Executive Summary

The Water Supply Regulations require that water from consumer taps should not have levels of individual pesticides and related products, including their relevant metabolites, degradation and reaction products that exceed 0.1 µg/L for individual pesticides, with the total sum of pesticide concentrations not to exceed 0.5 µg/L. Advice to water companies in the Inspectorate's Guidance Document is that "relevant" should be taken to mean any metabolites, degradation and reaction products that have similar pesticidal properties to their parent pesticides. Moreover general provisions of the Regulations require water companies to monitor for any substance that it believes may be present at a concentration that would constitute a potential danger to human health. The guidance document goes on to state that "in respect of drinking water, there is no evidence at the present time that any pesticide metabolites, degradation or reaction products are active pesticides or represent a risk to health and therefore no additional monitoring is required" Therefore the aims of the study were to review the area of pesticide metabolites, degradation and reaction products, to advise whether any additional monitoring needs to be conducted and to inform future guidance to the industry. These aims were met with six specific objectives:

- Review and collate information relating to pesticide metabolites, degradation and reaction products arising from pesticides (collectively termed metabolites in this study) currently approved for use in the UK;
- Identify metabolites that may exhibit pesticidal activity and/or may exhibit additional toxicological concerns;
- Estimate the likely concentrations of the metabolites identified in the previous objective in drinking water;
- Estimate the risk (if any) that these metabolites may pose to human health;
- Consider whether metabolites will react during water treatment with chlorine and ozone to form toxic compounds; and
- Advise whether the current guidance regarding pesticide metabolites needs to be updated.

The main findings of the project where:

- Limited data are available in the UK on the presence of pesticide metabolites in raw source and finished drinking waters. Most data available focus on metabolites of heptachlor and DDT with no data on metabolites from the majority of the high use pesticides;
- Data are available on the presence of pesticide metabolites in raw source and finished drinking waters for other countries, particularly the US but these data generally only focus on triazine and chloroacetamide herbicides;
- 485 metabolites were identified from pesticides with current approval in the UK and those that have recently lost approval;
- 53 metabolites were selected for further study; the selection was based on the potential to contaminate source water incorporating estimates of parental usage, formation rates in soil, persistence and mobility, and estimated toxicity and/or potential to exhibit pesticidal activity;
- Approximately half of the metabolites identified for further study are identified during environmental degradation as well as during mammalian degradation of the parent pesticides;
- Metabolite concentrations in raw source waters for three selected catchments were estimated using an empirical model previously developed to estimate pesticide concentrations on a catchment scale. A highly conservative estimate was generated and then refined on the basis of actual pesticide usage and/or more realistic metabolite soil DT_{50};
- Estimated removal efficiencies during water treatment of the selected metabolites ranged between 15 and 99%;
- Using computational method to predict the identity of compounds formed following chlorination and/or ozonation would have generated an excessive number of potential compounds making the further analysis extremely difficult;
- It was estimated that 21 metabolites would be detoxified by chlorination and/or ozonation, 11 were unlikely to be detoxified and due to a lack of information it was impossible to determine whether the remaining 21 metabolites studied would or would not be detoxified;
- Maximum concentration for any selected metabolite in finished drinking water using the more realistic estimate refined for actual pesticide usage and following conventional treatment (including powdered activated carbon) was 0.265 µg/L for metazachlor sulfonic acid a metabolite of the herbicide metazachlor which not considered to be pesticidally active;

- One of the metabolites selected on the basis of their potential pesticidal activity had an estimated concentration greater than 0.1 µg/L in finished drinking water for one of the catchments, phosphorous acid a metabolite of fosetyl-aluminium;
- Toxicological hazard assessments were performed for all selected metabolites and, in the absence of acceptable daily intake values, project specific derived values (PSDV) were estimated;
- Five metabolites had anticipated daily intakes greater than 10% of the acceptable daily intakes (or PSDV) for the conservative concentration estimate when considering toddlers; these fell below 10% when the refined estimate was considered;
- One metabolite had anticipated daily intakes greater than 10% of the acceptable daily intakes (or PSDV) for the conservative concentration estimate when considering adults; this fell below 10% when the refined estimate was considered; and
- None of the selected metabolites were considered to pose a significant risk to toddlers or adults.

Therefore considering the work undertaken in this study there is no evidence that the current guidance issued by DWI on the requirements to monitor for pesticide metabolites in drinking waters should be changed. However it may be prudent to validate this conclusion with experimental data due to the uncertainty that can be associated with predictive approaches.