposed developed estates.**
Riparian length	(a) No loss of length in Category 3 and 2 streams.
Environmental corridors	(b) Category 3 – Environmental Corridors – greater than 40M riparian corridor on either side (from top of bank).
Terrestrial and Aquatic Habitat	(c) Category 2 – Terrestrial and Aquatic Habitat – 20M riparian corridor + 10M buffer (from top of bank).
Bed and Bank Stability & Water Quality	(d) Category 1 – Bed and Bank Stability & Water Quality – 5M-10M riparian corridors (from top of bank).
9. Conservation of indigenous heritage (including items, values, and places of cultural significance)	**Identify and conserve indigenous heritage to promote conservation, interpretation and community engagement.**
Conserve indigenous heritage	a) 100% of significant items and places to be conserved.
Consultation with indigenous peoples	(b) Consultation occurs for 100% of estate's indigenous heritage issues.
Conservation Management Plans	(c) 100% of estate's indigenous heritage issues have Conservation Management Plans.
10. Conservation of European heritage	**Identify and conserve European heritage to promote interpretation, tourism, employment and community engagement.**
Conserve significant heritage items and places	(a) 100% of significant European heritage items and places conserved (unless there is safety or contamination issues).
Conservation Management Plans.	(b) 100% of estates including European heritage have Conservation Management Plans.
11. Indoor Environmental Quality (IEQ), Waste and Sustainable Material	**Identify and promote the use of low Volatile Organic Compounds (VOC) and reuse of materials in the dwelling and estate infrastructure.**
IEQ	(a) Promote the use of low VOC paint, adhesives and floor coverings to improve the health outcomes for residents of the estates.
Waste – Construction	(b) Achieve 85% recycling of building waste during construction and reduce waste to landfill by 50%.
Waste – Organic	(b) Achieve 95% recycling and reuse of organic waste during the operation of the estates through the implementation of an integrated organic reuse strategy.
Sustainable Materials	(c) Achieve the use of 100% recycled materials in all public domain infrastructures.
12. Number and nature of compliance	**Develop the estates with 100% compliance to government and the developer's workplace and environmental policies.**
Protection of Environment Operation (POEO) Act – The Developer	(a) Achieve full compliance with the Protection of Environment Operation (POEO) Act – The developer's actions (i.e. penalties issued in the developer's name)
Protection of Environment Operation (POEO) Act – Contractors	(b) Achieve full compliance with Protection of Environment Operation (POEO) Act – contractors' actions.
Other environment, OH&S and planning legislation – The Developer	(c) Achieve full compliance with other environment, OH&S and planning legislation – developer's actions
Other environment, OH&S and planning legislation – Contractor	(d) Achieve full compliance with other environment, OH&S and planning legislation – contractors' actions.
Environmental audits	(e) 100% of the developer's contracts have environmental audits procedures

CATHERINE HILL BAY ESD PROJECT GOALS & TARGETS	
ESD AREA	**ESD GOAL**
Environmental audits scores	(f) 100% of environmental audit scores are greater than 75%. (i.e. every audit score, not the average of all audit scores).

2.2 ESD DESIGN OPTIONS

To achieve the desired ESD outcomes the consultant team has been tasked with the challenge of delivering ESD based design, construction and operation outcomes for the Catherine Hill Bay project. ESD design is achieved through the application of design principles based on the following guidelines:

- Whole systems "thinking" to capture synergies and opportunities;
- Interconnectedness between supply and demand to capture cost savings;
- Service-based approach to broaden the choices and options;
- Comprehensive economic analysis that enables whole-of-life comparisons;
- End-use efficiency to secure upstream supply benefits;
- Bio-mimicry to reduce waste and match solutions to the local resources;
- Environmental footprint impact to maintain ecosystems and mitigate future costs;
- Innovation orientation to minimise risks and increase flexibility and adaptability

2.3 ESD DESIGN CONSULTATION

Comprehensive stakeholder consultation was undertaken during the preliminary design process of the project. Consultation was conducted with representatives of local community groups, local councils, representatives of traditional owners, design consultants and emergency, health and law enforcement agencies. A high level commitment to ESD design principles was demonstrated by those consulted.

2.4 ESD DESIGN EVALUATION

The ESD design options and suggestions that arose from the ESD design consultation were evaluated for their economic, environmental and social impacts. The ESD consultant prepared an ESD design report addressing energy and water issues (refer to Part 2 & 3 of this report). Other design team consultants will report on other ESD related design issues prior to project approval.

2.5 ESD DESIGN BRIEFS & REPORTING

The ESD consultant prepared ESD design briefs for each of the infrastructure services consultants to ensure that ESD targets and indicators were included in the ESD design documents and ESD reporting requirements were clearly articulated for use in tender and

specifications. The ESD design briefs are input documents for the design consultants. They set out the matters to be considered and addressed by their specifications, in design, construction and operation phases of the project.

2.6 ESD DESIGN DOCUMENTATION

All design documentation endeavour to address the goals of the ESD strategy. The design consultant team will develop tender documents that reflect the requirements of the ESD strategy, briefs and EMS reporting. The implementation of an EMS will be a key factor in the success of achieving ESD outcomes during the construction and operational phases.

2.7 ESD DESIGN GUIDELINES

The implementation of the ESD outcomes in the dwellings to be constructed on the land will be via project specific design guidelines. The guidelines will feature ESD design principles, the siting of each dwelling, location and design of garages and fencing and incorporate appropriate building elements, landscaping, colours, type of construction which contribute to the streetscape quality and promote casual surveillance.

The design guidelines include minimum solar access zones (generally indicates where private open space should be located) in accordance with SEDA's Solar Access for Lots Guidelines for residential subdivision in NSW. Buildings, infrastructure and the environment are inextricably linked. Energy, materials, water and land are all consumed in the construction and operation of buildings and infrastructure. These built structures in turn become part of our living environment, affecting our living conditions, social wellbeing and health. It is therefore important to explore environmentally and economically sound design and development techniques in order to design buildings and infrastructure that are sustainable, healthy and affordable, and encourage innovation in buildings and infrastructure systems and designs.

ESD construction is a way for the building industry to move towards achieving sustainable development, taking into account environmental, socio-economic and cultural issues. Specifically, it involves issues such as design and management of buildings, materials and building performance, energy and resource consumption - within the larger orbit of urban development and management.

The key here is to look at appropriate ESD rating tools and concepts for the design and assessment of the sustainability impacts of materials, components and technologies used in buildings and their construction. There is a need to develop a better understanding of the appropriateness of technologies that is used in buildings and for construction, including indigenous materials and technologies that are currently being used.

3. ESD CONSTRUCTION

3.1. INTRODUCTION

ESD construction will be achieved from the implementation of a project specific Environmental Management System (EMS). A Construction Management Plan (CMP) (construction and operation) should be prepared and implemented that complies with the requirements of the developer's EMS. The developer should review the plan before the commencement of construction, and regularly during operation. The EMS framework is designed to assist individuals and organisations manage the way they conduct their operations, generally to reduce their impact on the environment.

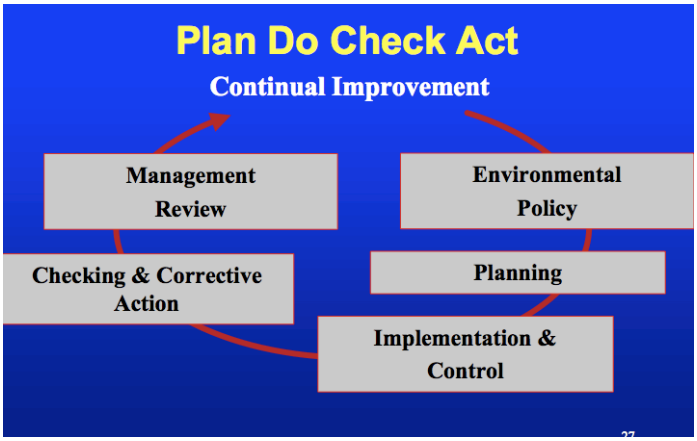
An EMS involves the development of a plan that includes the issues covered, the targets set, and details of the management actions that will be taken to achieve the targets, along with how performance will be monitored and evaluated.

The developer's EMS should be developed and preferably accredited to meet the requirements of ISO 14001 standard. The integration between an EMS/CMP and ESD is that the ESD framework is designed to encompass all aspects and issues of the management of activities that may affect natural resources.

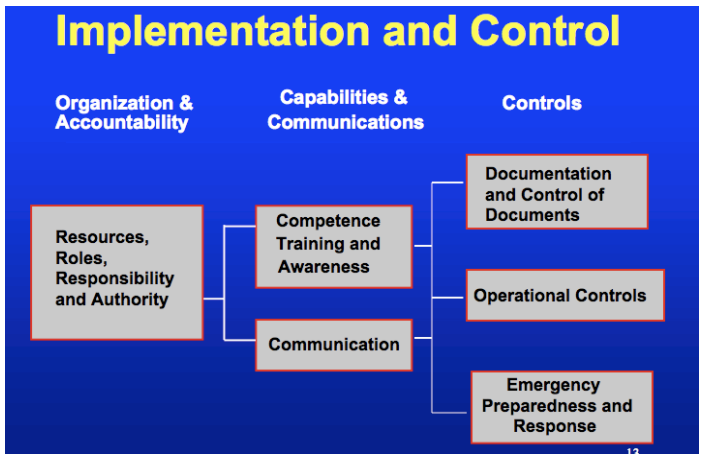
Therefore, having an EMS is an important mechanism in achieving the implementation of ESD principles. However, an EMS is only one possible method for achieving ESD principles. Prior to commencement of construction, a Construction Management Plan (CMP) will be issued. It includes:

1. Development of a site-specific soil erosion and sediment control plan.
2. Confirmation of construction hours in accordance with the conditions of consent.
3. Air quality/dust control procedures.
4. Noise management procedures.
5. Waste management plan.
6. Community safety plan.
7. Arrangements for temporary pedestrian and vehicular access.
8. Storage and handling of materials procedures.
9. Environmental training and awareness.
10. Contact and complaints handling procedures.
11. Emergency preparedness and response

CMP is based on a process of continual improvement cycles as shown below. This ensures that the CMP remains relevant and achieves its desired outcomes. See table below:



The process of implementation and control is shown in the diagram below. This process shows how Coal & Allied, as the responsible organisation, would remain in control of the CMP at the Catherine Hill Bay project.



3.2 ESD CONSTRUCTION - REPORTING REQUIREMENTS

ESD reports should be prepared and submitted by the Principal Contractor to the developer at each stage of the project. The reporting requirements for each stage of the development are shown in the following sections.

Tender Stage

The Principal Contractor should submit with the tender documentation an ESD report, which outlines how the ESD performance requirements will be achieved. The report shall include the following areas as a minimum and will be evaluated to assess both the confidence of the submitted design and the construction/operation contractor to achieve the ESD performance and essential requirements:

- Transport impact minimisation
- Social sustainability
- Innovation
- Management (design, construction and operation)
- Lot layout and footprint
- Building design guidelines, including
    1. Passive design features
    2. Indoor environment quality optimisation
    3. Energy use minimisation
    4. Water use reduction
- Waste minimisation
- Emission reduction
- Land use and ecology
- Choice of materials

Design & Construction Stage

The Principal Contractor should submit ESD reports in progress reviews of design and construction to outline how the ESD performance requirements will, or have been achieved. Design reports shall follow the developer's "ESD section of Design report template" which should be contained in the EMS.

For 'Management', The Principal Contractor should submit;

- monthly reports during construction on the implementation of the construction management plan and sub-plans
- reports on commissioning in progress reviews.

For 'Waste', The Principal Contractor should submit monthly reports during construction;

- on the implementation of the waste management sub-plan;
- confirming weight or volume of wastes by waste streams, leaving site and the percentage of waste reused / recycled; and
- on hazardous wastes.

Provide ESD update at Project Control Group (PCG) meetings.

Provide reports on facility management reviews throughout the contract period.

To be consistent with the monitoring protocols of the developer's EMS reporting framework, The Principal Contractor should submit a quarterly ESD Report (for the duration of the defects liability period) which states:

- Energy consumption for construction, including monthly breakdown and annual summary, including gas, fuel and electricity use, including HVAC.
- Greenhouse gas emissions; monthly breakdown and annual summary.
- Water consumption; total and for sub-metered uses; monthly breakdown and annual summary, including potable and recycled water use, and
- Waste; total percentage to landfill and total recycled by waste streams.

Report Submission

During the design and construction stages, the Principal Contractor should submit reports as required under the project specification to the Developer.

4. ESD OPERATION

An operational Environmental Management Plan should be prepared prior to the opening of the development. Consideration should be given to the engagement of the community in the continual monitoring and maintenance of the ESD initiatives incorporated into the project. This could include reporting, monitoring and corrective action of the ESD indicators and targets. Where appropriate the reporting should be consistent with the monitoring protocols of the developer's EMS reporting framework. Possible ESD indicators that should be reported include:-

- Energy consumption for construction, including monthly breakdown and annual summary, including gas, fuel and electricity use.
- Greenhouse gas emissions; monthly breakdown and annual summary.
- Water consumption; total and for sub-metered uses; monthly breakdown and annual summary, including potable and recycled water use.
- Waste; total percentage to landfill and total recycled by waste streams.

5. CONCLUSION

The proposed 222 lot residential development at Catherine Hill Bay can deliver the environmental, economic and social outcomes that are consistent with the industry best practice ESD benchmark and principles.

The ESD Design outcome is to develop the proposed Catherine Hill Bay residential estate, creating a social, economic and environmental legacy for the people of the Lower Hunter region as outlined in the ESD strategy.

The ESD Construction outcomes could be achieved through the development and implementation of a Construction Management Plan (CMP) that is consistent with the developer's EMS. The CMP will address the following:

1. Development of a site-specific soil erosion and sediment control plan.
2. Confirmation of construction hours in accordance with the conditions of consent.
3. Air quality/dust control procedures.
4. Noise management procedures.
5. Waste Management Plan.
6. Community Safety Plan.
7. Arrangements for temporary pedestrian and vehicular access.
8. Storage and handling of materials procedures.
9. Environmental training and awareness.
10. Contact and complaints handling procedures.
11. Emergency preparedness and response

ESD Operation is achieved through a comprehensive reporting and monitoring process that will also be addressed in the CMP.

PART 2

ENERGY SAVINGS ACTION PLAN

1. ACTION PLAN FRAMEWORK

This Energy Saving Action Plan has been prepared for the proposed Catherine Hill Bay development in response to the Director General's Requirements under Section 75F of the Environmental Planning and Assessment Act 1979 issued as part of the assessment requirements for this development. The lot owner is the direct beneficiary of an investment in energy or water saving measures in a dwelling.

This section reports the energy and water saving measures from the land purchaser's perspective. The financial analysis is based on an evaluation of the cost effectiveness from this perspective. If this report was written from the developer's perspective no measure would be cost-effective and therefore no energy or water saving measures would be implemented.

This Energy Savings Action Plan has been prepared based on a framework set out in the Guidelines for Energy Savings Action Plans published in October 2005. The guidelines provide the following framework for a preparation of a plan:

1. Overview and introduction to the business
2. Identification of baseline energy use
3. Identification of the efficiency opportunities
4. Energy management actions
5. Energy saving measures

2. ENERGY SAVINGS ACTION PLAN

This Energy Savings Action Plan created for the proposed Catherine Hill Bay land subdivision has been prepared to address the following topics:

1. Overview and introduction to the business
2. Identification of baseline energy and water use
3. Identification of the efficiency opportunities
4. Energy & Water management actions
5. Energy and Water saving measures
6. Implementation and Review

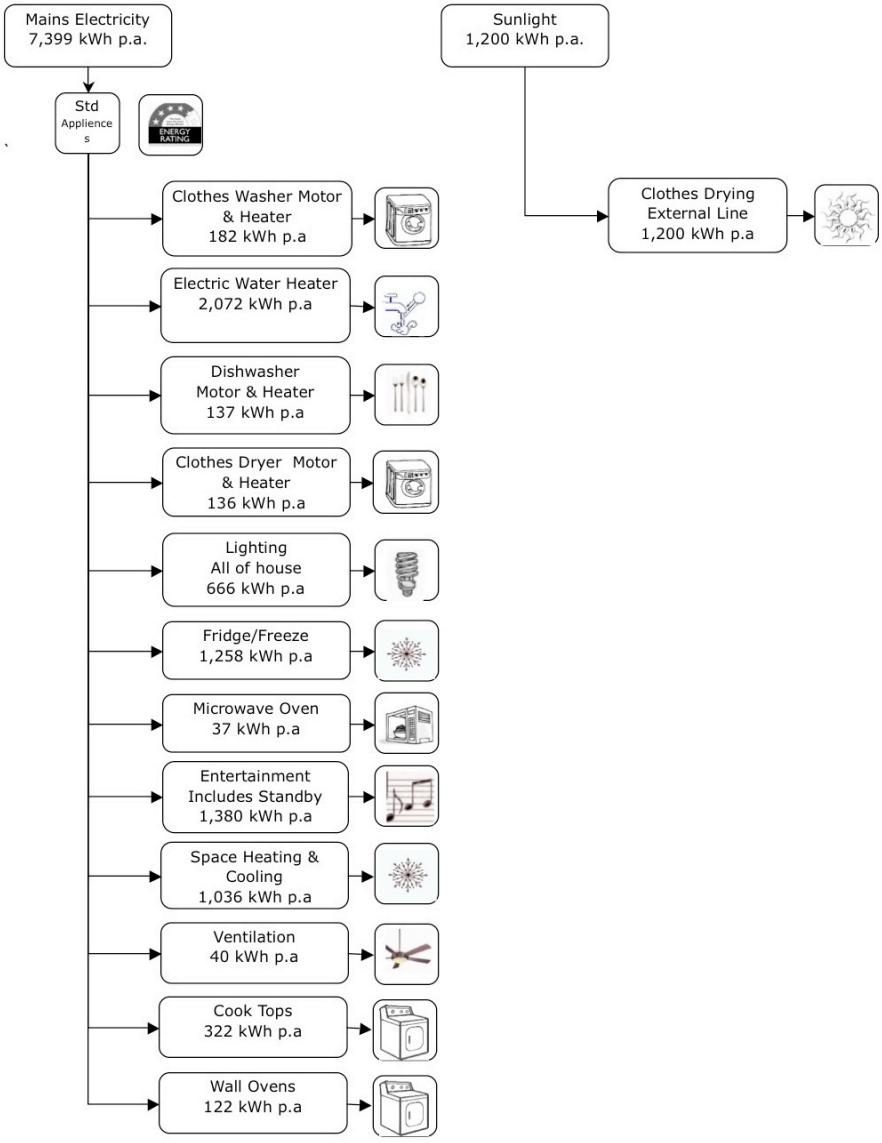
2.1 OVERVIEW

It is proposed to develop a 222 lot residential subdivision in the Catherine Hill Bay area. The consultant Cardno has reviewed existing electricity, natural gas, water and sewerage treatment infrastructure in their report "*Lower Hunter Land Development, Concept Plan Infrastructure Report Catherine Hill Bay*". Energy Australia has indicated that the high voltage supply to Catherine Hill Bay may be upgraded with a new zone substation at Catherine Hill Bay. Natural gas is not readily available.

2.2 IDENTIFICATION OF BASELINE ENERGY USE

The baseline energy use for the proposed 222 lot residential subdivision is derived from the total number of lots (residential houses) and the energy use of a typical NSW dwelling. The energy use of a typical dwelling is 7,399 kWh as was reported in the NSW Standing Committee on Public Works 'Inquiry into Energy Consumption in Residential Buildings' (report no.53/02, March 2004). The breakdown to 'end use' energy service is based on data published in the same report.

Household Energy Balance Baseline



The total baseline energy use on a per dwelling basis in 7,399 kWh per annum which equates to 7,917 kilograms of greenhouse gases using the standard NSW grid multiplier of 1.07 kilograms/kWh. The total energy baseline for the 222 lots is shown in the right hand column of the table below.

BASELINE ENERGY CONSUMPTION PER ANNUM CATHERINE HILL BAY		
Number of Lots	**Average Electricity Use per dwelling kWh p.a.**	**Total Electricity Consumption kWh p.a.**
222	7,399	1,642,578

Energy Balance Baseline

The greenhouse gas emission baseline for the entire development is shown in the table below.

BASELINE GREENHOUSE GAS EMISSIONS PER ANNUM CATHERINE HILL BAY	
Total Electricity Consumption kWh p.a.	**Total Estimated GHG Emissions Tonnes p.a.**
1,642,578	1,758

The energy activity indicators for a residential dwelling are five fold; total energy consumed for the project, total greenhouse gas emissions generated for the project, energy consumed per dwelling, peak dwelling electrical demand (summer & winter). These are reported for the proposed Catherine Hill Bay development in the table below.

BASELINE ENERGY ACTIVITY INDICATORS CATHERINE HILL BAY	
INDICATORS	**MEASURE**
A= baseline Energy use per annum (kWh)	1,642,578
Greenhouse Emissions (T)	1,758
Is baseline representative of normal Energy use? YES / NO	Yes
B= Impact of variation on energy use (i.e. variation from normal) per annum (kWh)	0
C= A – B baseline energy use corrected for variation (kWh)	1,642,578
Business Activity Indicators	Household
D= Quantity of Site Business Activity Indicator	222
E= C / D baseline energy use Key Performance Indicator (KPI)	7,399
Baseline summer peak Electrical use (kVa)	4.5
Baseline winter peak Electrical use (kVa)	2.6

2.3 IDENTIFICATION OF THE EFFICIENCY OPPORTUNITIES

2.3.1 MANAGEMENT REVIEW

A management review was conducted of the key areas of Coal & Alied's performance in sustainable energy management. These included the following:

- Senior management commitment to, and involvement in energy management
- Understanding of energy savings potential at operations and maintenance levels, and within new capital works
- Management of energy targets and key performance indicators
- Energy metering and monitoring

- Energy management reporting
- Energy supply management and alternative energy supply options
- Incorporation of energy management into operating and maintenance procedures
- Accountabilities for energy management
- Training and awareness procedures
- Compliance with legal or other requirements.

The response and scoring of management to the above questions is shown in the table below.

Area	Review Area	Rating				
		Low	Moderate	Minimum Sustainable	Industry Leader	Best Practice
A	Senior management commitment					
B	Understanding of energy savings potential					
C	Energy targets and key performance indicators					
D	Energy metering and monitoring					
E	Energy management reporting					
F	Energy supply management					
G	Operating and maintenance procedures					
H	Accountabilities for energy management					
I	Training and awareness procedures					
J	Compliance with legal and / or regulatory requirements					

The management review indicates that Coal & Allied has adequate systems in place to manage the implementation of the Energy Savings Action Plan.

The three management areas to be addressed for this project are listed in the next table.

Project No	Energy Management Action	Responsibility	Planned Completion Date	Actual Completion Date
CHB-1	Confirm energy targets for Catherine Hill Bay. **Step 1.** Review and amend project brief and tender documents to incorporate energy targets for project. **Step 2.** Obtain PCG approval and have noted in Environmental Actions. **Step 3.** Communicate to staff and consultant team.	Project Director/General Manager	Three months Part 3A approval	
CHB-2	Increase project team awareness of energy saving opportunities. **Step 1.** Consult with Lake Macquarie Climate Action coalition and visit leading project sites. **Step 2.** Obtain PCG approval for awareness training plan. **Step 3.** Senior staff and development consultants attend site visits and workshops.	Project Director/General Manager	Three months Part 3A approval	
CHB-3	Establish strategy for metering for the project, including feedback to householder for energy saving opportunities. **Step 1.** Consult with Energy Australia on remote metering and householder feedback options and obtain costings.	Project Director/General Manager	Three months Part 3A approval	

	Step 2. Obtain PCG approval for budget to investigate options. **Step 3.** Communicate results to PCG to determine if implementation is viable.			

2.3.2 TECHNICAL REVIEW

Name of the Assessor

Francis Barram, EnSIGHT, Unit 1/37 Cordelia Street, South Brisbane, QLD, 4101

Description of the site and methodology used

Catherine Hill Bay is located on the coast east of Lake Macquarie and south of Swansea. 222 residential lots will be made available from the proposed land development at Catherine Hill Bay. The methodology adopted for this project compares the energy and greenhouse savings based on each lot, meeting the Compliance and where possible local Council DCP requirements for energy. A second scenario is created based on the Beyond Compliance approach, which includes additional energy measures.

Metering, historical usage

There are no metering records as the project is at the approval stage.

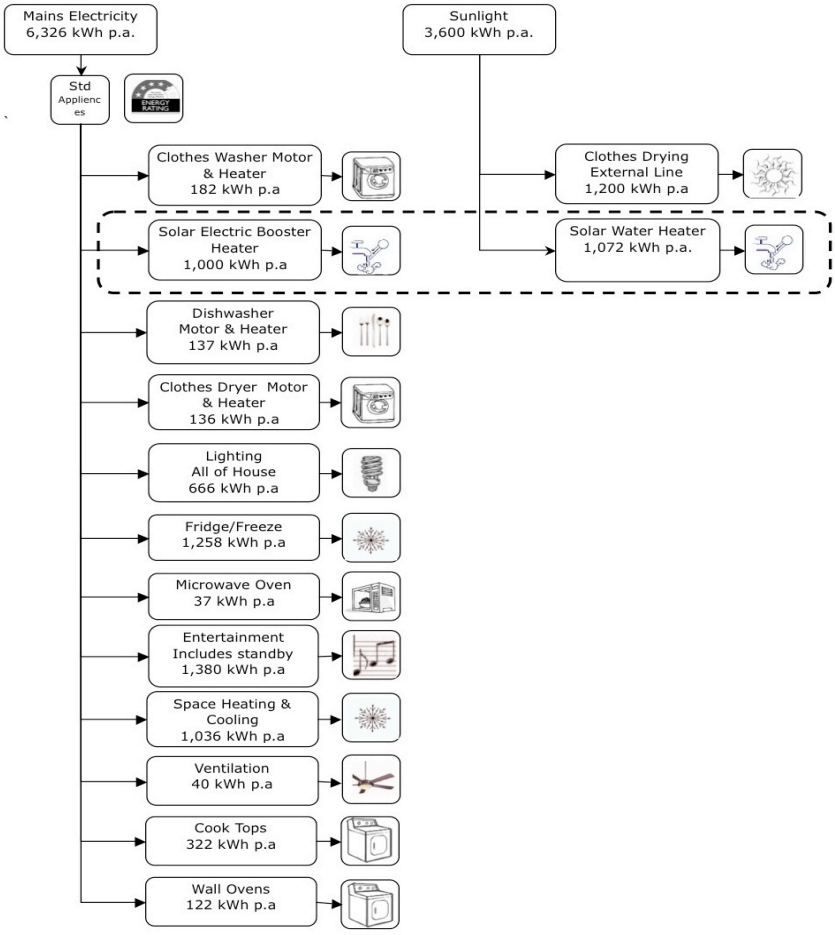
Comments on Targets

There are two targets for the project. The first one is a Compliance target, which is to achieve a 40% reduction in greenhouse gas emissions usage. The second one is a Beyond Compliance target; to reduce greenhouse gas emissions by 60%. The first target is easily achieved. The second target will require substantial educational engagement of the lot purchasers in order to be realized.

2.3.3 ENERGY COMPLIANCE

The 40% energy reduction target for the Catherine Hill Bay residential subdivision is based on the necessary measures to achieve a compliant dwelling. The efficiency initiatives needed to achieve this reduction includes an electric boosted solar water heater, passive solar design, use of ceiling fans in every house, in order to meet thermal performance requirements and those of the local Council DCP.

Household Energy Balance Basix Compliance



The energy use of a compliant house is estimated at 6,326 kWh. This is based on the energy service breakdowns as reported in the NSW Standing Committee on Public Works 'Inquiry into Energy Consumption in Residential Buildings' (Report No. 53/02, March 2004). The table below shows the breakdown in annual energy demand by end use service, based on the Compliance energy reduction initiatives having been implemented.

The total Compliance energy use on a per dwelling basis in 6,326 kWh per annum which equates to 6,769 kilograms of greenhouse gases using the standard NSW grid multiplier of 1.07 kilograms/kWh. The total energy for Compliance for the 222 lots is shown in the right hand column of the table below.

BASIX ENERGY CONSUMPTION PER ANNUM CATHERINE HILL BAY		
Number of Lots	**Average Energy Use kWh p.a.**	**Total Energy Consumption kWh p.a.**
222	6,326	1,404,372

The greenhouse gas emission from the adoption of the Compliance for the entire development is shown in the table below.

BASIX GREENHOUSE GAS EMISSIONS PER ANNUM CATHERINE HILL BAY	
Total Energy Consumption kWh p.a.	**Total Estimated GHG Emissions Tonnes p.a.**
1,404,372	1,503

Basix Compliance Energy Balance

The Energy Balance for the Basix Compliance approach is shown in the diagram above, categorised into services and fuel source on a per dwelling basis. The energy activity indicators for a residential dwelling are five fold; total energy consumed for the project, total greenhouse gas emissions generated for the project, energy consumed per dwelling, peak dwelling electrical demand winter and summer. These are reported in the table below for the proposed Catherine Hill Bay development.

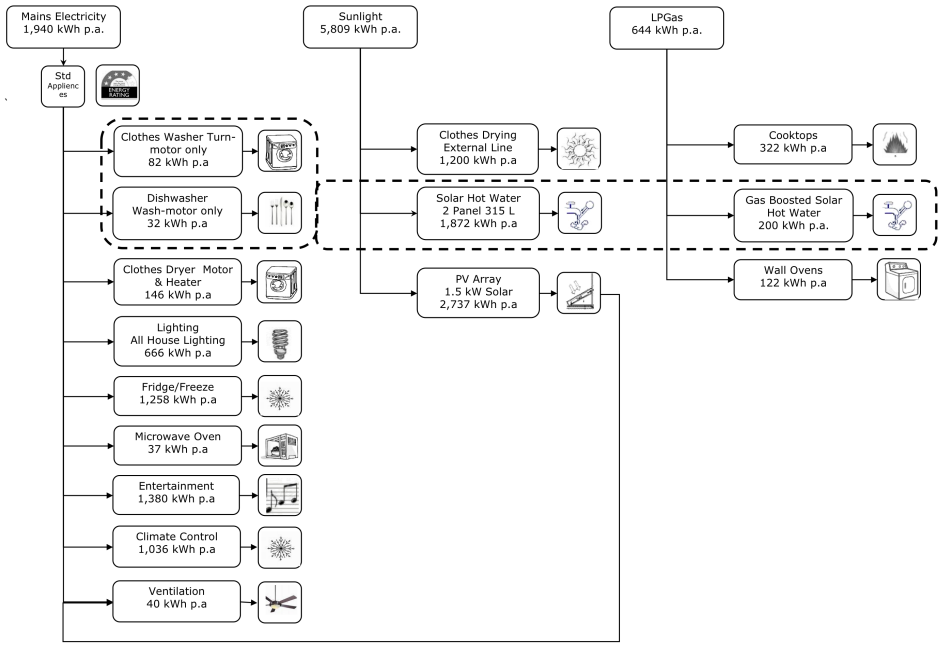
BASIX ENERGY ACTIVITY INDICATORS CATHERINE HILL BAY	
INDICATORS	**MEASURE**
A= baseline energy use per annum (kWh)	1,404,372
Greenhouse Emissions (T)	1,503
Is baseline representative of normal Energy use? YES / NO	Yes
B= Impact of variation on energy use (i.e. variation from normal) kWh per annum	0
C= A – B baseline energy use corrected for variation (kWh)	1,404,372
Business Activity Indicators	Household
D= Quantity of Site Business Activity Indicator	222
E= C / D baseline Energy use Key Performance Indicator (KPI) (kWh)	6,326
Baseline summer peak Electrical use (kVa)	4.5
Baseline winter peak Electrical use (kVa)	2.6

2.3.4 ENERGY - BEYOND BASIX

The energy reduction target of 60% for the Catherine Hill Bay residential subdivision is achieved by implementing all measures in the Compliance approach as well as implementing the use of LPGas for boosting the solar water heater, gas cooking and a 1.5 kW solar photovoltaic array. The annual energy use of a Beyond Compliance house is 2,584kWh, 1,940 kWh of electricity and 644 kWh of LPGas. This is based on the energy services

demand of a typical house in NSW as reported in the NSW Standing Committee on Public Works 'Inquiry into Energy Consumption in Residential Buildings' Report No. 53/02, March 2004. The table below shows the breakdown in annual energy demand by end use service based on the Beyond Compliance energy reduction initiatives having been implemented.

HOUSEHOLD ENERGY BEYOND BASIXS



The total Beyond Basix energy use on a per dwelling basis in 2,584 kWh per annum which equates to 2,175 kilograms of greenhouse gases using the standard NSW grid multiplier of 1.07 kilograms/kWh for electricity and with those of kilograms/kWh for natural gas.

The total energy for Beyond Basix for the 222 lots is shown in the right hand column of the table below.

BEYOND BASIX ENERGY CONSUMPTION PER ANNUM - CATHERINE HILL BAY		
Number of Lots	**Average Energy Use kWh p.a.**	**Total Energy Consumption kWh p.a.**
222	1,940 (ELEC) 644 (LPG)	430,680 (ELEC) 142,968 (LPG)

The greenhouse gas emissions from the adoption of the Beyond Compliance approach for the entire proposed development is shown in the table below.

BEYOND BASIX GREENHOUSE GAS EMISSIONS PER ANNUM CATHERINE HILL BAY	
Total Energy Consumption kWh p.a.	**Total Estimated GHG Emissions Tonnes p.a.**
430,680 (ELEC) 142,968 (LPG)	483

Beyond Basix Energy Balance

The energy balance for the Beyond Compliance approach is shown in the diagram above, categorised by services and fuel source on a per dwelling basis. The energy activity indicators for a residential dwelling are five fold; total energy consumed for the project, total greenhouse gas emissions generated for the project, energy consumed per dwelling, peak dwelling electrical demand winter and summer. These are reported for the proposed Catherine Hill Bay development in the table below.

BEYOND BASIX ENERGY ACTIVITY INDICATORS CATHERINE HILL BAY	
INDICATORS	**MEASURE**
A= baseline energy use per annum (kWh)	430,680 (ELEC) 142,968 (LPG)
Greenhouse Emissions (T)	483
Is baseline representative of normal Energy use? YES / NO	Yes
B= Impact of variation on energy use (i.e. variation from normal) kWh per annum	0
C= A – B baseline energy use corrected for variation (kWh)	430,680 (ELEC) 142,968 (LPG)
Business Activity Indicators	Household
D= Quantity of Site Business Activity Indicator	222
E= C / D baseline Energy use Key Performance Indicator (KPI) kWh per household	1,940 (ELEC) 644 (LPG)
Baseline summer peak Electrical use (kVa)	3.5
Baseline winter peak Electrical use (kVa)	1.6

2.3.5 Description of Measures

Basix Compliance is achieved with the following measures;

1. Electric boosted solar water heater (33-35 RECs)
2. 3.5 star NATHERS rated base building that meets the maximum MJ rating for Compliance Thermal performance requirements
3. Ceiling fans, but no active heating or cooling installations at time of construction.
4. External clothes hoist/line

Beyond Basix; in addition to the initiatives listed in Compliance the following measures are included;

1. LPGas boosted solar water heater
2. LPGas cook tops and wall oven
3. 1.5 kW photovoltaic solar array
4. Hot water connection provided to dishwasher and washing machine

Additional information on Beyond Compliance Measures

Solar Photovoltaic Power: The NSW Government's Solar Bonus Scheme which has electricity utilities pay 68 cents/kWh for all electricity generated from a solar power system commenced on 1 January 2010. The Renewable Energy Credits (RECs) scheme pays a 5 times bonus for the next four years for up to a 1.5 kW solar array, which provides around $6,000 credit. The installed cost of a 1.5 kW solar array reduces to be in the order of $2,000 RECs are taken into account. It is suggested that a 1.5kW array could be installed on each dwelling, providing a 2 year payback for householders. It is proposed that polycrystalline silicon solar panels be used for each solar array as they have higher power densities than amorphous type panels. The output of the solar array will connect to the Energy Australia grid via a grid-interactive inverter system. Special precautions will be used at each dwelling switchboard to ensure electrical safety, locally and on the network. Each solar array will produce on average 2,737 kWh per annum per dwelling. This output will account for nearly 58% of each typical dwelling's electricity demand, which is 4,677 kWh per annum per dwelling.

Efficient Building Design (including heating/cooling); Building design is to achieve a 3.5 star NATHERS rating and meet Thermal performance requirements; a maximum cooling load of 58.4MJ per m^2 p.a. and a maximum heating load of 119.7MJ per m^2 p.a.

LPGas Water Heating for boosting solar hot water and cooking could be provided via local 45 kg LPG storage tanks.

- Gas boosted solar hot water system; Dux, Beezley or equivalent. These systems would need to achieve a RECs score of at least 40. They reduce greenhouse gas emissions by 95%. The system contains a 315-litre pressure storage tank; 200MJ instantaneous gas water heater and 2 open circuit solar collectors, pump and controller.
- Westinghouse 600mm gas oven (GON476S) & gas cooktops or equivalent

3. IMPLEMENTATION & REVIEW

The purpose of this report is to demonstrate that land purchasers of the proposed Catherine Hill Bay estate can achieve the requirements of BASIX for a 40% greenhouse gas emission reduction, at the time of making a building approval application. The second purpose of the report is to demonstrate that land purchasers of the proposed land development can also achieve a 60% reduction in greenhouse gas emissions. The implementation of this Energy Savings Action Plan should commence at the Design Development phase of the project. This plan should be incorporated into the developer's corporate and annual plans to ensure its implementation is monitored. A review of this project should be conducted in line with the developer's EMS requirements.

4. CONCLUSION

The proposed 222 lot residential development at Catherine Hill Bay can achieve compliance with a Basix energy assessment. A strategy "Beyond Basix" has been developed to achieve a 60% reduction in greenhouse gas emissions for each household. Whilst the developer is not undertaking these strategies they should be promoted to each lot purchaser. The quantifiable outcomes of both approaches are set out below.

Basix Compliance (BC)

The BC approach to energy use reduction achieves an annual greenhouse gas emission (GHG) saving of an estimated 1,149 kgs per lot. The total GHG saving over the estate is estimated at 255 tonnes per annum. Energy saving measures include passive building design and electric boosted solar water heating. Incorporating these measures, it is predicted to meet Basix 40% reduction.

Beyond Basix (BB)

The Beyond Compliance (BB) approach to energy use reduction achieves an annual greenhouse gas emission (GHG) saving of an estimated 5,743 kilograms per lot. The total GHG saving over the estate is estimated at 1,275 tonnes per annum. Energy saving measures include; a 1.5 kW photovoltaic grid interactive array, gas boosted solar water heating and gas oven and cook tops. Incorporating these measures are predicted to reduce greenhouse gas emissions by 73%.

The table below shows the energy Baseline compared with Compliance and Beyond Basix approaches.

ENERGY SAVING PREDICTIONS			
INDICATORS	**BASELINE**	**BASIX**	**BEYOND BASIX**
A= baseline energy use per annum (kWh)	1,642,578	1,404,372	430,680 (ELEC) 142,968 (LPG)
Greenhouse Emissions (T)	1758	1503	483
Assessment GHG Reduction Score		40%	73%
Is baseline representative of normal Energy use? YES / NO	Yes	Yes	Yes
B= Impact of variation on energy use (i.e. variation from normal) kWh p.a.	0	0	0
C= A – B baseline energy use corrected for variation (kWh)	1,642,578	1,404,372	430,680 (ELEC) 142,968 (LPG)
Business Activity Indicators	Household	Household	Household
D= Quantity of Site Business Activity Indicator	222	222	222
E= C / D baseline energy use Key Performance Indicator (KPI) per household (kWh)	7,399 (ELEC)	6,326 (ELEC)	1,940 (ELEC) 644 (LPG)
Baseline summer peak Electrical use (kVa)	4.5	4.5	3.5
Baseline winter peak Electrical use (kVa)	2.6	2.6	1.6

PART 3

WATER SAVINGS ACTION PLAN

1. ACTION PLAN FRAMEWORK

This Water Saving Action Plan has been prepared for the proposed Catherine Hill Bay development in response to the Director General's Requirements under Section 75F of the Environmental Planning and Assessment Act 1979 issued as part of the assessment requirements for this development. The Catherine Hill Bay estate is a 222-lot subdivision

This report will evaluate the water saving measures from the land purchaser's perspective. The investment analysis of a range of water saving measures is shown in Appendix 1. The financial analysis is based on an evaluation of the cost effectiveness from the landowner's perspective.

This Water Savings Action Plan has been prepared based on a framework set out in the DEUS Guidelines for Water Savings Action Plans published in October 2005. The principal purpose of the Action Plan is to demonstrate that the proposed Catherine Hill Bay development can achieve compliance with The NSW DEUS Energy and Water Savings Action Plan Framework. The guidelines provide the following framework for a preparation of a plan:

- Overview and introduction to the business
- Identification of baseline water use
- Identification of the efficiency opportunities
- Water management actions
- Water saving measures

2. WATER SAVINGS ACTION PLAN

This Water Savings Action Plan created for the proposed Catherine Hill Bay land subdivision has been prepared to address the following topics:

- Overview
- Identification of baseline water use
- Identification of the efficiency opportunities
- Water management actions
- Water saving measures
- Implementation and Review

2.1 OVERVIEW

It is proposed to develop a 222 lot residential subdivision in the Catherine Hill Bay area. The consultant Cardno has reviewed existing electricity, natural gas, water and sewerage treatment infrastructure in its report "*Lower Hunter Land Development, Concept Plan Infrastructure Report Catherine Hill Bay*". Water and sewerage supply can be made available from Swansea.

2.2 IDENTIFICATION OF BASELINE WATER USE

The most recent published data on domestic water consumption is from Sydney Water. Sydney Water household water consumption data was revised in 2007 to take account of water efficiency gains in households over the past 2 years. These data are conservative and ensures that a prudent approach is taken towards the water supply design solution.

A breakdown of Sydney Water's average house water usage is provided in the table below. Total internal water usage is 586 litres. External use totals 223 litres.

STANDARD WATER USE Daily Household Water Demand By Service		
Description	**Percent usage by service total**	**Litres per day by service**
Toilet	32	186
Hand basin	5	28
Bath/shower	33	193
Kitchen	7	44
Laundry	23	135
Total	**100**	**586**

STANDARD WATER USE Daily Household Water Demand By Service		
Description	**Percent usage by service total**	**Litres per day by service**
External Use only	100	223

The water activity indicators for a residential dwelling are two fold; total water consumed for the project and total water consumed per household. These indicators are reported for the proposed Catherine Hill Bay development in the table below.

BASELINE WATER ACTIVITY INDICATORS CATHERINE HILL BAY	
INDICATORS	**MEASURE**
A= baseline water use per annum (kilolitres)	65,550
Is baseline representative of normal Water use? YES / NO	Yes
B= Impact of variation on water use (i.e. variation from normal) kilolitres per annum	0
C= A – B baseline water use corrected for variation (kilolitres)	65,550
Business Activity Indicators	Household
D= Quantity of Site Business Activity Indicator	222
E= C / D baseline Water use Key Performance Indicator (KPI) (kilolitres)	295

2.3 IDENTIFICATION OF THE EFFICIENCY OPPORTUNITIES

2.3.1 MANAGEMENT REVIEW

A management review was conducted of the key areas of Coal & Allied's performance in sustainable water management. These included the following:

- Senior management commitment to, and involvement in water management
- Understanding of water savings potential at operations and maintenance levels, and within new capital works
- Management of water targets and key performance indicators
- Water metering and monitoring
- Water management reporting
- Water supply management and alternative water supply options
- Incorporation of water management into operating and maintenance procedures
- Accountabilities for water management
- Training and awareness procedures
- Compliance with legal or other requirements.

The response and scoring of management to the above questions is shown in the table below.

Area	Review Area	Rating				
		Low	Moderate	Minimum Sustainable	Industry Leader	Best Practice
A	Senior management commitment					
B	Understanding of water savings potential					
C	Water targets and key performance indicators					
D	Water metering and monitoring					
E	Water management reporting					
F	Water supply management					
G	Operating and maintenance procedures					
H	Accountabilities for water management					
I	Training and awareness procedures					
J	Compliance with legal and / or regulatory requirements					

The management review indicates that Coal & Allied has adequate systems in place to manage the implementation of this Water Savings Action Plan.

The three management areas to be addressed for this project are listed in the next table.

Project No	Energy Management Action	Responsibility	Planned Completion Date	Actual Completion Date
CHB-1	Confirm energy targets for Catherine Hill Bay. **Step 1.** Review and amend project brief and tender documents to incorporate water targets for the project. **Step 2.** Obtain PCG approval and have noted in Environmental Actions. **Step 3.** Communicate to staff and consultant team.	Director/General manager	Three months Part 3A approval	
CHB-2	Increase project team awareness of energy saving opportunities. **Step 1.** Consult with Hunter Water and visit leading project sites. **Step 2.** Obtain PCG approval for the awareness training plan. **Step 3.** Senior staff and development consultants attend site visits and workshops.	Director/General manager	Three months Part 3A approval	
CHB-3	Establish strategy for metering for the project, including feedback to householder for water saving opportunities. **Step 1.** Consult with Hunter Water on remote metering and householder feedback options and obtain costings. **Step 2.** Obtain PCG approval for the budget to investigate options. **Step 3.** Communicate results to PCG to determine if implementation is viable.	Director/General manager	Three months Part 3A approval	

2.3.2 TECHNICAL REVIEW

Name of the Assessor

Francis Barram, EnSIGHT, Unit 1/37 Cordelia Street, South Brisbane, QLD, 4101

Description of the site and methodology used

Catherine Hill Bay is located on the coast east of Lake Macquarie and south of Swansea. 222 residential lots will be made available from the proposed land development at Catherine Hill Bay. The methodology adopted for this project compares the water demand on a per lot basis, meeting the Compliance and local Council DCP requirements for water efficiency. A second scenario is based on the Beyond Compliance approach, which includes additional water efficiency measures.

Metering, historical usage

There are no metering records as the project is at the approval stage.

Comments on Targets

There are two targets for the project. The first one is a Compliance target, which is to achieve a 40% reduction in water usage. The second one is a Beyond Compliance target; to reduce water use by 60%. The first target is easily achieved. The second target will require substantial educational engagement of the lot purchasers in order to be realized.

2.3.3 WATER BASIX COMPLIANCE

The Water Basix Compliance approach is made of two parts; the first is water use minimisation strategy and the second is rainwater capture and reuse strategy. Each will be described below.

Minimising Water Use

Water use will be minimised through the implementation of water efficiency measures. Through the application of water efficient fixtures, fittings and appliances the average household water demand is now estimated to be 586 litres per day. This is a 20% reduction compared to standard water use of households in 2005. This is the standard for water efficiency that will be included in the design guidelines and will include the following:

- Water efficient shower roses, minimum 3 star WELS rating
- Water efficient taps, minimum 6 star WELS rating
- Water efficient toilets, minimum 4 star WELS rating
- Water efficient landscaping, designed for the Lake Macquarie climate

Each of the above water efficiency measures will be implemented in each household via the design guidelines. These initiatives also meet the local council DCP requirements.

Storm Water Balance Compliance

Each house will feature a stormwater tank, as part of the Water Sensitive Urban Design (WSUD) strategy for the development. The stormwater tank is proposed to have a capacity of 5,000 litres. This tank will be plumbed to the toilet cistern and external house taps. This will reduce potable water use by 409 litres per day. The Compliant daily water demand for potable water is estimated at 400 litres. This system was modelled with the Compliance Assessment Tool, which predicted a reduction in potable water use of 49%.

Basix Compliance Water Balance

The water balance for the Beyond Compliance approach is shown in the diagram below, categorised into services and water source on a per dwelling basis.

The table below shows daily water demand for potable water, stormwater use and flow to sewer, for a household with a Basix Compliant water system.

SERVICE VOLUMES HOUSEHOLD WATER USE COMPLIANCE Daily Household Water Demand By Service Basix Compliance			
Description	**Potable Water Use Litres per day by Service**	**Rainwater Water Use Litres per day by Service**	**Flow to Sewer Litres per day by Service**
Toilet	0	186	186
Hand basin	28	0	28
Bath/shower	193	0	193
Kitchen	44	0	44
Laundry	135	0	135
Total	**400**	**186**	**586**
External Use		223	
Total Reuse		**409**	

The water activity indicators for a residential dwelling are twofold; total water consumed for the project and total water consumed per household. These are reported in the table below for the proposed Catherine Hill Bay development.

BASIX COMPLIANT WATER ACTIVITY INDICATORS CATHERINE HILL BAY	
INDICATORS	**MEASURE**
A= baseline water use per annum (kilolitres)	32,412
Is baseline representative of normal Water use? YES / NO	Yes
B= Impact of variation on water use (i.e. variation from normal) kilolitres per annum	0
C= A – B baseline water use corrected for variation (kilolitres)	32,412
Business Activity Indicators	Household
D= Quantity of Site Business Activity Indicator	222
E= C / D baseline Water use Key Performance Indicator (KPI) kilolitres	146

2.3.4 WATER - BEYOND COMPLIANCE

For the Beyond Compliance approach each dwelling will include a rainwater tank in addition to the stormwater tank, which is installed as part of the WSUD for the development. The rainwater tank is proposed to have a capacity of 5,000 litres. In this approach the rainwater tank will be plumbed to the laundry and toilet cistern. The stormwater tank will be plumbed to the external house taps. This option is predicted to reduce potable water use by 544 litres per day. The Beyond Basix Compliance daily potable water demand is estimated at 265 litres. This system was modelled with the Energy and Water Savings Action Framework. The model showed a reduction in potable water use of 60%. The table below shows daily water demand for potable water, stormwater use and flow to sewer for a household with a Beyond Compliance water system.

SERVICE VOLUMES HOUSEHOLD WATER USE Daily Household Water Demand By Service BEYOND BASIX			
Description	**Potable Water Use Litres per day by Service**	**Rainwater Water Use Litres per day by Service**	**Flow to Sewer Litres per day by Service**
Toilet	0	186	186
Hand basin	28	0	28
Bath/shower	193	0	193
Kitchen	44	0	44
Laundry	0	135	135
Total	**265**	**321**	**586**
External Use		223	
Total Reuse		**544**	

Beyond Basix Compliance Water Balance

The water balance for the Beyond Basix Compliance approach is shown in the diagram below, categorised into services and water source on a per dwelling basis.

The water activity indicators for a residential dwelling are two fold; total water consumed for the project and total water consumed per household. These are reported for the proposed Catherine Hill Bay development in the table below.

BEYOND BASIX WATER ACTIVITY INDICATORS CATHERINE HILL BAY	
INDICATORS	**MEASURE**
A= baseline water use per annum (kilolitres)	21,473
Is baseline representative of normal Water use? YES / NO	Yes
B= Impact of variation on water use (i.e. variation from normal) kilolitres per annum	0
C= A – B baseline water use corrected for variation (kilolitres)	21,473
Business Activity Indicators	Household
D= Quantity of Site Business Activity Indicator	222
E= C / D baseline Water use Key Performance Indicator (KPI)	97

Maintaining Rainwater Quality. To ensure the highest water quality is reused, the project design guidelines will include a specification for rainwater quality and rainwater pre-treatment measures that are required to be installed at each house to ensure that the water entering the tank is clean. These include;

- First flush diverters
- Inlet screening for mosquitoes
- Leaf guards

For all water supplied to the residence, a standard treatment system and filter package will be required to be installed. The package includes a backwash sand filter and a UV filter.

Summary of Measures

Basix Compliance is achieved with the following measures:-

1. Water efficient shower roses, minimum 3 star WELS rating
2. Water efficient taps, minimum 6 star WELS rating
3. Water efficient toilets, minimum 4 star WELS rating
4. Water efficient landscaping, designed for the Lake Macquarie climate
5. 5,000 litres stormwater tank with connection to toilet cistern and landscape watering

Beyond Basix, in addition to the initiatives listed in Compliance the following measures are included:-

1. 5,000 litre rainwater tank with connection to toilet cistern and laundry
2. 5,000 litres stormwater tank dedicated to landscape watering

3. IMPLEMENTATION & REVIEW

The purpose of this report is to demonstrate that the land purchasers of the proposed Catherine Hill Bay estate can meet the Energy and Water Savings Action Framework requirements for a 40% reduction in water use, at the time of making a building approval application. The second purpose of the report is to demonstrate that land purchasers of the proposed land development can also achieve a 60% reduction in water use. The implementation of this Water Savings Action Plan is proposed to commence at the Design Development phase of the project. This plan would be incorporated into the corporate and annual plans to ensure its implementation is monitored. A review of this project should be conducted in line with the developer's EMS requirements.

4. CONCLUSION

The proposed 222 lot residential development at Catherine Hill Bay can achieve compliance with a Compliance water assessment. A strategy "Beyond Basix" has been developed to achieve a 60% reduction in water use for each household. Whilst the developer is not undertaking these strategies they should be promoted to each lot purchaser. The quantifiable outcomes of both approaches are set out below.

The table below shows the water Baseline compared with Basix Compliance and Beyond Basix approaches.

WATER SAVING PREDICTIONS			
INDICATORS	**BASELINE**	**BASIX**	**BEYOND BASIX**
A= baseline water use p.a. (kilolitres)	65,550	32,412	21,473
Assessment Reduction Score		51%	67%
Is baseline representative of normal water use? YES / NO	Yes	Yes	Yes
B= Impact of variation on water use (i.e. variation from normal) p.a. (kilolitres)	0	0	0
C= A – B baseline water use corrected for variation (kilolitres)	65,550	32,412	21,473
Business Activity Indicators	Household	Household	Household
D= Quantity of Site Business Activity Indicator	222	222	222
E= C / D baseline Water use Key Performance Indicator (KPI) p.a. (kilolitres)	295	146	97

Basix Compliance (BC)

The Basix Compliance approach to water use reduction achieves an estimated annual water savings of 149 kilolitres per lot. The total water savings over the estate is estimated at 33,078 kilolitres per annum. Water saving measures include water efficient taps and fittings, collecting stormwater at each lot to supply toilet flushing and landscape watering. Incorporating these measures are predicted, according to the assessment tool, to reduce water use by 51%.

Beyond Basix (BB)

The Beyond Basix approach to water use reduction achieves an estimated annual water savings of 198 kilolitres per lot. The total water savings over the estate is estimated at 43,956 kilolitres per annum. Water saving measures include collecting rainwater at each lot to supply toilet flushing and the household washing machine. Incorporating these measures are predicted, according to the water assessment tool, to reduce water use by 67%.

[i] principles. (n.d.). Dictionary.com Unabridged (v 1.1). Retrieved October 14, 2007, from Dictionary.com website: http://dictionary.reference.com/browse/principles