Inventory Multi-tiered Assessment and Prioritisation (IMAP) Framework Review

April 2016

Abbreviations

ACCC - Australian Competition and Consumer Commission

ACCS - Advisory Committee on Chemicals Scheduling

ACTRA - Australasian College of Toxicology & Risk Assessment

AICS - Australian Inventory of Chemical Substances

ASL - Average Staffing Levels

CLP - Classification, Labelling and Packaging

CMP - Chemicals Management Plan

CMR - Carcinogenic, Mutagenic, or toxic to Reproduction

CSCL - The Chemical Substances Control Law

EC - Environment Canada

ECAT - The Electronic Chemical Assessment Tool

ECHA - European Chemicals Agency

EPA - Environmental Protection Agency

EPI - Estimation Programs Interface

EU - European Union

GHS - Globally Harmonised

GRAS - Generally Recognised As Safe

HC - Health Canada

HCIL - GHS Hazardous Chemical Information List

HESI - Health and Environmental Sciences Institute

HPV - High Production Volume

HSIS - Hazardous Substances Information System

IARC - International Agency for Research on Cancer

ICNA - Industrial Chemicals Notification and Assessment

IFRA - International Fragrance Association

ILSI - The International Life Sciences Institute

IMAP - Inventory Multi-tiered Assessment and Prioritisation

IPCS - International Program on Chemical Safety

IRIS - Integrated Risk Information System Program

K-REACH - Korean Registration, Evaluation, Authorisation and Restriction of Chemicals

NICNAS - National Industrial Chemicals Notification and Assessment Scheme

NTP - National Toxicology Program

OECD - Organisation for Economic Co-operation and Development

OPHP - OASIS Pipeline Human Health Prioritisation

PBT - Persistent Bioaccumulative Toxic

PEC - Priority Existing Chemicals

QSAR - Quantitative Structure-Activity Relationship

REACH - Registration, Evaluation, Authorisation and Restriction of Chemicals

RISK21 - Risk Assessment in the 21st Century

SDS - Safety Data Sheet

SETAC - Society of Environmental Toxicology and Chemistry

SMILES - Simplified Molecular Input Line Entry System

SPIN - Substances in Preparations in Nordic Countries

SUSMP - Standard for the Uniform Scheduling of Medicines and Poisons

SVHC - Substances of Very High Concern

SWA - Safe Work Australia

TOPKAT - Toxicity Prediction by Komputer Assisted Technology

TOR - Term of Reference

TSCA - *Toxic Substances Control Act*

US - United States

UVCB - Chemical Substances of Unknown or Variable Composition, Complex Reaction Products and Biological Materials

Table of Contents

Executive Summary

The National Industrial Chemicals Notification and Assessment Scheme (NICNAS) established the Inventory Multi-tiered Assessment and Prioritisation (IMAP) framework to accelerate the assessment of risks to human health and the environment posed by chemicals listed on the Australian Inventory of Chemical Substances (AICS) that have not previously been assessed.

The IMAP framework was intended to be implemented in a staged manner, with Stage One assessing the risks of 3000 chemicals over four years from 1 July 2012. A review of the framework in the fourth year of its operation was aimed to inform the design of future stages.

The review of the framework has been undertaken, which incorporated analysis of data generated through Stage One assessments and feedback from key stakeholders. The continuation of an accelerated assessment approach to the remainder of unassessed chemicals on the AICS was generally supported by stakeholders, although the need to balance the assessment pace with consideration of the impact on stakeholders was emphasised.

The review has found that the IMAP framework has been very effective overall in accelerating high quality assessment outputs for chemicals.

By the end of December 2015, NICNAS had published 4315 human health and/or environment assessments for a total of 3215 chemicals in fifteen tranches. This figure represents 94.1 %[1] of the list of Stage One chemicals and indicates that NICNAS is on track to achieve the target of 95 % that was set in the Portfolio Budget Statements.

The IMAP framework has also been successful in supporting risk management of chemicals in Australia, with risk management measures implemented or being considered for a significant number of chemicals as a result of their assessment under the IMAP framework.

A number of opportunities to improve assessment and prioritisation processes have been identified. These improvements should contribute to a more robust and efficient framework that can be applied to the large number (approximately 34,000) of unassessed chemicals remaining on the AICS, for their potential effects on human health and the environment.

The findings described in this report have been grouped into six themes as follows:

- Enhancing chemical safety information;
- Supporting effective risk management;
- Prioritisation and deprioritisation of chemicals for assessment;
- Data utilisation;
- Efficiency and sustainability; and
- Quality and best practice

[1] This figure included 'additional chemicals' which were not included in the Stage One list of 3000 chemicals, but are members of groups of chemicals already being assessed in Stage One and have been added to gain further efficiencies.

The review of IMAP Stage One has coincided with public consultation on implementing the reforms to NICNAS that were announced by the Australian Government as part of its 2015-16 Budget.

The findings from this review will contribute to the design of the framework for 'NICNAS initiated assessments' being developed as part of the NICNAS reforms, which are expected to be fully implemented by September 2018.

Applying the review outcomes

Theme 1: Enhancing chemical safety information

- NICNAS will continue to engage with key stakeholders to ensure that assessment outputs, including the identification of chemicals that pose no unreasonable risk, meet their needs.
- Outputs from the IMAP framework are relevant not only to regulators responsible for managing human health and environmental risks, but are also relevant to people using chemicals in the workplace, the general public, and international risk assessment agencies.

Theme 2: Supporting effective risk management

- NICNAS will continue to engage with Australian risk management agencies to ensure the assessment outputs cater to their needs. In particular, focus will be given to:
    - data needs for new regulatory processes;
    - identification of circumstances where there is a critical need for Australian data;
    - assessment of chemicals for which imposing conditions of use or removal from the AICS are being considered; and
    - provision of technical expertise regarding interpretation of new types of hazard data.

Theme 3: Prioritisation and deprioritisation of chemicals for assessment

- NICNAS aims to develop criteria for prioritising chemicals requiring assessment, and identifying chemicals of low regulatory concern, by using:
    - indicators of concern such as international regulatory action;
    - refined tools and approaches developed for Tier I IMAP assessments;
    - consideration of existing risk management strategies;
    - available hazard and exposure information (including monitoring data);
    - information from the corresponding human health or environment assessment where relevant;
    - reports of actual impact in Australia; and

    - grouping strategies in accordance with international best practice.

- Once developed, these prioritisation criteria could readily be applied to a large number of chemicals remaining on the AICS.

- This activity will inform a rolling assessment work plan for the commencement in 2018 of the proposed NICNAS initiated assessments. NICNAS will continue to engage with stakeholders to ensure chemicals prioritised for assessment are relevant to their needs.

Theme 4: Data utilisation

- NICNAS will continue to actively collaborate with its international counterparts to optimise the use of international data, in accordance with criteria approved by the Minister for Health.

- NICNAS will continue to proactively engage with relevant stakeholders through early and transparent communication to maximise efficient input regarding chemicals to be assessed.

- Opportunities to enhance the NICNAS IT system to facilitate the provision of information from stakeholders, including features to enable the acceptance of external data and issue alerts for upcoming assessments, will be further explored as part of the NICNAS reforms.

- To efficiently make evidence-based and appropriately risk-proportionate recommendations for uptake by risk management agencies, maintaining NICNAS's current statutory powers to obtain information from introducers, in circumstances where publicly available data are not sufficient, is likely to remain important for assessing chemicals of significant concern. This is the subject of consultation in implementing the NICNAS reforms.

- The use of surrogate and default exposure data in the absence of Australian data was considered to be effective in undertaking risk assessment and this approach is likely to be continued. An audit of surrogate data sources would ensure accuracy and maximum coverage of data. New strategies to refine the default volume for chemicals on the AICS are expected to be explored to reduce the potential for significant overestimation of the release to the environment and subsequent risk of the chemicals.

- The availability of quantitative structure-activity relationship (QSAR) models, in addition to the emergence of new tools for the predictions of hazards, has changed significantly since the initial development of the IMAP framework. Based on the effectiveness of the QSAR strategy used for the IMAP framework, additional options to identify improvements in the predictive capabilities of this strategy will be identified.

Theme 5: Efficiency and sustainability

- The development of the process for conducting NICNAS initiated assessments will build on the lessons learnt from the review of Stage One of IMAP to deliver further improvements in the efficiency and effectiveness of the regulatory assessment system for industrial chemicals.

- A successful outcome of Stage One of IMAP has been the development of electronic data management systems to record and manage chemical information. Key concepts from this process are informing the development of the new IT system to support the NICNAS reforms.

- NICNAS initiated assessments will be conducted within resources defined through a Cost Recovery Implementation Statement. A rolling assessment work plan will be developed, which considers available resources, facilitates better engagement with stakeholders, and allows for the development of new fit-for-purpose methodologies.

Theme 6: Quality and best practice

- NICNAS will continue to develop the regulatory framework proposed under the NICNAS reforms (NICNAS initiated assessments) to continue to assess the (approximately 34,000) industrial chemicals on the AICS that have not been previously assessed.

- The IMAP framework was found to be capable of producing high-quality assessment outcomes. This was facilitated by:

    - the use of assessment methods and quality assurance mechanisms involving collaboration with stakeholders;
    - extensive peer review;
    - training and development of staff;
    - application of a weight of evidence approach;
    - use of international guidelines for risk assessment; and
    - use of in-house data management systems.

- These developments and methodological advances will need to be sustained in any ongoing program.

- The IMAP framework has utilised international best practice for chemical risk assessment. NICNAS will continue to align with international best practice by:

    - maintaining agility to respond to emerging concerns;
    - integrating exposure information at an initial stage;
    - expanding data sources (such as monitoring information);
    - providing transparency (by publishing outcomes); and
    - enabling strategic priority setting.

Introduction

Preface

The National Industrial Chemicals Notification and Assessment Scheme (NICNAS) established the Inventory Multi-tiered Assessment and Prioritisation (IMAP) framework to accelerate the assessment of risks posed to human health and the environment by previously unassessed chemicals listed on the Australian Inventory of Chemical Substances (AICS).

The IMAP framework was designed to be implemented in a staged manner, with Stage One concluding with a review of the framework in its fourth year of operation.

A review of the IMAP framework has been undertaken with the aim of evaluating whether it has been fit for purpose, ascertaining what further efficiencies may be gained, and considering whether other improvements are warranted in the future.

This report will summarise the findings of the review, including key data analyses and feedback provided from key stakeholders. The report will also highlight opportunities for applying the findings of this review to developing the proposed approach to NICNAS initiated assessment.

Specifically, the IMAP review considers:

- the strengths and weaknesses, and costs and benefits of the approach used in IMAP Stage One;
- the degree of success of specific assessment approaches used in IMAP Stage One to address different levels of assessment complexity, as well as to identify additional approaches for future consideration;
- the key elements to be retained in a revised framework and how efficiencies gained in the existing program can be sustained; and
- how best to operationalise a revised framework for assessment of existing chemicals and its potential ongoing role at the conclusion of IMAP Stage One in June 2016.

Background

The IMAP framework was established as a result of recommendations from the Existing Chemicals Program Review: 'Promoting safer chemical use – towards better regulation of chemicals in Australia' (2006) and the 'Productivity Commission Research Report into Chemicals and Plastics Regulation' (2008).

The IMAP framework is a science- and risk-based framework for the assessment and prioritisation of chemicals on the AICS, which was developed in consultation with stakeholders and technical experts. The IMAP framework consists of three tiers of assessment, with the assessment effort increasing with each tier.

During Stage One of implementing the IMAP framework, which commenced on 1 July 2012, approximately 3000 chemicals were to be screened and assessed over four years through Tier I (high throughput) and, where required, Tier II (case by case) and Tier III (in depth) chemical assessments.

The key performance indicators for Stage One of the implementation of the IMAP framework, outlined in the Portfolio Budget Statement 2012-13 (Australian Government, 2012), required the assessment of 95 % of the chemicals on the Stage One list within four years (see **Table 1**).

Table 1. Annual chemical assessment targets outlined in the 2012-13 Portfolio Budget Statement

Quantitative Indicators	2012-2013 Budget Target	2013-2014 Budget Target	2014-2015 Budget Target	2015-2016 Budget Target
Percentages of Stage One chemicals assessed through effective application of IMAP framework	20 %	50 %	90 %	95 %

Due to the difference in the characterisation criteria for human health and environmental risks and to optimise assessment efficiency, human health and environmental risks were assessed separately. The progression of chemicals through the tiered assessment process and assessment outputs may differ for human health and environment.

More information on the IMAP framework, including the recommendations from the 2006 and 2008 reviews, the development of the framework and risk characterisation approaches, is available on the NICNAS website: http://www.nicnas.gov.au/chemical-information/imap-assessments/the-imap-framework

Terms of reference (TOR) of the IMAP Review

- Review the current IMAP framework as to whether it has been fit for purpose, and provide a rationale for whether or not it should continue to be applied to the assessment of chemicals on the AICS (and, if so, whether modification to the approach is desirable);
- Determine scope, size and resource effort of the framework required for the future;
- Provide suggestions (including criteria) on how to further prioritise chemicals on the AICS for assessment and what the scale of the assessments should be;
- Advise on the administrative and legislative frameworks and tools required for the implementation of a revised assessment framework for existing chemicals;
- Consult with risk management agencies regarding the uptake of recommendations during Stage One and obtain advice on the sustainability of the referral system;
- Examine the scientific contribution, quality assurance practices and procedures against international best practice for risk assessment, taking into consideration IMAP's available resources;

- Review the data requirements, software programs, format, content and presentation of the IMAP risk assessment and make recommendations for improvement; and
- Provide suggestions to improve the inputs from the different information sources (international, local, industry and community) of data used in the risk assessments.

The key findings and 'next steps' identified in this review are linked with relevant terms of reference in this document.

Review process/methodology

The review consisted of three overlapping stages (data collection and analyses, consultation, finalisation, and documentation). The review drew on the experience of NICNAS staff in the application of the IMAP framework, and coincided with consultation on the NICNAS reform processes announced by the Australian Government in its 2015-16 Budget.

Numerous stakeholders have been involved in the development of the IMAP framework, from its inception through to its implementation and review. Significant importance was placed on their input and a range of avenues for them to contribute to the review were available.

Technical experts instrumental in the early stages of the program and key international regulatory agencies were also engaged individually. Input was sought from all relevant Commonwealth and State and Territory regulatory bodies, industry associations and relevant community organisations.

The recently established Strategic Consultative Committee (consisting of representatives from industry and community groups) provided important input into the review. In addition, other key stakeholders who had provided input to IMAP assessments were also directly approached for comment. This included 39 national and international industry bodies/industry associations. Input on a range of aspects of the framework was sought through consultation including the:

- efficiency, format, content and presentation of IMAP reports;
- the public comment process;
- Tier I approaches and criteria;
- risk management referral processes;
- data-poor chemical strategies;
- data management; and
- future priorities.

De-identified stakeholder feedback is incorporated into this document where appropriate in subsections labelled '***What we heard***'.

Six key themes have been identified through the review of IMAP and 'next steps', associated with these themes, are discussed in each section and will help inform the direction of the framework under which existing chemicals will be assessed by NICNAS in the future. The six themes identified were:

- Enhancing chemical safety information;
- Supporting effective risk management;
- Prioritisation and deprioritisation of chemicals for assessment;
- Data utilisation;
- Efficiency and sustainability; and
- Quality and best practice.

Review findings

Theme 1: Enhancing chemical safety information

In line with recommendations from previous external reviews of the NICNAS Existing Chemicals Program in 2006 and 2008, chemical risk assessment was greatly accelerated with the implementation of IMAP Stage One. Using a tiered approach with publication of outcomes at each tier, NICNAS achieved a major objective of the IMAP framework, which was to significantly increase the availability of chemical safety information in Australia.

The Tier I assessment criteria, and the incorporation of both validation and peer review processes, meant that the Tier I approaches not only prioritised chemicals for assessment, but were also able to determine risks posed to human health and the environment.

By the end of 2015, 1833 chemicals for human health and/or environment had been identified as not posing an unreasonable risk and were published at the Tier I level. Stakeholder input, provided as part of this review, confirmed the importance of the identification of low concern chemicals at Tier I to a number of audiences including regulators and users of chemicals (refer below to ***What we heard: enhancing chemical safety information***).

The publication of information on chemicals identified as being of low concern at Tier I was also highlighted as being important for transparency, and strengthened the process by providing the opportunity for others to contribute further data. Some enhancements to the published information to further facilitate use of this data were suggested (refer ***What we heard: enhancing chemical safety information***).

By the end of 2015, Tier II human health and/or environment assessments for 2482 chemicals had been completed and published. Tier II assessments provide more comprehensive chemical safety information than Tier I assessments and include information on:

- use;
- existing national or international restrictions;
- a summary of chemical identity information;
- physico-chemical properties;
- environmental fate;
- relevant (eco) toxicological data
- risk characterisation;
- advice to the public and industry; and
- recommendations for risk management.

The Tier II assessments were found to be a valuable source of information for a range of stakeholders. The content was found to be fit for purpose with some minor modifications suggested (refer ***What we heard: enhancing chemical safety information***).

What we heard: enhancing chemical safety information

- The transition process from Tier I to Tier II, and hence to Tier III, is well-rationalised and transparent (on the NICNAS website).
- It is important to be clear about the status of an assessment where the human health and environment components have progressed at different rates and one is available before the other. Assessments have been published where the environment component was pending – this makes the chemical's status uncertain. The assessment outcome isn't determined until both components are complete.
- The information on the NICNAS site is useful core information. Consideration could be given to providing some additional information and periodic review.
- (...) suggests that there are more structured updates on the specific assessment of chemicals.

Tier I assessments

- [Provision of information on low concern chemicals is valuable], because it contributes to the knowledge available on chemicals more broadly and can assist in future management actions, especially if alternate data becomes available at a later date.
- The availability of information on low concern chemicals (…) provides a useful resource to chemical users that can assist in choosing lower impact chemicals for use in their processes.
- [Provision of information on low concern chemicals is valuable, because] it provides a useful snapshot for regulators and potential chemical users. The information could be enhanced by including the common name(s) for the chemicals.
- Information published for chemicals found to be low concern at Tier I is brief but does the job.
- Ideally, as much info as possible and easily searchable (including common names of chemicals and key uses) [should be provided for low concern chemicals]. A rationale for the decision, such as provided in the supporting info, should be provided.
- It should be clear, with as much specific detail as possible, which use(s) of the chemical is/are "low concern". Ideally an assessment would indicate which other plausible/likely uses might not be categorised the same way and which would require further assessment if such uses were undertaken.
- Additional information regarding the hazard profile of the chemical could facilitate the use of the information.

Tier II assessments

- The [Tier II] reports provide a good synthesis of the assessment findings. The assessment reports provide valuable information on relevant criteria (e.g. uses and environmental

concentrations, if available, environmental fate and transport, ecological effects). They are presented in a clear and methodical manner. They are well referenced which allows the end-user to follow up and find more detail.

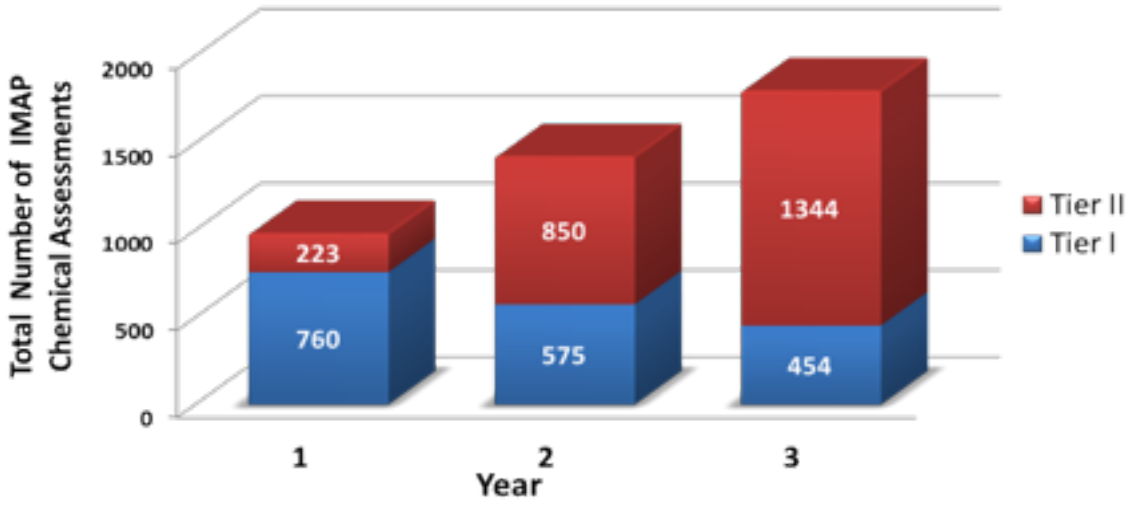
- Consideration should be given to review and update of 'Group Assessment' and 'Australian Uses' periodically.
- The format of reports is considered logical, easy to read with a sensible flow. Assessments have appropriate level of detail.
- Reports are easy to use; however, identification and explanation of endpoints covered would be beneficial.
- Assessments have been an effective process to review many existing hazardous chemicals to a reasonable standard. The IMAP summary data are now another useful source of reviewed data for persons preparing Safety Data Sheets and chemical management procedures.

The hazard classifications are a critical parameter for stakeholders and the classifications are listed at the bottom of web pages and have low visibility. A more user-friendly format with hazard classifications more easily accessed or summarised in the tables would be welcomed by stakeholders.

The availability of chemical safety information significantly increased throughout Stage One. **Figure 1** shows an increase in the total number of IMAP chemical assessments published, with approximately 1800 assessments published in year three of the program.

As Stage One progressed, there was an increase in the proportion of Tier II to Tier I assessments published. This reflects work on increasingly complex chemicals as initial screenings were completed and processes were streamlined. Tier II reports made up 23 %, 60 % and 75 % of the total number of IMAP assessments in years 1, 2 and 3 of the IMAP program, respectively (corresponding to 2012-13, 2013-14 and 2014-15).

Figure 1. Breakdown of Tier I and Tier II assessments in Stage One of IMAP



The Tier II assessments provided critical information to support risk management (refer **Supporting effective risk management** section). IMAP assessments have contributed significantly to the availability of definitive information for industrial chemicals, with hazard classification or categorisation in accordance with the Australian Approved Criteria for classifying hazardous substances; Australian Persistence, Bioaccumulation and Toxicity (PBT) criteria; and the Globally Harmonised System (GHS) for classification and labelling included in the majority of Tier II reports.

A significant number of classifications were made for chemicals without equivalent classifications internationally (see **Supporting effective risk management** section).

Given the large number of chemical assessments published, NICNAS developed summary tables for the NICNAS website which contain key information and links to the reports to facilitate access to relevant information. Separate tables were published for Tier I and Tier II human health and environment assessments. Feedback during Stage One and the review of the program indicated that whilst these summary tables were valuable, the retrieval of reports and navigation through them presented challenges.

During Stage One, NICNAS made significant improvements to its website and publications following stakeholder feedback, to facilitate searching for assessments (including incorporation of anchor points to allow stakeholders to go directly to a section of interest).

Key findings and next steps (TOR1, TOR7)

Through using the IMAP framework, NICNAS was able to significantly increase the availability of chemical safety information both nationally and internationally.

By the end of December 2015, NICNAS had published 4315 human health and/or environment assessments for a total of 3215 chemicals in fifteen tranches. This figure represents 94.1 %[2] of the

[2] This figure included 'additional chemicals' which were not included in the Stage One list of 3000 chemicals, but are members of groups of chemicals already being assessed in Stage One and have been added to gain further efficiencies.

Stage One list. NICNAS is currently anticipated to achieve the target of 95 % set in the Portfolio Budget Statements.

The published information at both Tier I and Tier II was found to be a valuable source of information for a range of audiences, including regulators and users of chemicals. Opportunities to improve the information and its dissemination have been identified, including the provision of common names for chemicals published at Tier I and clear information on the assessed use(s).

Over the next few years, there will be changes to the types of data available for assessments (refer **Quality and best practice** section) and risk management requirements in Australia (refer **Supporting risk management** section). In addition, there are moves internationally to deliver data in different assessment formats to suit various stakeholder needs.

For example, in January 2016, the European Chemicals Agency (ECHA) changed the way in which users view chemical data on their website, with information structured in three layers: Infocard, Brief Profile and detailed source data.

As such, any future implementation of the IMAP framework will need flexibility in the way data are integrated and presented.

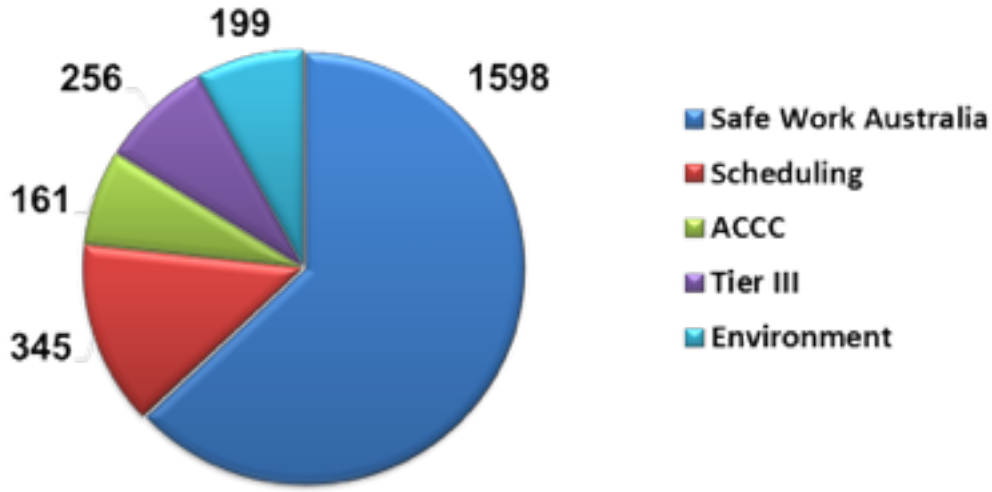
NICNAS will continue to engage with key stakeholders to ensure that assessment outputs, including the identification of chemicals that pose no unreasonable risk, meet their needs.

Theme 2: Supporting effective risk management

Through the IMAP framework, NICNAS has been able to make regulatory recommendations about existing chemicals to a range of risk management agencies, covering worker health and safety, public health and the environment.

By the end of December 2015, 2559 recommendations have been made for 2000 unique chemicals. The majority of recommendations have been made to Safe Work Australia (SWA) (62.4 %) and to the Chemicals Scheduling Delegate for the Poisons Standard (13.5 %) (**Figure 2**).

Figure 2. Breakdown of Tier II risk management recommendations



NICNAS continuously engaged with risk management agencies during the development of IMAP and throughout the implementation of Stage One to ensure that the support for recommendations and referral processes were optimal.

Feedback from risk management agencies emphasised the important role that NICNAS assessments play in risk management of chemicals in Australia. The IMAP assessments and referral processes were found to be fit for purpose in supporting risk management decisions, with continuous improvement in the content of the reports highlighted.

Some opportunities to further enhance the reports, in particular articulating areas of uncertainty, were noted. Whilst a significant number of recommendations were able to be made in the absence of specific information about the use of a chemical in Australia (refer **Data utilisation** section), all risk management agencies provided feedback that they would appreciate increased access to Australian use and exposure information (refer ***What we heard: Supporting risk management***).

What we heard: supporting risk management

- [IMAP] assessments provide vital information to support a risk-based regulatory system.
- IMAP has done a good job in identifying chemicals that required risk management.
- IMAP reports support whole of government process (…) [we] value the IMAP assessment process and recommendations made.
- Recommendations (…) are very helpful and clear. Summary tables are useful.
- Further information on read-across methodologies and validity of studies would be useful.
- The referral process for risk assessment advice was effective and reflects the good working relationship between the two agencies. It would be preferable, where possible, to provide as much time as possible to respond to requests for advice [made prior to publication].
- Grouping and subsequent referral of similar chemicals improves efficiency of decision making process for regulators.
- A key to the Existing Chemical program is identifying all the existing uses in sufficient detail for risk assessment to be undertaken and any subsequent management action to be formulated. The more detailed information about actual existing uses that is available to risk managers, the better the existing end uses of a chemical can be targeted.
- Better access to exposure data and a better understanding of the product would help.

In some limited circumstances, the appropriate risk management structures to address the potential concern identified in the assessment were not available.

Therefore, mechanisms to restrict introduction by making changes to the AICS may be desirable in these instances (refer ***Case study: regulatory powers***), and are being considered in the context of the NICNAS reforms. This would need to include consultation with risk managers to ensure this does not duplicate current risk management measures.

Case study: regulatory powers

Perfluorinated chemicals (PFCs) are used in numerous specialty applications. Certain PFCs are persistent, bioaccumulative and toxic (PBT). Evidence from animal studies indicates some PFCs exhibit toxicity to mammals and aquatic animals and cause reproductive and developmental problems.

NICNAS has been working since 2002 to reduce the importation and use of some PFCs. During Stage One, NICNAS has assessed nearly 230 PFCs. The potential to give rise to adverse outcomes for the environment was identified for 183 of these chemicals. These chemicals are currently listed on the AICS and are available to be introduced into Australia without the requirement for assessment by NICNAS. Existing risk management mechanisms outside of NICNAS to limit the use of these chemicals are not available.

Therefore, it was recommended that NICNAS consult with industry and other stakeholders to consider strategies, including regulatory mechanisms available under the *Industrial Chemicals (Notification and Assessment) Act 1989* (the ICNA Act), to encourage the use of safer chemistry.

Worker health and safety

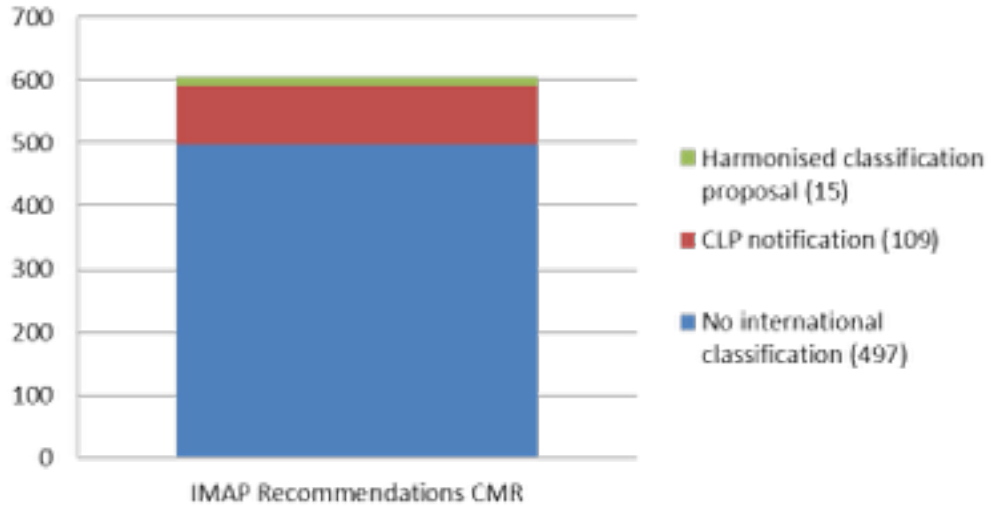
By 31 December 2015, a total of 1598 chemicals had been recommended for hazard classification (amendment of the hazardous classification information system (HSIS) and adequacy of current worker exposure standards). In addition, information in IMAP reports has assisted Safe Work Australia (SWA) with the development of the GHS Hazardous Chemical Information List (HCIL).

To date, approximately 438 amendments have been made to both the HSIS and the HCIL. Given the large volume of classification information, significant time was required to develop the optimum format for referrals to update the HSIS and the HCIL with considerable resources required in both NICNAS and SWA to collate the data. A number of recommendations for amendments to classifications are in the process of being incorporated into the system.

SWA considers that IMAP assessments conducted by NICNAS are an authoritative source of classification information (Safe Work Australia, 2016). Whilst SWA also includes classification information from authoritative overseas sources, significant enhancements to the availability of definitive classification information, compared with that available internationally, has been achieved through IMAP.

As part of IMAP Stage One, over 600 chemicals have been recommended for classification for carcinogenicity, mutagenicity or toxicity to reproduction (referred to as CMR, henceforth). The majority of these had no international classification. There were 109 chemicals which had one or more notifications to the European Classification and Labelling (C&L) Inventory for CMR and a small number (15) had a harmonised classification proposal in Europe (**Figure 3**).

Figure 3. CMR classification comparison with overseas



In November/December 2015, SWA held a public consultation process to examine the role of exposure standards and how they could be reviewed and maintained. This consultation process has now closed and will help inform policy options for the regulation of exposure standards.

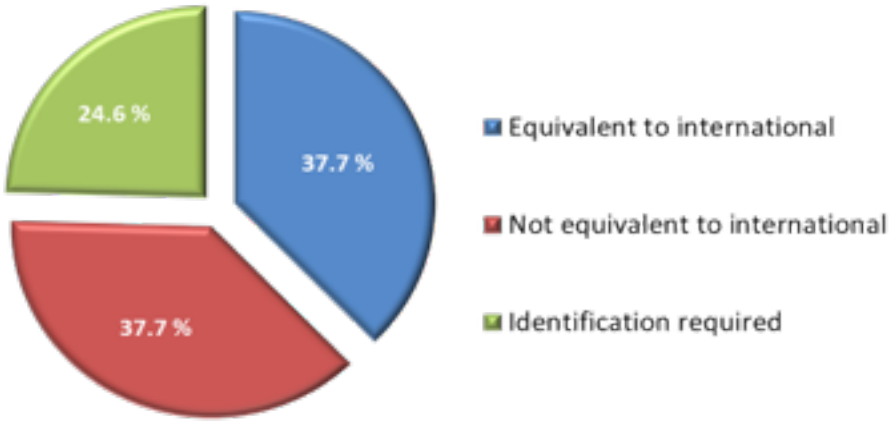
Pending the outcome of this review, recommendations in relation to adequacy of exposure standards have been deferred.

Public health

By 31 December 2015, a total of 345 chemicals (assessed in 95 reports) had been recommended for scheduling under the *Poisons Standard*. Of these, 298 chemicals (assessed in 72 reports) have been reviewed by the scheduling delegate or the Advisory Committee on Chemicals Scheduling (ACCS) with decisions made for 285 of these chemicals to date.

A new entry or amendment to the *Poisons Standard* occurred for 228 chemicals (80 %). An analysis of IMAP chemical assessments which resulted in an adjustment to the *Poisons Standard* indicated that 37.7 % of the restrictions implemented were equivalent to existing restrictions by other regulatory authorities internationally. There were no identified restrictions in other countries for 37.7 % of these chemicals; 24.6 % were not uniquely identified in international restrictions, and significant effort was required to identify the restrictions that applied to these chemicals (**Figure 4**).

Figure 4. Changes to public health controls; a comparison with international risk management



The majority of recommendations that were not taken up were for chemicals referred to the scheduling delegate prior to August 2014, indicating that continuous improvement in the quality and content of the reports contributed towards increasing the uptake of recommendations.

Some circumstances where scheduling recommendations were not accepted by the delegate and/or ACCS are as follows:

- the category of use was considered inappropriate to justify scheduling;
- the potential use is a concern for public health but the history of known use did not show particular concern requiring scheduling;
- despite indications the chemical is used overseas, use was deemed unlikely in Australia; and
- toxicity data for a critical endpoint (mutagenicity, carcinogenicity, etc.) were considered insufficiently conclusive to support a scheduling decision.

NICNAS had made recommendations to the Australian Competition and Consumer Commission (ACCC) for 161 chemicals by the end of December 2015. The majority of these related to the use of certain azo dyes in textiles in Australia. NICNAS recommended that the ACCC consider mechanisms to limit the supply of textiles and leather articles that could come into direct and prolonged contact with the human skin and might plausibly result in human exposure to these chemicals at unacceptable levels.

In response to NICNAS recommendations, the ACCC also undertook two surveys to identify the presence of aromatic amines in various dyed articles such as clothing. This resulted in 12 voluntary recalls related to azo dyes with carcinogenic amines, involving 37 product lines and over 207,000 items.

In addition, the ACCC has published guidance to consumers, retailers and manufacturers and continues to consult on regulatory and non-regulatory options to limit the supply of these dyes (ACCC, 2014).

Environment

Currently, there is no national framework for the streamlined uptake of environmental risk management recommendations in Australia. To address this, the Australian Government Department of the Environment is currently developing the Australian Chemicals Environment Standard, which will enable categorisation of chemicals for environmental risk management, in a manner similar to that in which the *Poisons Standard* is used to manage public health risks. Implementation of the Australian Chemicals Environment Standard is expected to occur in 2018.

As the Australian Chemicals Environment Standard is currently under development, environmental assessments conducted under IMAP made comparatively broad recommendations. The focus was placed on providing the critical information necessary to inform current and/or future frameworks and standards for efficient and effective risk management. For example, over 100 chemicals were categorised according to existing domestic PBT criteria by the end of 2015.

Classifications according to the GHS have been made for a similar number of chemicals. Many of these classifications had not been made internationally. For example, approximately 65 % of chemicals which were classified for environment hazards according to GHS under IMAP do not have an environment GHS classification listed in the European Classification, Labelling and Packaging (CLP) database.

Feedback on risk management recommendations suggested that this was the area with most potential for improvement. Current recommendations were observed to be broad and primarily process-based (i.e. prioritised for further assessment under IMAP), and not easily translated into tangible or practical risk management actions across the various jurisdictions.

It was acknowledged that the development of the Standard is expected to address many of the issues noted (refer ***What we heard: environmental risk management***).

What we heard: environmental risk management

- The outcomes of risk management measures achieved by states/territories are in line with the environmental risk assessments under IMAP.
- IMAP recommendations (appear to be) mainly process-oriented and the environment related recommendations are brief. States and territories need more practical environmental risk management information and guidance in order to control a chemical in the absence of a national standard.
- [Risk management recommendations made in IMAP environment assessments are not likely to be easily translated into actions that can be implemented by risk management agencies, because of] the range of processes that are followed and systems in place across Australian jurisdictions. Hopefully the chemical reforms for the environmental risk management of industrial chemicals activities will address some of the issues with the Australian industrial chemicals management system.

Key findings and next steps (TOR1, TOR4, TOR5, TOR6, TOR7)

The IMAP framework has been successful in supporting risk management of chemicals in Australia with risk management measures implemented or being considered for a significant number of chemicals as a result of the IMAP assessments. This was facilitated by continuous engagement with risk managers, resulting in improvements to reports and referral processes throughout Stage One.

Opportunities to enhance reports were identified, particularly where data from more traditional animal tests are not used. This will be increasingly important with the emergence of alternative test methods and new tools for the predictions of hazards (refer **Quality and best practice** section).

Changes to regulatory processes, for example, the development of Australian Chemicals Environment Standard, are anticipated to increase opportunities to utilise outcomes of the IMAP assessments. Information included in the report may need to be tailored for these new processes.

Risk management agencies indicated that NICNAS assessments played an important role in identifying risks that are relevant in Australia. This is supported by a large number of risk management outcomes implemented in the absence of equivalent measures overseas.

Although significant regulatory action could be taken in the absence of Australian use data under some circumstances (refer **Data utilisation** section), risk management agencies also emphasised that risk management decisions were better informed where Australian use information is available.

Assessment outcomes from Stage One supported the need to maintain the ability to add conditions of use, or remove a chemical from the AICS in circumstances where the appropriate risk management systems to address the potential concern are not available.

NICNAS will continue to engage with Australian risk management agencies to ensure the assessment outputs cater to their needs. In particular, focus will be given to:

- data needs for new regulatory processes;
- identification of circumstances where there is a critical need for Australian data;
- assessment of chemicals for which imposing conditions of use or removal from the AICS are being considered; and
- provision of technical expertise regarding interpretation of new types of hazard data.

Theme 3: Prioritisation and deprioritisation of chemicals for assessment

Use of selection criteria

The 3000 chemicals on the IMAP Stage One list were identified based on the following criteria, agreed by stakeholders as priorities for early consideration:

- chemicals for which NICNAS already holds exposure information;
- chemicals identified as a concern, or for which regulatory action has been taken overseas; and
- chemicals detected in international studies analysing chemicals present in the blood in babies' umbilical cords.

Chemicals identified by these criteria were assessed and published as both Tier I (chemicals that pose no unreasonable risk) and Tier II assessments (chemicals requiring more detailed assessment and/or risk management).

The selection criteria were transparent and useful in prioritising chemicals; however, the criteria and the early identification of the 3000 chemicals impacted on NICNAS's ability to address potentially higher concern chemicals not on the list. To gain further efficiencies in the implementation of IMAP Stage One, and to ensure that relevant chemicals were assessed, NICNAS included additional chemicals, where appropriate, in groups of chemicals already being assessed.

By the end of December 2015, 416 chemicals that were not included in the Stage One list of 3000, had been assessed as part of groups of the Stage One chemicals. Whilst this approach increased the flexibility of the Stage One list, other chemicals which could not be included in groups, but had equivalent hazards to those on the list, were not able to be assessed.

The availability of exposure information did not significantly affect the ability to determine outcomes at Tier I or Tier II for human health assessments, although a slight increase was observed in recommendations for Tier III assessments, due to the need to obtain Australian use data under certain circumstances. Chemicals with information about introduction volume, which often indicated introduction volumes less than 100 tonnes per annum, were less likely to be prioritised to Tier II for environment compared to those without data (refer **Data utilisation: exposure information** section).

A significant number of chemicals detected in cord blood (68 %) were published at Tier I as these were found not to be used for industrial purposes under the remit of the ICNA Act. Chemicals selected in the IMAP Stage One list, based on 'a concern or regulatory action taken overseas', were found to be the most likely to be assessed at Tier II for human health, with 73 % having recommendations for regulatory control or further assessment.

Findings were similar for environment assessments, with most of the chemicals prioritised for Tier II assessment added to the Stage One list on the basis of international concern or regulatory action. However, over 600 chemicals (approximately 25 % of Tier II human health assessments) that did not

meet this criterion had recommendations for new regulatory controls as part of their IMAP Tier II assessment.

Feedback received as part of the review supported undertaking screening activity in addition to use of external indicators of concern. Suggestions for criteria other than those used in Stage One, e.g. adverse event reports, that could be utilised to prioritise chemicals were provided as part of the review process (refer ***What we heard: use of selection criteria***).

In addition, other lists of chemicals of concern developed by international regulatory agencies (for example, the Japanese list of Class I Specified Chemical Substances and the Canadian Toxic Substances List), by international organisations (for example, the Organisation for Economic Co-operation and Development (OECD) High Production Volume List), as well as chemical hazard classifications (for example, European CLP classifications) could be considered.

What we heard: use of selection criteria

- It is critical that the criteria triggering assessment be discrete and clearly communicated to chemical importers and manufacturers.
- Actual reports of impacts in Australia would be a key criteria so some sort of consumer/ industry "adverse experience" reporting process could be considered.
- The current screen, based (in part) on chemicals identified as hazardous by international processes is useful but may place too much emphasis on potential human impacts as opposed to environmental/ecological impacts. A screen of aquatic toxicity is one possibility to incorporate ecological factors. A more rigorous approach for organic chemicals might include PBT assessment.

Tier I approaches

The Tier I assessment has both an assessment and prioritisation role and consists of three parts:

1. applying exclusion filters;
2. applying risk characterisation tools; and
3. validating Tier I assessment outcomes.

Human health and environmental Tier I activities use different criteria, tools and approaches, and hence were conducted separately.

Following identification of chemicals that required Tier II assessment, a number of factors were considered in the timing of these assessments, including potential grouping, impact on related assessments, potential risk management outcomes and availability of data. However, the relative priorities of chemicals that required assessment at Tier II were not considered.

Exclusion filters

In accordance with external advice received during the development of the IMAP framework, and in consultation with experts, NICNAS developed approaches to rapidly identify certain chemicals of inherently low regulatory concern to human health and the environment (due to hazard or exposure considerations). Using these approaches, 300 chemicals were removed from further consideration at an early stage, which maximised the use of resources.

These criteria have subsequently been reviewed by independent experts and found to be fit for purpose with possible modifications to expand the exclusion filters identified (refer ***What we heard: exclusion filters***).

Furthermore, whilst additional chemicals (not on the Stage One list) were routinely included in Tier II assessments, this did not occur extensively for chemicals published at Tier I. To efficiently identify chemicals of low regulatory concern, groupings could be formed from the remainder of the AICS for chemicals assessed as posing no unreasonable risk in Stage One.

What we heard: exclusion filters

- The approaches followed by NICNAS [to identify chemicals of low concern] are considered to be fit for purpose. In particular, the approaches to grouping similar substances, including the identification of ‘simple’ anions, cations, organic acids and esters, would be very valuable and effective.
- I note, and approve, the deliberate approach to using listings from comparable international programs (e.g. EU REACH, US HPV & GRAS) to assist with prioritisation of Tier I chemicals, and the potential for selected chemicals to be shifted to a 'low concern chemicals' category.

Risk characterisation tools

To determine chemicals that potentially required more detailed assessment at Tier II, the majority were assessed at Tier I, using tools and methods that integrated available hazard and exposure data. These tools were found to be effective for identifying chemicals of concern and enabled efficient identification of chemicals that warranted assessment at Tier II.

Of the chemicals prioritised for Tier II assessment, the majority (92 % for human health and 69 % for environment) had recommendations for regulatory control and/or further assessment. The assessments of the remaining prioritised chemicals typically provided critical information for the public interest and/or future risk management frameworks and standards (refer **Supporting risk management**).

For some assessments, additional recommendations were not necessary due to the presence of effective existing regulatory controls.

Tier I validation

In all cases, the data used to determine the Tier I outcome underwent an appropriate level of validation, with the final outcomes peer reviewed. The Tier I validation step allowed surrogate exposure data to be gathered and analysed for chemicals for which there were no Australian use data (refer **Data utilisation** section). The validation was only performed to the extent necessary to confirm a Tier I outcome.

The inclusion of a validation step allowed the use of information that was not conducive to high-throughput screening such as international assessment reports.

The inclusion of a validation step as part of the Tier I assessment was found to significantly reduce the number of chemicals that were prioritised to Tier II. For example, consideration of use concentration data, as part of the validation process approach, led to Tier I assessments for over 90 chemicals.

Feedback provided during the review supported this approach and suggested other factors that could be considered as part of the validation step including the presence of existing risk management (refer ***What we heard: Tier I risk characterisation tools***).

What we heard: Tier I risk characterisation tools

- The IMAP framework is a valuable tool in the identification of potential public health and safety concerns posed by unregulated materials.
- I note, and approve, the hazard banding approach, with its consideration of both systemic and local toxicity indicators.
- For screening purposes, the principle of considering the severity of an end point is sound.
- The framework would benefit from more explicit commentary around the exposure side of the equation – is there an opportunity to incorporate environmental monitoring data or biomonitoring data into the framework to refine the exposure input beyond production volumes.
- The hazard bandings merge two different concepts – hazard identification and hazard characterisation. From a risk assessment perspective, hazard characterisation (dose-response assessment) is more useful.
- A consideration of existing risk management controls is critical – these may be engineering controls, personal protective equipment, controls around access and use, training, industry stewardship etc. Potentially, a high-risk chemical may be of low regulatory concern if existing controls limit human and environmental exposures to acceptable levels.
- The presence of existing regulatory controls is considered an important factor in identifying chemicals that do not pose an unreasonable risk. Other criteria that could be taken into account are low volumes/concentrations of use (e.g. as with the Tier I assessment for EDTA) and manner of use e.g. closed system uses, non-isolated intermediates.

Parallel screening for human health and environment

NICNAS and the Department of the Environment work in parallel using separate criteria to assess industrial chemicals listed on the AICS. However, this does not preclude cross-transfer of knowledge and consideration of risks for both human health and the environment. Resources (including reference material and assessment outcome information) are shared wherever possible to optimise efficiency. In addition, synchronous assessment activity was undertaken where it was identified as being efficient. For example, groups of PFCs were assessed at the same time.

The use of different criteria, tools and approaches for the screening of chemicals on the AICS was found to be appropriate, resulting frequently in different outcomes for human health and environment. For example, 42 % of chemicals published at Tier I for environment, required assessment at Tier II for human health.

However, the alignment of chemical priorities for human health and environmental assessment could not always be considered and there are circumstances where the outcome of one assessment has a

direct impact on the other. For instance, there is specific consideration in the human health assessments for chemicals that are persistent and bioaccumulative in the environment. The synchronisation of early screening activities is therefore important.

Key findings and next steps (TOR1, TOR3, TOR8)

The tools and approaches developed for Tier I were successful for prioritising and identifying chemicals of low regulatory concern. Feedback provided as part of the review has identified opportunities to refine the criteria to further enhance these tools and approaches.

The parallel screening for human health and environment with separate outcomes was found to be appropriate, although early synchronisation of activities and adopting a more integrated approach to this stage of assessment would further enhance the robustness of screening outcomes.

The publishing of information for chemicals of low regulatory concern is becoming more important (refer **Quality and best practice** and **Enhancing chemical safety information** sections). The use of exclusion criteria and validation of Tier I data were found to be valid approaches for the efficient identification of chemicals of low regulatory concern.

The use of both external indicators (in particular, 'identified as a concern or regulatory action taken overseas') and NICNAS screening activities that use risk characterisation tools, was necessary for identifying chemicals that required assessment.

It is important that any future framework be dynamic, flexible and agile to respond to emerging issues. Several of the sources used to identify chemicals on the IMAP Stage One List, such as chemicals included in the EU REACH Substances of Very High Concern (SVHC) Candidate List have been updated since the establishment of the Stage One List. Furthermore, new data, additional hazard data sources and criteria and stakeholder requirements have and will continue to emerge.

With more than 34,000 chemicals that were 'grandparented' onto the AICS, remaining unassessed for their potential effects on human health and the environment, there is a need to continue to prioritise and deprioritise chemicals for assessment, based on newly identified or existing criteria.

NICNAS aims to develop criteria for prioritising and identifying chemicals of low regulatory concern that utilise:

- external indicators of concern such as international regulatory action;
- refined tools and approaches developed for Tier I;
- consideration of existing risk management;
- available hazard and exposure information including monitoring data;
- information from the corresponding human health and environment assessment where relevant;
- reports of actual impact in Australia; and
- grouping strategies in accordance with international best practice.

Once developed, these more detailed prioritisation criteria could readily be applied to a large number of chemicals remaining on the AICS.

This activity will inform a rolling assessment work plan for commencement of NICNAS initiated assessments in 2018. NICNAS will continue to engage with stakeholders to ensure chemicals prioritised for assessment are relevant to stakeholder needs.

Theme 4: Data utilisation

Access to information

Publicly available information

In undertaking IMAP assessments, NICNAS drew on a range of sources including:

- international assessments and databases;
- previous NICNAS assessments;
- literature reviews;
- advice from other regulators, both national and international; and/or
- external peer reviews.

The use of data from international sources has been fundamental to the assessments conducted under IMAP, with the framework developed to maximise the use of these data (where appropriate) in the Australian context.

For example, the human health and environment scientific criteria were aligned with existing hazard classification frameworks already in use across industry and internationally (refer ***What we heard: utilisation of international data***).

The assessments leveraged data available from various international reports and databases, such as:

- the Canadian Categorisation of the Domestic Substances List and various Canadian assessments;
- the European Union (EU) Registration, Evaluation, Authorisation and Restriction of Chemical substances (REACH) dossiers and various EU reports;
- Scientific Opinions on Cosmetic Substances by European Commission Committees;
- OECD assessments, eChemPortal database and QSAR Application Toolbox;
- various United States (US) Environmental Protection Agency (EPA) reports;
- National Toxicology Program (NTP) reports;
- the US National Library of Medicine Hazardous Substances Data Bank (HSDB);
- the Substances in Preparations in Nordic Countries (SPIN) database;
- International Program on Chemical Safety (IPCS) publications; and
- International Agency for Research on Cancer (IARC) reports.

Information utilised included chemical identity, composition, potential groupings, chemical hazard and exposure information, use restrictions, risk assessment outcomes and approaches as well as identification of potential concerns. The efficient and consistent use of these data was greatly enhanced by the development of new in-house electronic data management systems.

Feedback from risk management agencies in Australia emphasised the important role NICNAS plays in evaluating international data (refer ***What we heard: utilisation of international data***). Although the majority (99 %) of Tier II assessments include reference to one or more international information sources, there was significant diversity in scope of the international data and; therefore, significant effort was required to extract and evaluate the information.

REACH dossiers, which were utilised in approximately 75 % of assessments, were by far the most readily available source of information for chemicals. The dossiers contain study summaries for various toxicity endpoints (often with multiple studies available for a single endpoint and multiple dossiers for any given chemical). The dossiers are not risk assessments, nor do they provide regulatory decisions. Therefore, significant assessment effort and expert judgment was required to utilise the information appropriately, and based on that information, determine the optimal assessment outcomes for the Australian context. International risk assessments, particularly those covering all factors prescribed in relevant Australian legislation (i.e. the risk to public health, workers' health and safety and the environment), were less readily available and as such, data available from a range of international sources were considered most effective for the assessment of chemicals (refer ***Case study: utilisation of International data***).

Whilst chemical grouping was undertaken in accordance with international best practice, there were some differences in groups of chemicals for IMAP assessments to those formed internationally. This was due to differences in inventories or rationale for the grouping; for example, some US EPA assessment groupings only applied to high volume chemicals.

The application of expert judgement to form AICS-specific groupings so that data for one chemical could be used to assess chemicals with no data (refer **Hazard data** section below) maximised the utility of international information. For example, the formation of AICS-specific groupings in particular for azo dye and petroleum stream chemicals allowed Canadian assessment data for 132 chemicals to be utilised in the assessment of 902 AICS chemicals as part of Stage One.

NICNAS worked collaboratively with its international counterparts, in particular, the Government of Canada, US EPA, the European Chemicals Agency (ECHA) and international industry bodies throughout Stage One to facilitate the sharing of information where appropriate.

What we heard: utilisation of international data

- (Risk management agency) assesses high level international data but appreciates the role NICNAS plays in the interpretation of literature and putting it in the Australian context. IMAP reports are a good filter of international data.
- [The alignment of hazard bands with GHS criteria] will allow the greatest and most direct use of overseas GHS classifications, particularly those from ECHA and as now presented via the OECD's eChemPortal.

Case study: utilisation of international data

During Stage One, environment assessments (Tier I) and human health (Tier II) were published for 160 petroleum and refinery gases (including 28 chemicals not on the Stage One list). The outcome of the human health Tier II assessments was a recommendation for amendment of the classification for worker health and safety for all chemicals.

The IMAP assessments used international data from several international sources including:

- US EPA Screening Level Hazard Characterisation documents, which provided chemical composition and hazard information for 146 chemicals;
- Government of Canada Screening Assessments for 44 chemicals, which provided hazard data, exposure scenarios and risk characterisation approaches; and
- REACH dossiers for two chemicals, which provided critical study details for classification under the current approved criteria and adopted GHS.

Neither the US EPA nor the Government of Canada classifies chemicals in accordance with the GHS. Whilst the Canadian assessment identified a potential risk for populations living in the vicinity of refineries, this was not considered to be a risk in Australia (based on Australian information) and risk management was not recommended.

Using a combination of international sources enabled a rapid and robust assessment of 160 chemicals. However, NICNAS resources were required to identify relevant chemicals on the AICS to group together, to collate and evaluate the data, classify the chemicals for worker health and safety, and characterise the risk in the Australian context.

Data Provision

Following evaluation of available information for chemicals, it was identified for some chemicals that additional information could have a significant impact on outcomes e.g. where conservative assumptions were required due to limited information.

NICNAS approached specific industry sectors (where these could be identified) to ascertain whether relevant information to inform the assessment was available. To keep stakeholders informed, NICNAS published a list of chemicals for which NICNAS was to commence assessment at the start of each year of Stage One.

The provision of information by introducers and users of these chemicals was considered extensively as part of the assessments, but was kept confidential when requested. Organisations providing data were also given the opportunity to review the draft reports for factual corrections (only) prior to publication.

As a result of these activities, information was provided by 12 local organisations and 10 international organisations. Use and/or volume information was provided for 350 chemicals, including 89 chemicals for which NICNAS previously held no data.

Hazard information was provided for 61 chemicals. Using scientific expert judgment, these data were also utilised to read-across for an additional 195 chemicals, leading to more informed assessments. In some cases, for example in the assessment of metal compounds, significant high quality information was provided that was critical for the assessment (refer ***Case study: provision of information***).

Additional hazard and exposure information was also provided as a result of the IMAP assessment public comment period (refer **Quality and best practice** section). All IMAP assessments had a six to eight week public comment period during which information that had potential to affect the outcome of an assessment, which had not been considered in the initial assessment, could be provided.

Public comments were provided by both national and international organisations. Overall public comments were made for approximately 2.7 % of IMAP assessments (approximately 116 Tier I and II Human Health and Environment assessment reports encompassing 449 unique AICS-listed chemicals). Overall the majority of public comments related to either the provision of exposure or hazard information or providing editorial and/or factual corrections. Feedback received during the review indicated that the large number of assessments published may have limited the ability of industry stakeholders to review and provide public comment (refer **Efficiency and sustainability** section).

Case study: provision of information

During IMAP Stage One, NICNAS sought to assess over 60 metal compounds, many of which had little toxicological information available (i.e. were 'data poor'). Use of predictive modelling such as QSAR software was not considered to be an appropriate method for assessing these compounds as available QSAR models could not reliably predict toxicity endpoints for metal compounds.

One challenge with assessing these chemicals was the lack of publicly available data on similar compounds, which could have been used to enable a robust, read-across to inform the assessments (read-across is a technique for predicting endpoint information for one substance, by using data from another similar substance). Many of these data were held by industry as confidential material. Following a voluntary call for information issued by NICNAS, and through close stakeholder consultation, NICNAS was provided access to data from around 200 study reports and documents, which were essential to the assessment of the metal compounds.

The data allowed the formation of scientifically robust groupings that resulted in the streamlined assessment of 61 chemicals with less precautionary outcomes for a number of chemicals.

The nature of the engagement and information exchange between NICNAS and industry enabled a more transparent and efficient assessment process where all parties benefited.

Feedback provided as part of the review emphasised the importance of early and transparent communication to support better engagement with stakeholders (refer ***What we heard: provision of information***) and also indicated that the ability for industry to provide comment on the assessments was hindered by the large number of assessments (refer **Efficiency and sustainability** section).

The data provided by industry as a result of voluntary calls for information had to be manually entered into the data management systems as there was no capacity to directly upload electronic hazard and exposure data from industry submissions.

What we heard: provision of information

- Improved upfront communication of chemicals prior to assessment would be beneficial to industry to support assessment reviews. Communication of chemicals assessment forecast would enable industry to proactively understand if there are any product line impacts early on in the process and to support any potential future assessment or comments.
- The IMAP [Program] and assessments are very useful; however, it is very difficult to keep track of all the chemicals that may be relevant and whether they are being assessed. An alert system of sorts would be beneficial where a list of relevant chemicals could be entered so that a notification could be sent when a chemical from the list is being assessed.
- IMAP assessments for many chemicals are also hampered by a lack of Australian environmental concentration data. Linking IMAP to any potential scheme(s) for gathering such information would significantly improve the confidence of the recommendations for management in Australia.
- The comment periods need to be longer (I suggest three months).

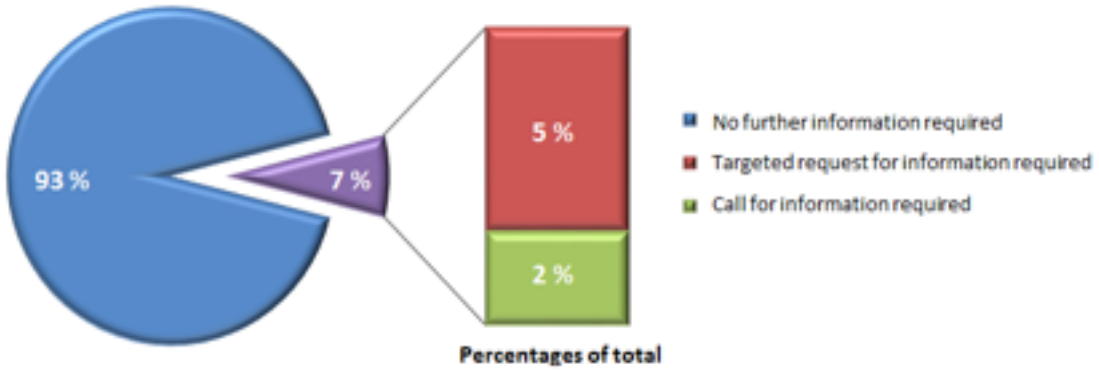
In a limited number of circumstances, risk assessment conclusions at Tier II and/or recommendations for risk management could not be made on the basis of the available information (refer ***Case study – Tier II: further information required***).

Figure 5 shows that of the 2428 chemicals assessed at Tier II under the IMAP framework (as of end December 2015), consultation with industry was recommended for only 7 % (173/2428) of the chemicals to determine the extent of Australian use and any specialised containment measures that may be required based on the pattern or type of use.

Whilst further targeted voluntary calls for information were anticipated to be possible for the majority of these chemicals based on known stakeholders (e.g. introducers, industry associations, etc.), this process was not considered possible for a smaller subset (2 % of chemicals assessed at Tier II under the IMAP framework), as the relevant companies/organisations could not be identified.

A mandatory call for information for these chemicals would have enabled NICNAS to determine the risk and provide adequate information to support risk management recommendations.

Figure 5. Targeted requests and calls for information required for Tier II assessments



Case studies – Tier II: further information required

A Tier II assessment of a chemical found that exposure to the chemical caused adverse reproductive effects in animals at low concentrations. Australian use data for the chemical are not available. International use information indicates that the chemical has cosmetic and domestic use, although recent information in the USA and Europe indicated that the cosmetic or domestic use was likely to be limited. Considering the potential for serious health effects at relatively low levels of exposure (regardless of route), information on the use of the chemicals in cosmetic and domestic products in Australia is still required to quantify the risk.

Another Tier II assessment found that a chemical that is typically used overseas as an antioxidant/ stabiliser in hydrocarbon fuels and lubricants is a PBT substance according to domestic environmental hazard criteria. Although industrial uses for this chemical have been identified in other industrialised countries, there is currently no specific information on either the annual volumes of this chemical that are introduced or the industrial use pattern in Australia.

It is currently prohibited for industrial uses in Japan and has been proposed for virtual elimination under specific risk management plans in Canada. A key component of effective risk reduction measures for PBT chemicals is to identify the routes of potential environmental exposure and the quantities of chemicals entering the environment by various exposure pathways.

Currently, this analysis cannot be conducted in Australia due to the lack of essential exposure information including introduction, volumes and industrial uses. These are critical data gaps in the risk profile for the industrial uses of this chemical in Australia.

Utilisation of available exposure data

During IMAP Stage One, Australian use and/or volume data were only available for approximately one third of assessed chemicals. The IMAP framework was developed to utilise surrogate

information, such as from overseas sources or conservative default values for the remaining chemicals.

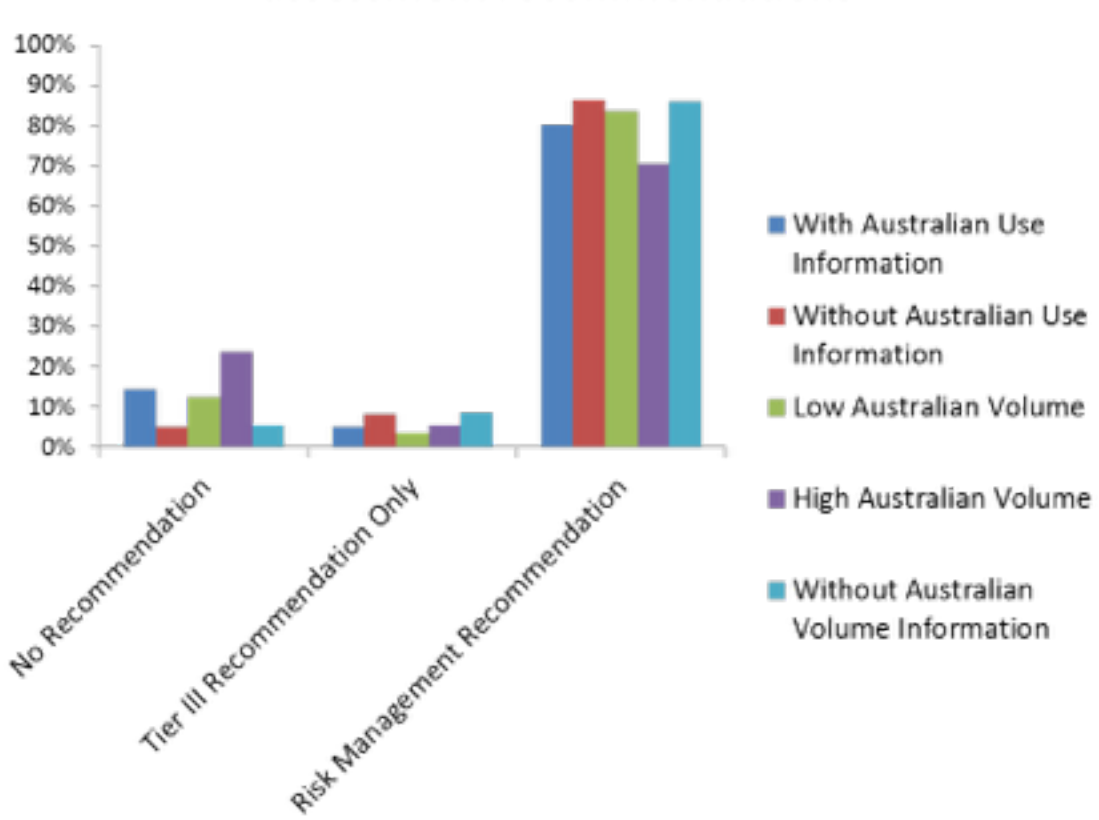
Surrogate use information was found to be effective for: identifying chemicals that pose no unreasonable risk to human health and/or environment, assessing chemicals and making recommendations in the Tier II assessments.

Figure 6 illustrates the general trend for Tier II human health assessment outcomes, which were similar regardless of the availability of Australian use and volume data. A slight increase was observed in recommendations for Tier III assessments due to the need to obtain Australian use data under certain circumstances.

Surrogate use data also assisted in identifying chemicals considered to be a low priority for risk management or further assessment; however, if Australian use was found not to be consistent with trends overseas, then further assessment of these chemicals would be required.

The assessment reports for these chemicals indicated the importance of Australian use information in determining recommendations for risk management.

Figure 6. Availability of Australian volume information and its effect on recommendations through the IMAP program



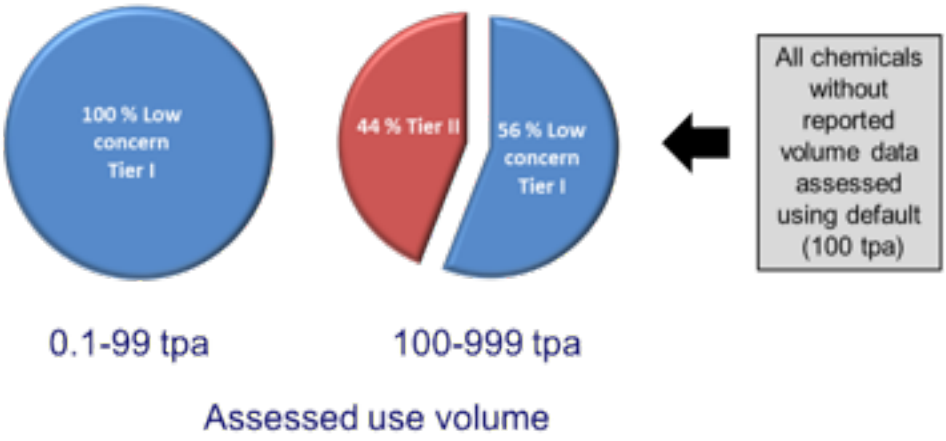
In many cases, the use of the default volume (100 tonnes) for chemicals that had no reported volume information is considered to significantly overestimate the release to the environment and

subsequent risk of the chemicals. Reported volume information indicating an annual use volume less than 100 tonnes per annum was available for a relatively low number of chemicals (less than 50).

None of these chemicals were prioritised for Tier II environment assessments with the risk for about a third of these mitigated by use at low volumes (less than 5 tonnes per annum). For chemicals where an annual introduction volume of 100 tonnes per annum or more was used, 44 % were prioritised for Tier II environment assessment (**Figure 7**).

During IMAP Stage One, international volume information demonstrated limited ability to significantly refine the default volume assumption. NICNAS continues to liaise externally, for example with the International Fragrance Association (IFRA), to identify options for refining the default volume assumptions for fragrance ingredients.

Figure 7. Environment Tier I outcomes based on risk quotient (calculated from an estimated exposure, divided by an estimated effect)



Utilisation of available hazard data

Although international data and early communication with key stakeholders to obtain information were used extensively in IMAP assessments, approximately 10 % of Tier II assessments had data for all standard toxicity endpoints considered.

The greatest data gaps were found for long-term studies and studies investigating dermal and inhalational routes of exposure. For example, 37 % of assessment reports did not have carcinogenicity data from animal studies, human case reports or QSAR modelling.

Internationally-accepted approaches such as grouping of chemicals or read-across between chemicals based on similar characteristics (e.g. physico-chemical properties) and the application of QSAR tools (e.g. use of structural alerts to derive toxicity) have all been routinely employed, where relevant, to reach a conclusion regarding the toxicity profile of a chemical.

Assessment conclusions were also achievable in the absence of specific data for a chemical by consideration of existing, or proposed risk management measures (e.g. where existing or proposed

controls for known hazards were considered sufficient to protect the public and/or workers from any risks from unknown hazards.)

Case study: read-across of hazard data

During IMAP Stage One, an environment Tier II assessment was published for a group of four nitromusks. The risk assessment of these chemicals was conducted as a group because all four of the substances were structurally-related compounds with industrial use as synthetic musk fragrances. By assessing these structurally-related chemicals as a group it was possible to complete the assessment by filling the data gaps of the individual chemicals by read-across.

One such data gap in the nitromusk assessment was the lack of a bioaccumulation study for musk moskene. However, musk moskene had a comparable octanol-water partition coefficient (a concentration ratio that indicates the likelihood of bioaccumulation) to that of musk xylene (another chemical in the group). Measured bioconcentration data available for musk xylene indicated a high potential for bioaccumulation. Read-across of these data, in combination with the available octanol-water partition coefficient, provided sufficient weight of evidence to confidently categorise musk moskene as bioaccumulative. As a result, musk moskene was categorised as PBT according to domestic environmental hazard criteria, and found to potentially meet the Annex D screening criteria for Persistent Organic Pollutants under the *Stockholm Convention*.

During the development of IMAP, a comprehensive QSAR strategy that simultaneously used different mechanistic and statistical models was established in consultation with experts. To identify human health hazards, the OECD QSAR Toolbox[3], OASIS-TIMES[4] models, and TOPKAT[5] were used.

The OASIS-Pipeline Human Health Prioritisation (OPHP) scheme was developed for NICNAS to integrate the prioritisation criteria according to the IMAP hazard bands. This tool provided an efficient system to access publicly available experimental data (using the databases contained within the OECD QSAR Toolbox) and human health endpoint predictions (using the OASIS-TIMES models).

To identify environmental health hazards, the OECD QSAR Toolbox, OASIS's[6] POPs and CATALOGIC models, and the US EPA Estimation Programs Interface (EPI) Suite[7] were used.

The use of QSAR is mainly suitable for organic chemicals, which are only a subset of chemicals on the Stage One list, and is further limited by the applicability domains[8] of the models. This meant that, in practice, QSAR was often unable to provide sufficient information to fill data gaps. For example,

[3] OECD QSAR Toolbox (http://www.oecd.org/chemicalsafety/risk-assessment/theoecdqsartoolbox.htm)

[4] OASIS-TIMES (http://oasis-lmc.org/products/software.aspx)

[5] DS TOPKAT (http://accelrys.com/solutions/scientific-need/predictive-toxicology.html)

[6] OASIS POPs, and CATALOGIC (http://oasis-lmc.org/products/software.aspx)

[7] US EPA EPI Suite (http://epa.gov/oppt/exposure/pubs/episuitedl.htm)

[8] The applicability domain of a QSAR model is the physico-chemical, structural or biological space, knowledge or information on which the training set of the model has been developed, and for which it is applicable to make predictions for new compounds.

QSAR was unable to be used to fill data gaps for over 85 % of chemicals published at Tier II for environment as they were outside the applicability domains.

QSAR predictions have mainly been used in IMAP for initial screening of chemicals and weight of evidence considerations where available experimental data are either conflicting or of limited reliability. QSAR predictions were also useful in providing suggested modes of action or mechanistic interpretations of an (eco) toxicity endpoint of the chemicals being assessed. Significant assessment resources are required to interpret QSAR data and reduce uncertainty, particularly when QSAR predictions are used to support risk management recommendations.

A retrospective analysis of QSAR predictions for known sensitising and genotoxic chemicals indicates that the mechanistic models (OASIS-TIMES) used in IMAP had improved predictive power compared to the statistical model (TOPKAT) used, with potential opportunities to further improve the predictive capabilities of these models identified.

During IMAP Stage One, NICNAS assessed approximately 180 chemicals with extremely limited hazard and/or exposure data (even taking into account QSAR and read-across from other chemicals). Approximately 20 % of these were identified as posing no unreasonable risk to human health based on the anticipated uses and expert judgment interpretation of the limited data available. The remaining chemicals were assessed as part of 12 separate Tier II assessments.

Following assessment at Tier II, all chemicals were recommended for a Tier III assessment to determine whether any exposure to these chemicals occurs in Australia and also to determine whether industry holds information that would better characterise the hazards of the chemicals.

Key findings and next steps (TOR1, TOR4, TOR8)

Access to information

NICNAS has extensively used international data within the IMAP framework. Feedback from Australian risk management agencies emphasised the important role NICNAS plays in evaluating international data.

International risk assessments, particularly those covering all factors prescribed in relevant Australian legislation (i.e. the risk to public health, worker health and the environment) were less readily available, and as such, data from a range of international sources were considered most effective for the assessment of chemicals. Given the varying scope and format of these data, considerable resource effort and expert judgment were required to determine their relevance within the Australian context.

Efficient and effective use of international data was enhanced by the formation of AICS-specific groupings, the development of in-house electronic data management systems, and engagement with international regulatory agencies and industry bodies.

The use of international OECD guidance, combined with the application of expert judgement to formulate AICS-specific groupings is considered to be important in the future to continue to fully utilise the available international data.

The chemicals assessed in IMAP Stage One are anticipated to have a greater prevalence of international data compared to the remainder of chemicals on the AICS due to the Stage One selection criteria for chemicals on the AICS. REACH dossiers are expected to continue to be a major source of hazard data, with the deadline for registering substances manufactured or imported in Europe at 1-100 tonnes a year in May 2018.

Ongoing programs such as the Canadian Chemicals Management Plan (CMP), the Chemical Substances Control Law (CSCL) in Japan and the South Korean Chemicals Information (K-REACH) should also provide valuable data. NICNAS will continue to actively collaborate with its international counterparts to optimise the use of international data, in accordance with criteria approved by the Minister for Health.

In many cases, the information gathered by NICNAS was sufficient to complete an assessment and make any relevant recommendations, without the need to seek more information from stakeholders. However, in some cases, it was considered necessary to seek information directly from introducers. Strategies used to gain access to additional data to those held by NICNAS or available publicly included general and targeted voluntary calls for information and the opportunity to provide public comment on all assessments. The information provided was often critical for the assessment and obviated the need to use more conservative assumptions because information was limited.

Enhanced access to information could be supported by early and transparent communication of chemicals to be assessed and consideration of stakeholders' ability to respond to the number of chemicals assessed (refer **Efficiency and sustainability** section).

Consideration should also be given to identifying the most relevant stakeholders, given the type of chemicals being assessed. NICNAS will continue to proactively engage with relevant stakeholders through early and transparent communication to maximise efficient input regarding chemicals to be assessed. Opportunities to enhance the NICNAS IT system to facilitate the provision of information from stakeholders, including features to enable the acceptance of external data and issue alerts for upcoming assessments, will be further explored as part of the NICNAS reforms.

There were a limited number of circumstances where recommendations for risk management could not be made on the basis of the available information and targeted voluntary calls for information were not considered possible. Without the ability to make a mandatory call for information, adequate information to support risk management recommendations (or to conclude that such recommendations were not necessary) for these chemicals was not available.

Therefore, maintaining NICNAS's current statutory powers to obtain information from introducers in circumstances where publicly available data are not sufficient, is likely to remain important for assessing chemicals of significant concern, in order to efficiently make evidence-based and appropriately risk-proportionate recommendations for uptake by risk management agencies.

Utilisation of available exposure data

All chemicals for which NICNAS held Australian exposure data were included in IMAP Stage One; therefore, very limited Australian data are expected to be available for the remainder of chemicals listed on the AICS.

The use of surrogate and default exposure data in the absence of Australian data was considered to be effective in undertaking risk assessment and this approach will likely continue to be used. An audit of surrogate data sources would ensure accuracy and maximum coverage of data.

Given the absence of readily available volume information for the remainder of chemicals on the AICS, new strategies to refine the default volume for these chemicals are expected to be explored to reduce the potential for significant overestimation of the release to the environment and subsequent risk of the chemicals.

Utilisation of available hazard data

Internationally-accepted approaches such as grouping of chemicals or read-across between chemicals based on similar characteristics (e.g. physico-chemical properties) and the application of QSAR tools (e.g. use of structural alerts to infer toxicity) were routinely employed, where relevant, to reach a conclusion regarding the toxicity profile of a chemical.

As alternative test methods are validated internationally and are increasingly used in risk assessments, there may be fewer animal toxicity data available for the remainder of chemicals on the AICS.

The availability of QSAR models in addition to the emergence of new tools for the predictions of hazards (refer **Quality and Best Practice** section) has changed significantly since the initial development of IMAP. Based on the effectiveness of the QSAR strategy used for the IMAP framework, additional options to identify improvements in the predictive capabilities of this strategy will need to be identified.

Theme 5: Efficiency and Sustainability

Assessment efficiency

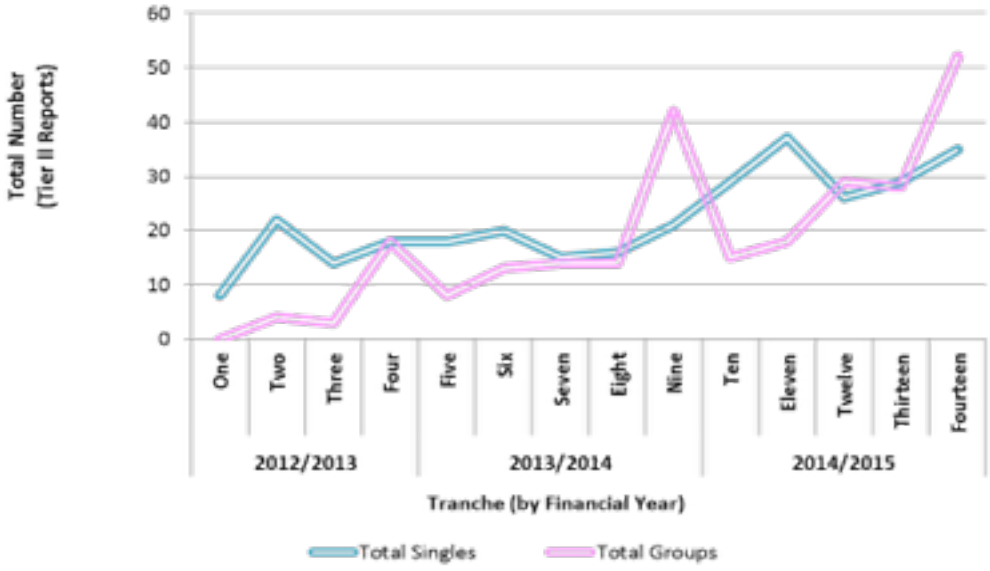
Throughout Stage One of IMAP, assessment capabilities and efficiencies were improved as demonstrated by the sustained increase in the amount of chemical safety information published (refer **Enhancing chemical safety information** section).

Significant efficiencies were gained during IMAP Stage One through the assessment of chemicals in groups and the use of read-across data. Chemicals were grouped and assessed together where possible, to minimise the use of resources and to maximise the use of available data (refer **Data utilisation** section). Chemicals were grouped in accordance with OECD guidelines, using expert judgement (refer **Quality and best practice** section).

Several factors are considered when grouping chemicals including the similarity of chemical structures, similarities in toxicological profiles as well as use/volume and exposure patterns. For efficiency purposes, additional grouping criteria such as 'likelihood of no industrial use' were used for chemicals with extremely limited hazard and/or exposure data (refer **Data utilisation** section).

Figure 8 demonstrates an increase in the total number of Tier II reports published over the first three years of Stage One of IMAP. It also illustrates an increase in the number of both single and group assessments published during this period.

Figure 8. Published Tier II human health reports – single assessments versus groups



The use of a validation step as part of Tier I (refer **Prioritisation and deprioritisation of chemicals for assessment** section) provided significant efficiencies. Typically, the validation of Tier I outcomes was the most resource-intensive part of the Tier I process to ensure scientifically robust outcomes. However, this step required significantly less resources than those required to assess a chemical at Tier II.

The development of entirely new in-house electronic data management systems has provided new capabilities which have resulted in significantly increased assessment efficiency, including:

- facilitated access to chemical data obtained from multiple high quality sources;
- facilitated assessment of chemicals in groups;
- features to enhance quality and consistency (refer **Quality and best practice** section);
- efficient publication of assessment information to the website; and
- easily generated statistical reports for management and stakeholder communication.

Case study: development of in-house electronic data management systems

The electronic chemical assessment tool (ECAT) is a software solution developed in-house by the Environment IMAP team to enable and enhance the high-throughput assessment of IMAP chemicals. It comprises a database containing the chemical information, but is much more than a conventional database. The database and its associated tools have the capacity to recognise molecular structures, compare critical data, interface with models and automate repetitive tasks, making it a powerful tool for conducting, quality assuring and peer reviewing chemical risk assessments.

The incorporation of ECAT into the assessment workflow has been pivotal for the environmental component of IMAP Stage One. The quality of entered data is automatically assured by a validation schema. Sophisticated search functions and viewing tools have allowed chemical groups to be formed with ease, allowing related chemicals to be efficiently assessed together.

By facilitating the viewing of related chemicals and their critical data side-by-side, the quality and consistency of environment assessments have been enhanced. This has also improved peer review processes, and peer reviewers can enter any comments directly into ECAT – streamlining work and maintaining important records. With all work centralised in one location, managers can also easily review the status of chemicals and run administrative reports, allowing more time to be spent on technical assessment work.

However, due to IT limitations, separate systems were developed for the human health and environment assessments. The lack of integration of these systems resulted in some inefficiencies due to the need for manual exchange of data (refer **Quality and best practice** section) and potential for duplication of effort.

Other initiatives that have improved the efficiency of the assessment process include commitment to the training and development of staff, routine sharing of information and continuous review and improvement of processes.

For example, standard text for assessments within the in-house data management systems, was updated periodically to account for new risk scenarios or updates to commonly used reference sources.

Use of resources

Costs associated with the administration of the Existing Chemicals Program are fully recovered from the regulated industry through the NICNAS registration charges. Additional resources were provided through these cost recovery arrangements to fund IMAP Stage One. These are outlined in **Table 2**.

Table 2. Additional monetary resources provided during Stage One.

2012-13	2013-14	2014-15	2015-16
$1.6 million	$2.0 million	$2.4 million	$2.4 million

Stage One of the IMAP framework was delivered within the budget. The majority of the additional resources were used to fund staff costs.

Key activities undertaken by staff included:

- undertaking Tier I and Tier II assessments;
- peer review (refer **Quality and best practice** section);
- responding to public comment (refer **Quality and best practice** section);
- consultation with key stakeholders (refer **Data utilisation** section);
- referral of recommendations to risk managers (refer **Supporting risk management** section);
- dissemination of assessment information (refer Enhancing chemical safety information section);
- professional development and training;
- research, including gathering and evaluating surrogate use data;
- methodology and IT development; and
- administration, planning and reporting.

Leveraging funding allocated to the Existing Chemicals Program enabled NICNAS to achieve the performance targets within tight timeframes and budget. Building staff capacity and flexibility across human health and environment risk assessment teams early in the implementation of the IMAP framework was essential to provide high quality peer review and sufficient support to assessors and to mitigate potential reputational risk for NICNAS (refer **Quality and best practice** section).

The average staffing level (ASL) dedicated to the operation of the Existing Chemicals Program including undertaking Priority Existing Chemicals (PEC) and IMAP assessments for both human health and the environment increased (as anticipated) from 19.6 in 2012-13 to 25.4 in 2014-15. The projected ASL for 2015-16 is 29.5. Flexibility in redirecting resources for peer review was critical during peak publication periods and when new assessors were engaged. Increases to staffing were supplemented using contract arrangements when required.

The increase in staffing was necessary to manage the large volume of Tier II reports being completed along with the associated peer review activities. The percentage of chemicals assessed for human health at Tier II (68 %) was greater than that estimated from the pilot evaluation of the IMAP framework (42 %), which informed the original costings (NICNAS 2012).

Estimated resource requirements for Environment were based on the costs for undertaking assessments of organic chemicals with externally compiled hazard information, simple IT solutions, and minimal assessment outputs. The need for environment assessments to be conducted on a large number of chemicals across multiple classes (such as inorganics and UVCBs) under the IMAP framework necessitated the development of a more robust IT system and assessment methods. In addition, the Environment Tier II assessment reports evolved to provide more information in response to feedback from key stakeholders requiring more assessors.

The public comment period also became more resource-intensive as the process was adjusted to address feedback from stakeholders (such as increasing transparency by publishing more information regarding NICNAS's response to stakeholder comments).

Feedback from staff, collected as part of the review, indicated that the focus of staff effort on assessment priorities detracted from further enhancing other key areas, such as:

- development of new fit-for-purpose methodologies;
- IT systems;
- horizon scanning;
- update to guidance materials; and
- development and progression of assessments for Tier III (although Tier III assessments have commenced).

Furthermore, feedback received as part of the review suggested the effectiveness of the program may have been enhanced by additional staff resources to enable the following:

- More timely referral and follow up of risk management recommendations (refer **Supporting effective risk management** section).
- Publication of additional information at Tier I and additional communication products (refer **Enhancing chemical safety** information).
- Increased engagement with industry and regulatory partners (both domestic and international), particularly in relation to upfront notification of assessments (refer **Data utilisation** section).

The investment in screening tools (e.g. QSAR) resulted in significant efficiencies because NICNAS assessors were able to build in-house expertise and increase the application of these tools.

What we heard: use of resources

- The IMAP framework has been running for nearly four years; therefore, the experiences from this program should be instituted to drive better cost efficiency in any future existing chemicals process.

Impact on stakeholders

In line with its objectives, the IMAP framework greatly enhanced the availability of chemical safety information. Feedback received as part of the review provided differing perspectives regarding the sustainability of the production of such large volumes of assessment information (refer ***What we heard: impact on stakeholders***). All stakeholders supported the publication of assessments in tranches.

Risk management agencies had no significant concerns regarding the number of assessments produced during Stage One but indicated any increase may be difficult to manage. Community stakeholders fully supported the continued accelerated assessment of chemicals on the AICS given the large numbers of chemicals remaining unassessed. In general, Industry indicated difficulty in reviewing assessments, commenting on conclusions, considering the need to provide additional information, and implementing subsequent changes to risk management. Industry also emphasised that the assessment pace in the ongoing program needs to be balanced with Industry's ability to effectively review assessment outputs (and provide information and/or comment where appropriate).

What we heard: impact on stakeholders

- Tranches are considered to be more efficient (administratively) rather than publishing reports one by one as they become available.
- A major industry challenge with IMAP has been keeping up with the high number of chemicals being processed rapidly in short timeframes. Industry has not been able to effectively review and provide comment on chemical assessments. Ineffective consultation can lead to conditions that are inappropriate to the circumstances, costly to comply with and poor adherence.
- There have been a significant number of high consequential impacts with assessment recommendations from NICNAS which is driving post-market challenges for industry to meet from risk managers, i.e. consumer product changes due to scheduling amendments (SUSMP). There has been little consideration of transitional challenges for industry to meet the requirements with post market changes. These high frequency of post market changes (i.e. variation of labels, packages, SDS, etc.) are challenging for industry to meet and can drive significant costs due to limited time to implement. Any future review needs to consider the post market challenges.
- The sheer volume of chemicals coming through the IMAP process and then through the Schedule Poisons process has not been able to be adequately addressed by industry or the community, due to not having any extra funding to do this. The existing chemical review assessment process (IMAP) needs to be done at a rate so that everyone can reasonably make input at the time of assessment.
- Whilst we cannot keep up to date with the amount of material being published, NICNAS should keep going at this pace. We have confidence in the material produced.
- Community and environment groups got behind the IMAP program as an effective method to fast-track the assessment of the 85 % of unassessed chemicals on the AICS.
- Some 8 % of AICS chemicals have been assessed through IMAP and there have been subsequent recommendations to “risk management agencies”. The continuance of this work is supported.

Key findings and next steps (TOR1, TOR2, TOR5)

The IMAP framework has provided a platform for efficient chemical risk assessment.

Several initiatives were implemented during IMAP Stage One to maximise the efficient output of chemical assessment reports, including:

- Tier I validation;
- training and development of staff;
- continuous improvements to processes;

- the grouping of chemicals; and
- the use of read-across data and improvements to IT systems.

Upfront investment in the IMAP data management systems allowed early achievement of economies of scale.

The ongoing assessment program for chemicals on the AICS will build on the lessons learnt from IMAP to deliver further improvements in the efficiency and effectiveness of the regulatory assessment system for industrial chemicals.

A successful outcome of IMAP Stage One has been the development of in-house electronic data management systems to record and manage chemical information. Key concepts from this process are informing the development of the new IT system to support the NICNAS reforms.

Stage One of IMAP was delivered on budget with the majority of the additional resources used to fund staff costs to undertake and support assessment activities. Several opportunities to enhance the effectiveness of the framework, which were not achievable within the available resources, were identified.

The continuation of an accelerated assessment program for the remainder of chemicals on the AICS was generally supported, although the need to balance the assessment pace in the ongoing program with consideration of the impact on industry stakeholders was emphasised.

In implementing the NICNAS reforms, the outcomes of this review will assist in designing a sustainable program for NICNAS initiated assessments, including a rolling assessment work plan which considers available resources, facilitates better engagement with stakeholders and allows for the development of new fit-for-purpose methodologies.

Theme 6: Quality and best practice

Comparison of framework with best practice

In developing the IMAP framework, NICNAS explored a variety of international approaches. The Canadian CMP scheme was selected as the best approach on which to base the framework due to the similarity between the two countries' regulatory arrangements, program objectives, resources needed for the program and the impact on industry.

As the Canadian scheme was chosen as a model for the IMAP framework, lessons already learned from Health Canada (HC) and Environment Canada (EC) helped NICNAS to have an earlier impact (i.e. early recommendations to risk managers were able to be made, whereas this was not the case under the Canadian scheme).

Feedback provided as part of the review supported the IMAP framework as a valid approach for the assessment of large numbers of chemicals (refer ***What we heard: best practice***).

Several features of the IMAP framework are consistent with national and international best practice. These include:

- proportionate risk based assessment;
- using a tiered risk-based model to align the assessment effort against human health and environmental chemical impacts (refer ***Case study: tiered assessment approach***);
- co-operative partnerships for the regulation of chemicals;
- screening chemicals against risk-based criteria;
- integration of exposure information at an initial stage;
- using appropriate methods for human health and environmental assessments;
- use of early problem formulation and consideration of risk mitigation options to inform the resources and methodologies required for assessment and ensure assessments are targeted; and
- publication of information on chemicals of low concern.

Although environmental and human health risks are assessed separately, assessors at the Department of the Environment and NICNAS share relevant knowledge so that a holistic assessment of risks may be undertaken in line with international best practice (WHO/UNEP, 2012; IPCS 2001; Reif, 2011).

Case study: tiered assessment approach

Various lead salts of acetic acid have been assessed for risks to human health and the environment using the IMAP framework. The Tier I validations supported the need to undertake human health and environment Tier II assessments to further assess potential risks relating to exposure to the chemicals. The Tier I assessment also informed the grouping and focus of the Tier II assessments (Note: different groupings were able to be established for human health and environment based on OECD guidance).

The Tier II assessments provided targeted information on the health and environmental effects of the chemicals with a focus on lead toxicity. At the Tier II level, a recommendation was made to amend the HSIS to include classifications for genotoxicity and carcinogenicity.

The Tier II assessment identified that the chemicals could be used in the manufacture of hair dyes in Australia without restrictions. Due to uncertainty regarding this use in Australia, a Tier III assessment was recommended to examine any quantitative data to identify if an unacceptable risk of public exposure exists from locally manufactured and/or imported hair dye products.

All other risks were considered to have been sufficiently assessed at the Tier II level, subject to implementing any risk management recommendations. However, depending on the scale of the reported potentially high use, a reassessment of the environmental risks may be required.

NICNAS continues to scan for international best practice in chemical screening and prioritisation and risk assessments to incorporate in the implementation of the IMAP framework. Some of the initiatives that informed NICNAS best practice included the US EPA which released a framework in 2014 for conducting human health risk assessments that are responsive to the Agency's decision-making needs. The framework highlights the importance of planning and scoping, as well as problem formulation to ensure the risk assessment will fulfil a specific need and is fit for purpose (US EPA, 2014).

The US EPA also operates the Safer Choice (previously Design for the Environment) program, which provides information on safer chemicals to help consumers, businesses and purchasers make more informed choices. The growing international push for the public identification of chemicals which are of low concern is reflected in the development of the Safer Chemical Ingredients List under the program.

The World Health Organization's Human Health Risk Assessment Toolkit describes the use of a Tiered assessment framework, in which the Tiers are characterised by the amount of quantitative or qualitative data required to establish the risk (WHO, 2010).

The International Life Sciences Institute (ILSI) Health and Environmental Sciences Institute (HESI)-coordinated Risk Assessment in the 21st Century (RISK21) project was initiated to develop a scientific, transparent, and efficient approach to the evolving world of human health risk assessment. Similar to the IMAP framework, RISK21 principles include focusing on problem formulation, utilising existing information, beginning with exposure assessment (rather than toxicity), and using a tiered process in which the results obtained from the lower tiers inform which resources and methodologies will be required within the upper tiers (Embry *et al*. 2014; Pastoor *et al*. 2014).

The methodology developed for Tier I assessments in IMAP used both the volume of a given chemical imported into Australia, where known, as well as the uses of the chemical. A very similar methodology to that utilised by the human health assessments has been published (Nazaroff et al. 2012), indicating that the approach taken by IMAP for screening level assessment was appropriate.

There has been significant interest in the IMAP framework internationally. Recently the IMAP framework was chosen as one of four assessment programs reviewed by the United States Government Accountability Office (US GAO, 2015) to provide information that the US EPA and Congress may find informative while considering improvements to the Integrated Risk Information System (IRIS) Program, *Toxic Substances Control Act* (TSCA), or other chemicals management efforts.

NICNAS was invited to present information on the IMAP framework at several national and international conferences including at the Australasian College of Toxicology & Risk Assessment (ACTRA) scientific meetings, the global Society of Environmental Toxicology and Chemistry (SETAC) European 25th Annual General Meeting 2014 and an upcoming ECHA workshop "Topical Scientific Workshop on New Approach Methodologies in Regulatory Science".

In addition, based on the experience developed during Stage One, NICNAS was invited to become an ad hoc member of Canada's CMP Science Committee to assist with the development of a risk assessment framework for addressing the remaining priorities under the planned next phase of the CMP. Health Canada (HC) and Environment Canada (EC) are now developing a level-of-complexity risk assessment framework for addressing the remaining priorities under the CMP.

The planned framework is based on the level of complexity and assessment effort required to address a substance or group of substances. These initiatives warrant due consideration in the ongoing development of a new framework for NICNAS- initiated assessments. Similar to NICNAS's current approach to human health and environment assessments, the CMP Science Committee has recommended that HC and EC consider conducting separate human health and environment assessment activity in order to focus resources on substances of concern for each individual Department (Government of Canada, 2015).

What we heard: best practice

- The IMAP framework is currently the best practice for how to move through a larger inventory in a very efficient way.
- The structure of the framework appears sound and has yielded an impressively high turnover of assessments in the four years of the program.
- (…) fully supports the need for the safe and appropriate use of chemicals. Given the number of chemicals involved we recognise that an effective scientific assessment process requires a pragmatic approach, as afforded through the IMAP framework.

The static nature of the Stage One list (unlike lists utilised internationally such as the SVHC Candidate List in Europe) potentially limited the ability for NICNAS to respond to emerging concerns nationally and internationally (refer **Prioritisation and deprioritisation of chemicals for assessment** section).

Quality assurance

Quality assurance practices, including extensive multi-stage internal peer review of all assessments, were an integral part of the IMAP framework, leading to high quality assessments that provided valuable chemical safety information (refer **Enhancing safety information** section) and supported risk management activities in Australia (refer **Supporting effective risk management** section). Building staff capacity through training and development was also critical for the delivery of high quality assessment outcomes.

IMAP assessments were utilised by a diverse range of audiences as evidenced by being referenced in documentation relating to chemical safety published by Government, industry and charities or non-profit organisations. In addition, requests were made for NICNAS experts to provide peer review of work by other international regulatory agencies on chemicals that had been assessed under the IMAP framework. Feedback received during the review commended NICNAS on the content and quality of its IMAP reports (refer ***What we heard: quality assurance*** and **enhancing chemical safety information sections**).

NICNAS collaborated with international risk assessment agencies, industry bodies and Australian risk management agencies, where necessary, to ensure accurate and relevant information was considered as part of assessment. The inclusion of a six to eight week public comment period also enabled the provision of exposure or hazard information, editorial and/or factual corrections or arguments suggesting alternative conclusions. Although the majority of the public comments received for approximately 116 assessments (approximately 449 chemicals) (refer **data utilisation section**) resulted in no change to the recommendations, where additional health hazard information was provided, it often resulted in amendments to recommendations. Amendments to recommendations have been made for 19 IMAP assessments reports (5 single assessments and 14 group assessments) for 197 unique chemicals. Although a small number of comments were made overall, the information received added important value to the assessment reports' outcomes.

NICNAS and the Department of the Environment work in parallel to assess industrial chemicals listed on the AICS (refer **Prioritisation and deprioritisation of chemicals for assessment** section). The sharing of information to maintain consistency and quality of reports was achieved through several mechanisms, including:

- regular teleconferences, videoconferences and face-to-face meetings;
- govdex (a secure online collaboration forum for Australian government staff); and
- emails.

In addition, assessment activity was synchronised where deemed critical for the integrity of the assessment outcome. In addition the IMAP framework provided sufficient flexibility to allow reconsideration of assessment outcomes for human health and/or the environment. For example, an environmental assessment may determine that a chemical is a PBT and this might lead to reconsideration of the health assessment for that chemical.

The sharing of information could be further facilitated by establishing an integrated data management system (refer **Efficiency and sustainability** section). The current in-house electronic data management system enhanced quality and consistency through:

- integrating peer review workflows;
- consistent formatting of assessment reports;
- standardising text where appropriate;
- facilitating the management of large and diverse sources of information;
- uploading of reports seamlessly from the database to the NICNAS website; and
- search and documentation features becoming more sophisticated.

What we heard: quality assurance

- The work output has been impressive and NICNAS should be commended for the thoroughness of its reviews, given the nature of the toxicological databases usually available for the listed chemicals.
- (…) admire the consistency and rigour that comes with [the reports] – completely common look and feel across multiple reports.

Data, tools and approaches

Given the limited availability of Australian use data, the majority of the human health risk assessments conducted under the IMAP framework were qualitative. This was found to be fit for purpose for the Australian regulatory system as evidenced by the uptake of its recommendations (refer **Supporting effective risk management** section).

The use of a qualitative approach was considered successful as many of the critical hazards identified, such as corrosivity and carcinogenicity, are less susceptible to quantitative assessment. In addition, for cases where quantitative considerations were needed to underpin risk management recommendations, reliable and relevant assessments were available. Chemicals were recommended for Tier III assessment in circumstances where more detailed quantitative risk assessment was required. This tiered approach to exposure assessment is consistent with other exposure frameworks such as that described in RISK 21.

Environment risk assessments used the internationally-accepted quantitative environmental risk assessment method of risk quotient derivation where possible, but also captured emerging considerations to identify chemicals of concern. It is increasingly being recognised internationally that some chemicals, such as those that are persistent, bioaccumulative and ecotoxic, pose levels of concerns in the environment that cannot be quantified using the risk quotient method.

For example, ECHA identifies PBT, very persistent and very bioaccumulative properties, and endocrine disruption as criteria for the listing of a chemical as a SVHC. In these cases, best practice semi-quantitative or qualitative assessment methods were used (refer ***What we heard: assessment methodologies***). However, the application of these methods was done on a case-by-case basis as appropriate. The PBT criteria were not applied to metals, for example. A similar approach is taken by the US EPA (US EPA, 2007).

Whilst the use of surrogate use data was considered to be largely successful for informing the assessment of risks of chemicals in Australia, a number of assessments completed highlighted the need to have mechanisms to identify where Australian use is not consistent with trends overseas so that further assessment could be undertaken (refer **Data utilisation** section). Feedback received as part of the review also indicated the importance of having a mechanism to identify new information when it becomes available (refer ***What we heard: identification of new data***).

What we heard: identification of new data

- Some Tier II assessments make recommendations such as; reassess if/when more data become available on Australian usage, concentrations, or additional toxicity information. It is important that a mechanism exists to identify new information when it is available and also to ensure that such open ended recommendations are followed up over time.

International best practice was upheld by applying the Organisation for Economic Co-operation and Development (OECD) guidance on grouping of chemicals, and using robust, scientifically informed methodology to advise on regulatory action for health and/or environmental risks of chemicals (refer ***What we heard: assessment methodologies***).

For example, bioaccessibility data in synthetic biological fluids were used as part of a weight of evidence approach to the grouping and assessment of a number of metal compounds. The risk assessments leveraged data available from a range of sources (refer **Data utilisation: Hazard data** section). Study quality was considered by giving more weight to tests conducted according to OECD test guidelines or using a weight of evidence for evaluating toxicity mechanisms or for endpoints such as genotoxicity and bioaccumulation.

Numerous tests and studies, covering both bioconcentration and the more complex biomagnification, are considered using a weight of evidence approach when determining the bioaccumulation potential of a chemical. Environment assessments conducted under IMAP aligned with international best practice in considering a range of data for biomagnification, and not just bioconcentration, when determining bioaccumulation potential.

In addition, applying a 'weight of evidence' approach in IMAP assessments, as outlined on the NICNAS website (NICNAS, 2016), enabled the methods for assessing risk to be scientifically transparent, helped to characterise uncertainties in risk assessments, and made recommendation referrals to risk management agencies more robust and consistent.

The IMAP framework utilised evidence from tests on animals and humans ('in vivo') and extensive use was also made of data from laboratory tests ('in vitro'), and from newer alternative methods such as computer-based models ('in silico'), in line with international trends.

The assessment approach used for chemicals with limited data (by using QSAR as an input into a 'weight of evidence' approach) (refer **Utilisation of available hazard data** section) was well recognised as evidenced by an IMAP case study on the use of QSAR to determine (lack of) carcinogenicity of a hair dye chemical, being cited in an OECD document (OECD, 2015). The use of the OPHP scheme provided a more efficient system to evaluate consistency between experimental data and modelling results.

The accuracy of the structural information including the SMILES (simplified molecular input line entry system) is critical for successful high-throughput QSAR modelling. Prior to commencing IMAP Stage One, the quality of SMILES descriptions of all chemicals on the AICS was externally quality validated. As a result the AICS now meets the criteria to be an OECD Toolbox high quality inventory.

What we heard: assessment methodologies

- The process of calculating predicted environmental concentrations, predicted no effect concentrations and risk characterisation by calculating risk quotients (where applicable) is consistent with best practices for environmental risk assessment. Incorporation of PBT assessment is also in keeping with international processes to address risks that cannot be assessed by a risk quotient approach.
- (….) agrees that the assessment methodology used should be consistent with international research. In particular, (...) recommends use of OECD methodology and assessments (we note this is listed in [IMAP documentation]). We also encourage NICNAS to align, where practicable, with international developments in assessment methodology, for example, with outputs from the Joint Research Centre in Ispra. The reports have matured throughout Stage One. (…) can recognise the continuous improvement.

Key findings and next steps (TOR 1, TOR 4, TOR 6, TOR7, TOR8)

Several features of the IMAP framework are consistent with national and international best practice. The framework was found to be an effective and practical way of assessing large numbers of chemicals in a short period of time.

The application of the IMAP framework demonstrated that it was capable of producing high quality outcomes. This was facilitated by use of several quality assurance mechanisms including collaboration with stakeholders, extensive peer review, training and development of staff, application of a weight of evidence approach, use of international guidelines for risk assessment and use of in-house data management systems. These developments and methodological advances will need to be sustained in any ongoing program for existing chemical assessments.

Legislative provisions to require NICNAS to be advised of changes to circumstances of chemical use considered at the time of the assessment would continue to ensure that chemical risk assessments remain up to date and relevant.

As the global regulatory arena moves away from traditional animal toxicity testing, even fewer data (particularly dose-response data) will be available for many chemicals. This represents an opportunity to evolve regulatory toxicology, by applying new technologies, in combination with the approaches described above (using existing hazard data, physico-chemical properties, QSAR), to undertake risk assessment. Harnessing in vitro and in silico data will be crucial in this regard and the US EPA toxicity forecaster (ToxCast) system is leading this area with the development of high-throughput screening efforts that evaluate and prioritise chemicals based on their reaction in hundreds of in vitro assays of cellular metabolism.

The development of adverse outcome pathways, with clearly defined cellular events that lead to specific types of toxicity, represents another opportunity to streamline data requirements for risk assessment and effectively integrate different types of toxicity information. In Canada, innovative ways to utilise ToxCast, Threshold of Toxicological Concern and bio-monitoring data are being considered (Government of Canada, 2015).

The predominantly qualitative risk assessment approaches used in the Tier II human health assessment may facilitate the use of newer data sources including in vitro and in silico tools where dose-response approaches are less relevant. However, the ability for risk managers to make decisions based on this new type of data may need significant support from NICNAS (refer **Quality and best practice** section).

NICNAS will continue to collaborate with international regulators progressing new approaches and tools to ensure Australia remains at the forefront of international best practice for chemical risk assessment. NICNAS will also engage in international dialogue on the interface between emerging risk assessment methodologies and risk management decision making processes. However, these activities will need to be prioritised and resourced accordingly.

As the IMAP framework was designed in consultation with stakeholders, it provides a good model for future approaches to chemical risk assessment. By continuing to align with international best practice, maintaining agility to respond to emerging concerns, integrating exposure information at an initial stage, expanding data sources (such as monitoring information), providing transparency (by publishing outcomes) and enabling strategic priority setting, NICNAS will remain well-placed to play an important role in contributing to the protection of human health and the environment by promoting the safe use of industrial chemicals.

NICNAS will continue to work on the regulatory framework proposed under the NICNAS reforms (NICNAS initiated assessments) to assess the remaining (approximately 34,000) industrial chemicals on AICS that have not been previously assessed. A key element of the NICNAS reforms is for regulation to be risk-based and proportionate. The lessons learned from this review of Stage One of the implementation of the NICNAS IMAP framework will contribute to the design of the NICNAS reforms to achieve this objective.

Conclusion

The review of Stage One of IMAP has found that the IMAP framework has been very effective in accelerating high quality assessment outputs for chemicals on the AICS. The tools and approaches developed for the IMAP framework to prioritise and deprioritise chemicals for assessment and produce targeted assessment outputs are considered to be aligned with international best practice and have been fit for purpose. Opportunities to further enhance and refine these tools and approaches have been identified and will inform the implementation of the NICNAS reforms announced by the Australian Government in May 2015.

The implementation of Stage One of the IMAP framework over four years has significantly increased the availability of chemical safety information and resulted in a significant number of changes to regulatory controls to aid in the protection of Australians and the environment. The development of in-house data management systems and building staff capacity across human health and environment risk assessment teams have significantly contributed to the success of the framework. The importance of continued stakeholder engagement to ensure that assessment priorities and published outputs meet their needs has been highlighted in this review.

A major challenge, in particular for industry, has been the high number of chemicals that are already in use being assessed rapidly. This has impacted on the ability of the industry to respond to subsequent risk management requirements and use information in a timely manner.

NICNAS will continue to consult with stakeholders on the regulatory framework proposed under the NICNAS reforms (NICNAS initiated assessments) to assess the remaining (approximately 34,000) industrial chemicals on the AICS that have not been previously assessed. A key element of the NICNAS reforms is for regulation to be risk-based and proportionate. The lessons learned from this review of Stage One of the implementation of the NICNAS IMAP framework will contribute to the design of the NICNAS reforms to achieve this objective.

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