Key Findings for

Pollution Source Assessment Tool 2012-2016
Executive Summary

WaterNSW must ensure that it maximises the value of its efforts to reduce the risk of pollution in Sydney’s drinking water catchments. The Pollution Source Assessment Tool (PSAT) highlighted the highest risk areas and land uses to target catchment programs under the 2016-2020 Healthy Catchments Strategy.

The highest risk priorities for the four pollutants (nitrogen, phosphorus, pathogens and suspended solids for Sydney’s declared catchments are:

a. **Grazing** has the potential to contribute the greatest pollutant loads in the Sydney’s declared catchment.

b. **Intensive animal production** (particularly dairies) remains high risk in the eastern Wingecarribee and Kangaroo valley areas.

c. **Forests** with a high risk rating occur in areas with high slope, high soil erodability and high fire susceptibility, however these results are generally an inherent (rather than human induced) risk scattered across large areas.

d. **Urban Stormwater** in urban areas such as the upper Blue Mountains and Mittagong

e. **Other urban landuses** such as industry and landfills in scattered high risk sites around the urban fringe, particularly in the Southern Highlands, the upper Blue Mountains and Lithgow.
Introduction

The Pollution Source Assessment Tool (PSAT) provides information on the location and relative risk of potential pollutant sources in Sydney’s declared catchment. The outputs can be summarised by a set of geographic regions to inform decision making at multiple spatial scales.

The PSAT is a geographic information system (GIS) that brings together the best science, catchment knowledge and other data on the sources, causes and pathways for pollutants. It analyses the relative risk of four priority pollutants from 13 land use activities or ‘modules’. The outputs of PSAT are used to identify and prioritise the location and type of pollution sources in the catchment to inform the design of Water NSW’s Healthy Catchment Strategy and the allocation of funding towards the improvement of existing activities.

Figure 1. Overview of the Pollution Source Assessment Tool.

The spatial data inputs into the PSAT include pollutant source locations, land management practices, landscape, environmental and climatic factors. The scientific inputs include pollutant generation rates, such as those from grazing stock, and site specific management practices. Inputs are weighted for each module to calculate relative pollution source risk indices. The outputs are spatial datasets with
detailed risk indices for each module at a grid cell, property and drainage unit scale for the four priority pollutants.

In 2012, comprehensive requirements for the project to rerun the PSAT for 2016 were gathered from internal stakeholders and used to create a project implementation plan, requirements statement, and scope and management plan. This identified the challenges and gaps in the data or knowledge and ensured delivery of results by 2015.

The objectives of the PSAT 2016 project were to:

- provide a strategic direction for the delivery of a set of new priorities for the Healthy Catchments Strategy in 2015;
- provide strategic water quality priorities to inform programs under the Strategic Plans of Management between WaterNSW and Office of Environment and Heritage;
- improve our contemporary knowledge of pollution source risks in the catchments;
- increase our confidence in the scientific methods used to assess the risk of key pollution sources and types;
- provide a more flexible and sustainable assessment tool; and
- improve the integration of catchment intervention monitoring and evaluation data into the modules.

The new version of PSAT16 has been upgraded to include the following functionality:

1. Improvements in the modelling process that will improve our ability to show change in the risk of pollution sources due to catchment intervention programs by WaterNSW and its stakeholders.
2. An improved scientific method for calculating the relative risk between modules to identify the priority ranking across all pollution sources for each of the four pollutants.
3. Outputs from PSAT are scalable from a pixel (25mx25m) to property and drainage unit scale and the method could be applied to any catchment.
4. The capability to run scenario testing for climate change, future planning, development and land uses and wet and dry weather.

Methods

The PSAT is a customised spatial decision support system that uses custom built scripts and models running on existing WaterNSW spatial software, systems and tools. This minimises maintenance costs and enables the integration of new technology as it becomes available.

Thirteen modules are analysed by the tool covering land uses in Sydney’s declared catchment which have the potential to contribute the four priority pollutants;
pathogens (such as Cryptosporidium and Giardia), nitrogen, phosphorus, and suspended solids, to streams and storages. These are:

1. Grazing
2. Gully erosion
3. Horticulture and Cropping
4. Forests
5. Industry
6. Intensive Animal Production
7. Landfills
8. Mines and Quarries
9. On-site Wastewater systems
10. Roads
11. Sewerage Treatment Plants
12. Sewers and Pumping Stations
13. Urban Stormwater

Each module is analysed using a unique set of risk factors, inputs and weightings, but with the same broad methodology.

Module analysis

To inform PSAT, conceptual models were developed for each of the 13 modules to predict the pollutant availability (as illustrated in Figure 2). Input datasets were developed to represent each factor in the conceptual model. These were classed as either land use and management practices (such as stock numbers, fertiliser use or waste disposal methods) or landscape and climate (such as soil, slope or rainfall).

Figure 2. Conceptual diagram for the Grazing module.

For the set of sites or grid cells representing the location of each particular module, inputs were transformed or categorised into a risk index ranging between 0 (lowest risk) and 100 (highest risk). For each site or grid cell, the risk index values were weighted and summed across all factors to produce a summed risk rating.
Scaling

The ratings provide a method for prioritising sites and grid cells within each module, however to allow planning processes incorporating combinations of potential pollution sources across modules, a scaling process was applied to transform the raw results into a single comparable risk index for each pollutant.

The basis for the scaled risk index was the potential annual pollutant export from each site or grid cell. Scaling values for each module were defined as the maximum and minimum annual pollutant export likely from a module. This information was sourced from pollutant export rates published in the scientific literature. The individual sites were scaled between the maximum and minimum rates based on their PSAT summed risk rating.

There was significant variation in the data available for scaling calculations. Several relevant studies could be utilised for modules such as grazing, intensive animal production, stormwater, roads and sewage treatment plants, but by comparison there was very little annual pollutant export data available for landfills, industry, sewers and onsite wastewater system. The scaled outputs of these modules therefore carry some uncertainty and will need to be the subject of further research in coming years.

Summation by Units

The output of scaled results (scaled risk index values for each site or grid cell), could be summarised by any set of units, providing a means of prioritising drainage units, properties, LGAs, larger grid cells or any other unit. As the greatest improvement in water quality through catchment interventions can usually be made by addressing the highest risk sites and grid cells, a summary of scaled index values was made using only the highest risk quarter of sites or grid cells in each module.

The main scaled output used for prioritisation of modules was the summary of highest quarter sites and grid cells by a set of 210 drainage units which covers Sydney’s declared catchment. These counts are used to categorise drainage units into low, moderate, high and very high risk for each module and pollutant.

Results

The PSAT was rerun for 13 modules and the results scaled using the best available pollutant export data. The outputs inform the overall Healthy Catchments Strategy, as well as, to provide information to focus individual land programs.

A summary of the risk, combined across all modules and aggregated by drainage unit, is shown in Map 1. In PSAT16, priorities were similar to the outputs of 2008 and 2012; however there is a reduced assessed risk from sewer infrastructure in
comparison with other modules, which in part reflects a history of projects that improved sewage treatment plants.

Map 1. PSAT 2016 risk by drainage unit for all modules combined.
The drainage unit summary results for the Sydney’s declared catchment indicate the following overall priorities:

1. **Grazing** has the potential to contribute the greatest pollutant loads in the Sydney’s declared catchment. It is a widespread activity and risk for pathogens in cattle grazing areas, such as the Wingecarribee. There is also an increased risk for suspended solids and associated nutrient loads being generated in grazed areas of the Wollondilly which has poor groundcover, are susceptible to drought and are over-stocking.

2. **Intensive animal production** (particularly dairies) remains high risk in the eastern Wingecarribee and Kangaroo valley areas. These properties experience high rainfall and dairies intrinsically have high risk, particularly for Cryptosporidium. While better effluent management has reduced the risk of many of these properties over the past decade, there are still improvements to be made, particularly in the maintenance of effluent structures, as these can act as sources of pollutants if they fail.

3. **Forests** with a high risk rating occur in areas with high slope, high soil erodability and high fire susceptibility, however these results are generally an inherent (rather than human induced) risk scattered across large areas. While the potential for wildfire to occur in these areas is normally low, erosion can be significant when a fire, such as the 2001/02 wildfire, is followed by heavy rainfall. The combination of steep, dissected terrain and shallow nutrient-poor soils is not conducive to the development of a stable ground cover or shrub layer. This results in a high risk of sheet and rill erosion during high rainfall.

4. **Urban Stormwater** in urban areas such as the upper Blue Mountains and Mittagong. In these areas urban density is high creating a high proportion of impervious surfaces which generate high rates of runoff and entrainment of pollutants. Rainfall conditions are generally high in these areas and stormwater treatment is poor or absent entirely.

5. **Other urban landuses** such as industry and landfills in scattered high risk sites around the urban fringe, particularly in the Southern Highlands, the upper Blue Mountains and Lithgow. These sites pose a high risk when they occur near to streams, in higher rainfall areas, when they are particularly large or are unregulated or poorly managed.

**Conclusion**

PSAT outputs for 2016 have been completed and provide a comprehensive risk assessment and prioritisation of potential sources of pollution in the catchments.

The PSAT highlights the continued potential for pathogens, nutrients and sediment from grazing and intensive animal enterprises in Sydney’s declared catchment. It indicates a reduced emphasis on sewage infrastructure in comparison with previous PSAT outputs, and highlights the risk of specific urban areas and point sources.