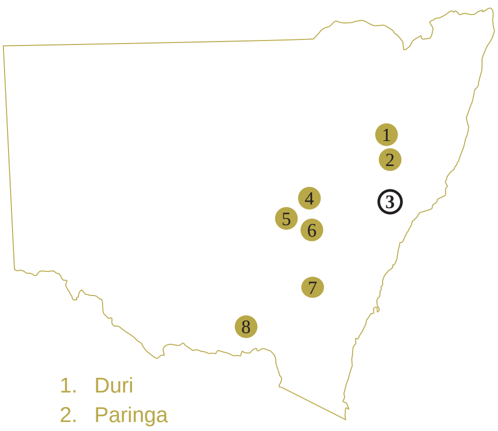
HUNTER KEY SITE

WHAT ARE WE ASKING?

- Where does rainfall go, how is salt mobilised, and where and how do salt and water move in the landscape?
- How do we account for water at a paddock scale and how does this relate to the catchment water balance?
- Are water and salinity models consistent with measured data and catchment observations?
- What are the long-term effects of rehabilitated mined landscape on surface and groundwater quantity and quality?



1. Duri
2. Paringa
3. **Hunter**
4. Sloanes Creek
5. Baldry
6. Gumble
7. Boorowa
8. Livingstone Creek

WHY THE HUNTER KEY SITE?

In the Hunter Valley geology, and in particular, the presence of Permian sediments, accounts for high volumes of mobilised salts which contribute up to 75% of the total catchment salt load. There is a risk that activities such as agriculture or mining could increase these already naturally high salinity levels.

Open cut coal mining has the potential to expose saline rocks to runoff and provide a point source of salinity in the region's surface waters by accelerating natural leaching and weathering, creating new connections between separate aquifers and creating changed flow paths.

Research at the Hunter Key Site is showing that runoff from mine spoil is much fresher (90 υS/cm as compared to 2100 υS/cm) than from natural pastures, and significant salt is mobilized from the Permian sediments.

However there is still uncertainty about the medium to long term cumulative effects of mining on the salt and water interactions between surface and regional ground water systems in the Hunter region.

Excess water from agricultural enterprises has the potential to transport salt from the soil to streams. Appropriate agricultural enterprises need to be identified or developed to reduce this risk. Continued long term research at the Hunter Key Site will help answer these questions.

THE HUNTER SITE

The Hunter Key Site is a paired catchment study between an open-cut rehabilitated coal mine and a natural (un-mined) grazing site in close proximity. The paired catchments are located north of the Hunter River between Singleton and Muswellbrook in northeast New South Wales, Australia. Research at the site targets impacts of land use change on recharge water quality (salinity) and quantity. Understanding the natural salt load to the catchment is critical to the development of management options for open cut coal mining and agricultural enterprises.

The Hunter Key Site was initiated in 2004 funded by the NSW Salinity Strategy. In 2005 it became a part of NSW DPI Key Sites Project. It now receives support under the National Action Plan for Salinity and Water Quality.

THE NATURAL SITE

The natural site, a subset of the Plashett Dam catchment, is composed of two major drainage lines: Saltwater Creek and Noname Creek.

Permian Measures of the Maitland Group underlay the sub-catchment area of Noname Creek consisting of shale, siltsone, sandstone and conglomerate. The majority of the Saltwater Creek sub-catchment is underlain by a volcanic tertiary igneous intrusion (basalts, dolerite). To a lesser extent the Greta Coal Measures (sandstone, siltstone,

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WHAT IS KEY SITES?

KEY SITES is generating new knowledge in priority dryland salinity areas of NSW.

It is a research project with eight sites across upland fractured rock aquifers in local and intermediate groundwater flow systems.

These areas have been identified as being major salinity sources for NSW.

Each site addresses a different and locally relevant gap in salinity knowledge. The sites are not simply eight replicates of a single methodology.

The impact of all major land uses is being investigated, including: *annual cropping, improved annual and perennial pasture, native pasture, native forestry, planted forestry and rehabilitated open cut coal mine.*

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shale, coal seams) and the Maitland Group are also present. Clay, sand, silt, and gravel make up the unconsolidated rocks present along both drainage lines.

Groundwater within unconsolidated rocks is part of a shallow alluvium system characterised by rapid groundwater flow. Groundwater in consolidated rocks (Greta Coal Measures, Maitland Group) occurs within coal seam fractures representing a separate regional groundwater flow system to the alluvial flats although they are connected.

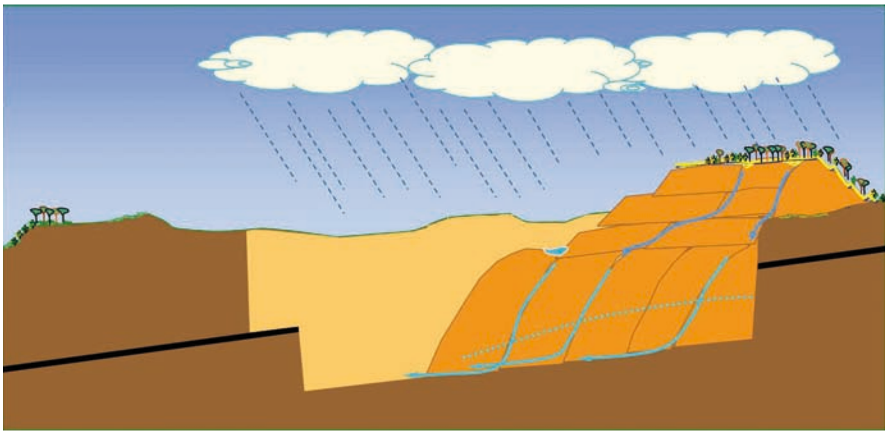
This suggests that management needs to be targeted to differing hydrogeologies as they have a high influence over the hydrology and hence salt transport.

Surface water sampling identified the dissolution of halite (present in Permian formations) as the source of salt matching observations of a constant Na:Cl ratio with progression downstream.

THE MINE SPOIL

The rehabilitated open cut coal mine site forms part of Coal & Allied Howick mine. The study area is a hill slope which rises approximately 40 m above the surrounding area. Contour banks have been formed across the slope and surfaces revegetated to help control overland flow, runoff and consequent erosion. The rehabilitated land is planted with pastures (Ryegrass, Rhodes Grass, Marrar Sub Cover, Couch grass and Lucerne) and trees (Acacia and Eucalyptus dominate).

Mine spoil exhibits dual-flow properties similar to karst or fractured rock aquifers. Macro voids within the spoil heap are capable of storing and transporting large quantities of water and acting as preferential flow paths, whereas spoil material itself behaves as a highly transmissive unconsolidated porous medium where water flows through but at a slower rate than the macro voids.



Conceptual model of the movement of water in a typical rehabilitated mine void and spoil pile

If the spoil contains high levels of salt then these properties allow for rapid transport of salt into the mined void, increasing the salinity of the water. Voids are designed to reach an equilibrium level below that of the surrounding water table. If the void water level exceeds surrounding ground water levels, this will create a flow of saline water away from the void into the regional groundwater system.

WHAT THE RESEARCH HAS FOUND

A salt source exists in the Noname Creek sub-catchment that is not present in the Saltwater Creek sub-catchment. The differing geological origins of the two sub-catchments are determined as the primary cause for their differing salt loads, with Noname Creek having Permian (marine) origins and Saltwater Creek comprising materials of volcanic origin. The process by which salt is transferred to the surface waters within the Noname Creek sub-catchment was determined to be through the dissolution of halite, although this requires further confirmation.

Surface runoff from the mine spoil, fifteen years after initial rehabilitation is of better quality than that in the natural sub-catchment. This may be because the salts within the surface spoil went through a period of high leaching initially, before vegetation was established to control runoff and erosion. Additionally, salts may have been leached downwards through the spoil itself and have a bigger effect on final void salinity.

WHERE TO FROM HERE?

There is limited data on flow in highly heterogeneous mine spoil systems. There is a critical need for experiments carried out over a wide range of spatial and temporal scales so that defensible conceptual frameworks and models can be developed and tested.

Appropriate land use for natural sites need to be developed to limit the movement of salt from the landscapes to streams.

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Research at the Hunter Key Site has been made possible due to the support of Coal & Allied and Macquarie Generation for access to their land; and the collaboration of many partners including Hunter-Central Rivers CMA and the University of Technology, Sydney.

September 2007

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