Ministry for Primary Industries
Manatū Ahu Matua

Overseer whole-model peer review by independent experts

Project overview including panel terms of reference

14 February 2020

Contents

Background

The Parliamentary Commissioner for the Environment's (PCE) December 2018 report, *Overseer and regulatory oversight*, outlined a series of steps for Overseer "to be confidently used in a regulatory context". A key recommendation made to improve public trust in the model was to undertake a "comprehensive and well-resourced" evaluation of Overseer. In particular, this includes a whole-model peer review by technical experts independent of those who performed the development work.

Some components of Overseer have previously been reviewed (the use of soil parameters[1], greenhouse gas sub-models[2], the animal metabolisable energy sub-model[3], the phosphorus loss sub-model[4], and the hydrology sub-model[5]), and this provides a starting point for the 'whole-model' review. Key themes raised by these reviews have included the need to update the model to reflect the latest science and to improve its documentation. Other critical components of Overseer for estimating nitrogen losses (e.g. urine patch and background nitrogen losses) have not been peer-reviewed. A whole-model peer review will also address the model's approach (i.e. design principles and scope) in the context of its use as a regulatory tool, and as a decision support tool for farmers.

As recommended by the PCE, the whole-model peer review will be complemented by a formal uncertainty and sensitivity analysis, further calibration of the model across a wider range of farming systems and conditions, investment in the geographic coverage of S-map and other underlying databases used by Overseer, and the development of guidelines on best practice for the use of Overseer in regional plans.

Objectives

The **overall objective** of this peer review is to conduct an independent scientific assessment of the Overseer model in the context of its use as a regulatory tool in specific scenarios outlined below. The review will include the aspects of the model that are commercially sensitive and protected by intellectual property rights.

[1] Pollacco *et al*. (2014)
[2] Kelliher *et al*. (2015); de Klein *et al*. (2017)
[3] Pacheco *et al*. (2016)
[4] Gray *et al*. (2016)
[5] This review was led by David Horne from Massey University, but it is not publicly available. However, the reviewed sub-models have since been updated, so this review is no longer useful.

Key principles

The peer review will be:

1. **Independent**: undertaken by experts who are objective and independent of the original developers, Overseer owners and Overseer Limited;

2. **Interdisciplinary**: involving environmental modelling and scientific experts from multiple disciplines;

3. **Comprehensive**: addressing the different sub-models and components, as well as the overall approach;

4. **Transparent**: reports and key documentation to be published.

Approach

The approach is a retrospective peer review of the whole-model, from the conceptual level (i.e. design principles, scope and modelling approach) to an assessment of specific components/sub-models. The peer review will be conducted in a phased approach, with each stage informing the subsequent stages (see Deliverables and Milestones below for further detail).

MPI and MfE have appointed a Science Advisory Panel to lead the peer review process. The Science Advisory Panel will conduct the first phase of the review directly, focusing on Overseer's overall modelling approach. For the second phase of the peer review looking at specific components of Overseer, the Science Advisory Panel will act as an 'editorial board' to oversee specific parts of the peer review. Upon their appointment, the Science Advisory Panel will have an opportunity to review and comment on the peer review process outlined in this document.

MPI and MfE officials will form a Secretariat to support the Science Advisory Panel. AgResearch staff will provide the panel and the Secretariat with technical information on the model. Following the first phase of the peer review, the Secretariat will prepare a draft Request for Proposals (RfP) to solicit proposals from the scientific and academic community to conduct specific parts of the second phase of the peer review. The Science Advisory Panel will review and confirm the RfP. The Science Advisory Panel will make an assessment of which components/sub-models to prioritise, and greater time and resources will be directed towards these.

An open call will be made to respond to the RfP to undertake specific parts of the second phase of the peer review. Because of the complexity/scope of the Overseer model, the independent teams who undertake the review will need to cover a range of disciplines. The Secretariat will make a recommendation on which proposal(s) to accept, to be confirmed by the Science Advisory Panel.

The independent experts will carry out the peer review and present their draft findings and recommendations to the Science Advisory Panel, who will provide feedback in an iterative loop. Overseer Limited and/or AgResearch will have an opportunity to provide fact checking for each assessment. After one or several rounds of feedback and refinement, the peer review reports will be accepted by the

Science Advisory Panel. The Science Advisory Panel will publish a final synthesis report and recommendations.

Phasing and deliverables

Design and preparation phase

1. Peer review process planned and documented in this paper, including timeline. Overseer Limited and Overseer's owners were consulted on this paper.

2. Shortlist of potential candidates for the Science Advisory Panel identified.

3. Science Advisory Panel and Chairperson selected and appointed.

Phase 1: Review of Overseer's overall model approach

4. All available documentation of the Overseer model provided to the Science Advisory Panel, including the confidential technical manual chapters (under the terms of a confidentiality agreement), and documentation of previous reviews of specific components of Overseer. Internal report prepared by Secretariat, stocktaking which components/sub-models have (and have not) been previously reviewed, including details such as, by whom and contact details, methodology, summary of key findings.

5. Inception workshop held to confirm the scope and focus of the peer review, and plan the first phase of the peer review in detail. The Science Advisory Panel will have the opportunity to discuss the approach outlined in this document and suggest any changes, to be approved by MPI's Deputy Director-General (Policy and Trade). Background and contextual information to support the peer review process will be provided, and there will be an opportunity for discussion with AgResearch scientists and modellers.

Science Advisory Panel to undertake two assessments:

6. An assessment of whether Overseer's current modelling approach (including key design principles and assumptions) is fit-for-purpose to model nutrient flows within New Zealand farm systems, in the context of:
   a. Use of Overseer as a decision support tool for land-users, and;
   b. Use of Overseer as a regulatory tool by regional councils following recommended guidelines, across different sectors.[6]

[6] During the inception workshop, MfE/MPI officials and planning experts will describe what is required of Overseer in terms of technical performance and outputs in modelling farm-level nutrient flows to support regulation of freshwater quality where regional councils are following best practice guidelines for the use of Overseer in regional plans.

7. An assessment of Overseer's modelling approach if it was to be used as a nutrient allocation tool in the future. This will provide an indication of whether Overseer is likely to be suitable (in its current state or with specific changes, or in combination with other tools) in different scenarios and for different sectors.[7]

8. For this purpose, assessment includes, but is not limited to, whether the model design is based on appropriate mathematical and modelling principles; the strengths and weakness of Overseer's modelling approach compared to alternative modelling approaches; and recommendations for prioritised improvements.

9. Overseer Limited and AgResearch will be given the opportunity to fact check the reports.

10. Science Advisory Panel's phase 1 assessment reports delivered to the government, Overseer Limited and the Overseer owners (following the no surprises convention).

11. Science Advisory Panel's phase 1 assessment reports published.

Products: *Internal report stocktaking which components/sub-models have (and have not) been previously reviewed; Two assessment reports as described in 6 and 7, above: Model Approach Assessment Report and Allocation Assessment Report*

Phase 2: Review of specific components/sub-models and coding

12. Science Advisory Panel to prioritise reviews of specific components/sub-models, based on the outcomes of preliminary report and the uncertainty and sensitivity analysis.

13. Request for Proposals (RfP) issued for specific components. The RfP will be prepared by the Secretariat and confirmed by the Science Advisory Panel.

14. Peer review teams for specific components identified and contracted.

15. Peer review reports for specific components accepted by Science Advisory Panel.

16. Fact checking by Overseer Limited and AgResearch.

17. A separate work stream will review Overseer's software coding, initially by reviewing the processes that Overseer Limited use to test code quality and the results of those processes.

[7] MfE/MPI officials will describe what is required of Overseer in terms of technical performance and outputs for possible nutrient allocation scenarios.

Products: *Peer review reports for specific model components; Final synthesis report and recommendations of the Science Advisory Panel.*

Communicating results

18. Science Advisory Panel's final report and recommendations delivered to the government, Overseer Limited and the Overseer owners (following the no surprises convention).

19. Science Advisory Panel's final report and recommendations published.

20. Workshop(s) held to disseminate peer review results to stakeholders including the New Zealand scientific community.

Products: *Dissemination workshop material.*

Initial expected milestones and timeframes

These milestones and timeframes will be revised after the first panel meeting 30/31 March, and at each subsequent stage of the review. Findings from the Model Approach Assessment Report will determine subsequent assessment priorities.

Milestones	Delivery
Design and preparation	
1. Peer review process planned and documented	31 January 2020
2. Science Advisory Panel and Chairperson appointed	31 January 2020
Phase 1	
3. Internal report prepared by Secretariat, stocktaking which components/sub-models have previously been reviewed, including details such as, by whom and contact details, methodology, summary of key findings	28 February 2020
4. Inception workshop	30/31 March 2020
5. Model Approach workshop	July 2020
6. Report review workshop 7. Model Approach Assessment Report delivered to the government, Overseer Limited and the Overseer owners (following the no surprises convention)	September 2020
8. Model Approach Assessment Report published	October 2020
9. Allocation assessment initiated	October 2020
10. Allocation Assessment Report delivered to the government, Overseer Limited and the Overseer owners (following the no surprises convention)	January 2021
11. Allocation Assessment Report published	February 2021
Phase 2	
12. Prioritisation of reviews of specific components/sub-models, based on the outcomes of 'Model approach assessment' report and the uncertainty and sensitivity analysis	September 2020
13. Request for Proposals drafted and confirmed	October 2020
14. Peer review teams selected following open call	November 2020
15. Draft peer review reports presented to Science Advisory Panel	December 2020
16. Final consolidated peer review report and recommendations delivered to the government, Overseer Limited and the Overseer owners (following the no surprises convention)	February 2021
17. Final consolidated peer review report and recommendations published	March 2021
Communicating results	
18. Stakeholder workshop(s) to present findings	October 2020 February 2021

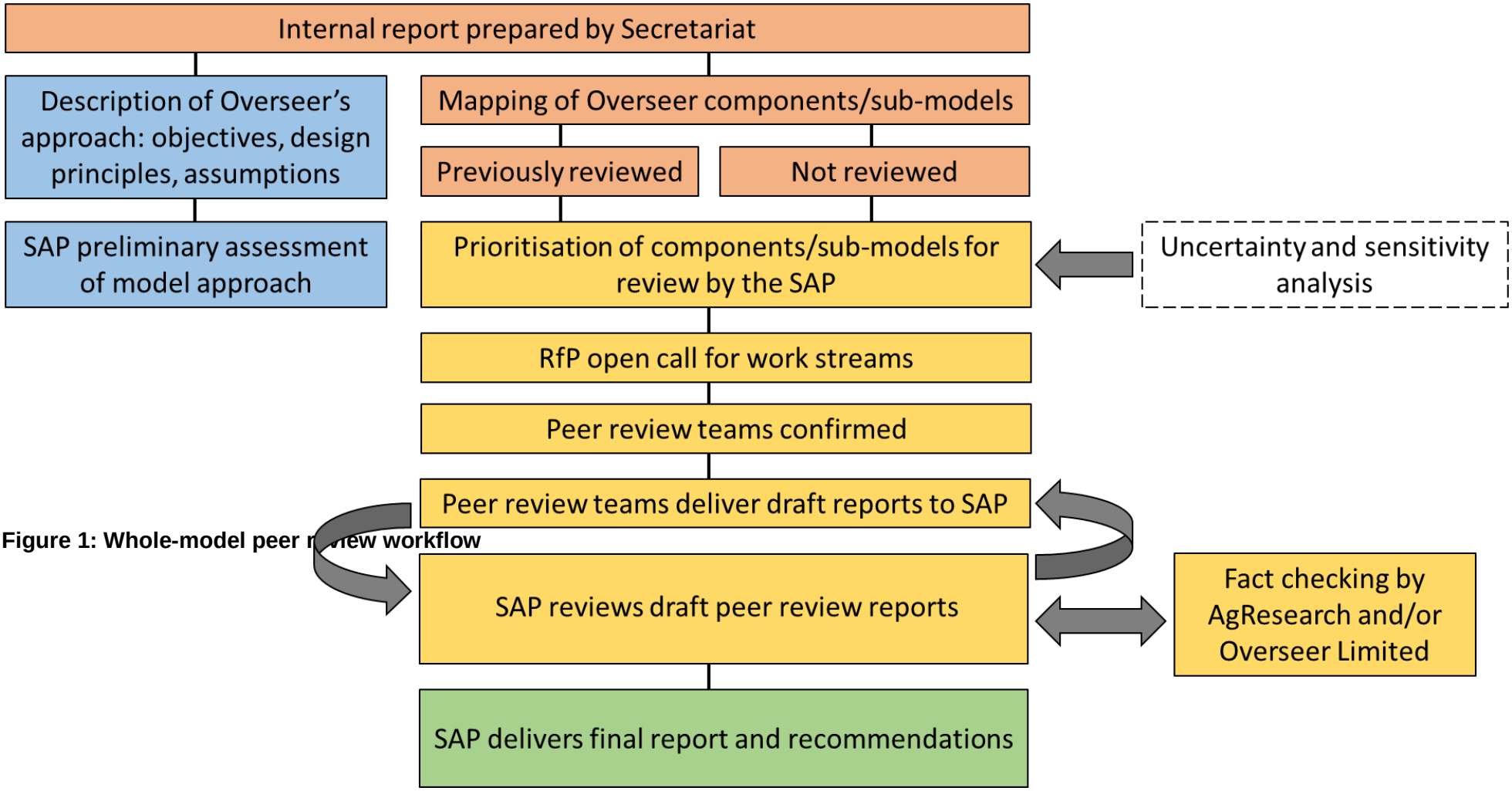

Figure 1: Whole-model peer review workflow

Linkages and dependencies

1. Overseer Limited and AgResearch have initiated an uncertainty and sensitivity analysis on the Overseer model with external collaborators to assess the uncertainty associated with different inputs, parameters, or components. Results of the uncertainty and sensitivity analysis could help inform the Science Advisory Panel's decisions in prioritising resources to review specific components/sub-models. The peer review report could refer to these results in making recommendations.

2. MPI's wider work programme on Overseer and other decision support tools, as part of the Budget 2019 Productive and Sustainable Land Use package, includes work streams focused on:

    a. Improving calibration of Overseer. The preliminary results of the peer review and uncertainty analysis may help determine priorities for subsequent rounds of calibration field trials;

    b. Improving coverage/quality of the supporting databases that Overseer uses (e.g. S-map, climate data);

    c. Collecting data to include more mitigation options for freshwater contaminants and greenhouse gases in Overseer;

    d. Working with regional councils, planners and scientists to develop new guidelines on best practice for the use of Overseer in regional plans. Work to develop guidelines on the use of Overseer in regulation will complement the peer review by focusing in detail on how Overseer can best be used in regulation to minimise risks, accounting for the model's strengths and weaknesses. The peer review will add to the existing body of knowledge and experience that inform these guidelines.

3. In parallel to this project, Overseer Limited is delivering its business plan, including improvements to Overseer's science and software and development of a protocol to peer review and validate future model developments. This step will complement this retrospective whole-model peer review.

4. Freshwater and greenhouse gas policy development processes will continue in parallel. For the most part this will not directly affect the peer review focusing on scientific aspects of the model. The future policy direction will influence the development of guidelines on the appropriate use of Overseer in regulation.

Scope

In scope

1. Assessment of Overseer's modelling approach (including key design principles and assumptions) in the context of its use as a as a decision support tool for land users and when used as a regulatory tool following recommended guidelines, across different sectors for freshwater quality.

2. Assessment of Overseer's modelling approach (in combination with other tools) to perform different regulatory functions that may be required by future policy changes.

3. Comparison of the advantages and disadvantages of Overseer's current modelling approach with alternative approaches.

4. Prioritisation of specific components/sub-models and/or structures to be reviewed in more detail.

5. Review of the model's components/sub-models including their scientific principles, assumptions, algorithms, equations and parameters. This includes components/sub-models that have and have not previously been reviewed.

6. A review of the model's overall structure (i.e. the way in which various components fit together).

7. Review of the processes that Overseer Limited use to test software code performance and the results of those processes.

8. Review of the technical documentation and of the Overseer model and its accessibility.

9. Identify opportunities and priorities to improve Overseer's modelling approach (e.g. in order to perform specific regulatory functions), structure, components/sub-models and coding.

10. The peer review could comment on aspects of Overseer's uncertainty and sensitivity, calibration, use of supporting databases and the representation of mitigation options in the Overseer model, but should not recreate other work streams as described in the Linkages and Dependencies section above. MPI, Overseer Limited and AgResearch will provide information and updates to the Science Advisory Panel on other pieces of work related to Overseer.

Out of scope

11. Assessment of freshwater and agricultural greenhouse gas emissions policy.

12. Other recommendations made by the PCE, including:

    a. Development of national best practice for the development, evaluation, and application of environmental models in regulation.

    b. Increasing Overseer's transparency, including the decision on shifting Overseer to an open-source model.

    c. Evaluation and recommendations on Overseer ownership, governance and funding.

13. All decisions on follow-up work in response to the peer review's recommendations as part of Overseer's business and development plan, which are the responsibility of Overseer Limited and the Overseer owners.

14. The effectiveness of Overseer in modelling agricultural greenhouse gas emissions and supporting regulatory activities for greenhouse gas emissions will be addressed elsewhere and is not the focus of this work. The panel can provide incidental commentary on Overseer's greenhouse gas modelling.

Who is involved

Overseer Ltd
Overseer Limited has agreed to provide the peer reviewers with access to the proprietary information on the model and will have the opportunity to present to the panel.

AgResearch
AgResearch scientists and modellers will provide technical information to the panel.

Chief Science Advisors
MPI/MfE's Chief Science Advisor(s) and the Prime Minister's Chief Science Advisor will support the selection process for the Science Advisory Panel and peer reviewers.

Science Advisory Panel
The Science Advisory Panel consists of eight experienced scientists and modellers, independent of Overseer's developers.

To appoint the panel, MPI and MFE first established a long list of potential candidates. Overseer Limited was given the opportunity to suggest panel members for the long list. Members of the public also suggested people for the long list. MPI and MfE conducted a screening process against the exclusion criteria (see below) and ranked the suitability of the long list of candidates as high, medium or low. Candidates that were identified as being suitable (high or medium) were contacted to enquire about their interest and availability, and to declare any conflicts of interest.

Those who indicated they were available, interested, and had no conflicts of interest were added to a shortlist.

A selection panel made up of the Prime Minister's Chief Science Advisor, and MPI and MfE Chief Science Advisers met on 28 November 2019 to review the shortlist. The panel concluded that several shortlisted candidates were highly suitable, but also identified skill gaps that were missing from the shortlist and a lack of diversity. The panel agreed that increasing the number of Science Advisory Panel members from five to seven or eight would help to cover a wider range of skillsets and allow for wider demographic representation. It was agreed that the Science Advisory Panel should include at least three members who are primarily modellers, alongside supporting scientists with an interdisciplinary range of skills including: agronomy, animal nutrition/physiology, crop and livestock systems and their modelling, hydrology/drainage, mātauranga Māori and Te Ao Māori, New Zealand farm systems, nutrient cycles/biogeochemistry, regional council experience, and soil science. MPI conducted a targeted search for additional candidates to address the skills and demographic gaps that were identified. The final panel membership was agreed on 17 December 2019 and recommended to the Deputy Director Policy and Trade, who then approved the appointments.

Peer reviewers

Under Phase 2, independent and interdisciplinary teams will undertake different work streams, including experts in environmental modelling, mathematics, agronomy, farm systems, soils, plants, animals and hydrology.

Secretariat

A Secretariat will assist in organising meetings, support the Science Advisory Panel by preparing written documents (e.g. draft RfPs), and provide an initial screening and recommendation on proposals to conduct parts of the second stage of the peer review (to be confirmed by the Science Advisory Panel). The Secretariat will consist of MPI and MfE officials, with technical information provided by AgResearch staff.

Quality control and quality assurance

Documents prepared by the Secretariat (e.g. draft RfPs) will be reviewed by MPI's Science Policy Team. Peer reviewers will deliver draft reports and recommendations to the Science Advisory Panel. The Science Advisory Panel will perform a similar role to the editorial board in an academic journal peer review process. They will evaluate the reviewers' arguments and accept or reject their findings. This process may involve several iterative rounds of exchange between the peer reviewers and the Science Advisory Panel.

Criteria and mechanisms to ensure independence

Candidates for the Science Advisory Panel and to undertake discrete parts of the peer review were screened against the following criteria:

1. Candidates who have been directly involved in the development of the Overseer model were not be considered. Candidates who have undertaken previous work with Overseer (e.g. on model review or improvements) were considered on a case-by-case basis.

2. Candidates who are currently employed by Overseer Limited or the Overseer owners were not be considered. Candidates who are occasionally contracted by Overseer (e.g. to work on interactions between Overseer and other models and databases) were considered on a case-by-case basis.

3. Candidates who have previously expressed strong positive or negative opinions on Overseer were not considered.

The following additional mechanisms have been and will continue to be used to protect the independence of the peer review process, the Science Advisory Panel and teams and individuals undertaking the peer review:

1. The Secretariat will ensure that the Science Advisory Panel and peer reviewers have all necessary access to the Overseer model, for the purposes of undertaking the peer review (under the terms of a non-disclosure agreement with Overseer Ltd as required).

2. Reports and key documentation produced by the peer review will be published and this transparency will provide a further check on the independence of the peer review.

Stakeholder engagement

Key stakeholders who will take an interest in the project include:

New Zealand agricultural sciences and modelling community (AgResearch, Manaaki Whenua, NIWA, Plant and Food Research, Lincoln, Massey, Waikato University) will be invited to respond to the RfP, or to suggest potential peer reviewers. Following the peer review, they will be invited to participate in a workshop(s) to disseminate the results. Specialist knowledge holders could be called on to provide support to the Science Advisory Panel at different stages of the peer review process as external experts.

Primary sector organisations (Beef + Lamb, DairyNZ, Foundation for Arable Research, Horticulture NZ, Tāhuri Whenua) will be invited to respond to the RfP, or to suggest potential peer reviewers. Following the peer review, they will be invited to participate in a workshop(s) to disseminate the results. Specialist knowledge holders could be called on to provide support to the Science Advisory Panel at different stages of the peer review process as external experts (not as representatives of sectors/organisations).

Farmers and growers will be informed and updated through Overseer Limited's outreach activities, MPI/MfE communication and media.

Central and local government (MfE, PCE, regional councils) will be invited to participate in the workshop(s) to disseminate the results.

International environmental modelling community will be informed through published reports and participation in conferences following the completion of the review.