



IALA MANUAL

USE OF THE PORTS AND WATERWAYS SAFETY ASSESSMENT (PAWSA) MKII TOOL

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10, rue des Gaudines – 78100 Saint Germain en Laye, France
Tél. +33 (0)1 34 51 70 01 – contact@iala-aism.org

www.iala-aism.org

International Association of Marine Aids to Navigation and Lighthouse Authorities
Association Internationale de Signalisation Maritime



DOCUMENT REVISION

Revisions to this document are to be noted in the table prior to the issue of a revised document.

Date	Details
November 2022	First edition. This manual was created from the separation of the annex from Guideline <i>G1124 Use of the Ports and Waterways Safety Assessment (PAWSA) Mk II Tool</i> , Edition 2.0, which was separately approved by IALA Council June 2022.
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CONTEXT

IALA Recommendation *R1002 Risk Management for Marine Aids to Navigation* [1] (as a normative Recommendation of IALA Standard *1010 AtoN Planning and Service Requirements* [2]) recommends the use of risk management and IALA risk management tools when assessing the risks in waterways, as part of the decision-making process for Marine Aids to Navigation.

IALA Guideline *G1018 Risk Management* [3] briefly introduces the tools included in the IALA Risk Management Toolbox, recognising the *Formal Safety Assessment (FSA)* process adopted by the IMO [4]. *G1018* also summarizes the principles of *ISO 31000 Risk Management* [5], which are implicit in the recommended risk assessment approach.

Further information on the *FSA*, *ISO 31000 Risk Management*, and their relationship to the IALA Risk Management Toolbox is contained within *G1018*.

The Toolbox is recognised by the IMO via *SN.1/Circ.296* [6]. Further, IMO Resolution *A.1158(32) Guidelines for Vessel Traffic Services* [7] states that “Contracting Governments are encouraged to take into account IALA standards and associated recommendations, guidelines and model courses”.

PAWSA MkII is one of the recommended risk assessment tools within the IALA Risk Assessment Toolbox.

This Manual should be read and used in conjunction its relevant annexes, Excel workbook and Guideline as follows:

- IALA Guideline *G1124 The Use of Ports and Waterways Safety Assessment (PAWSA MkII)* [8]
G1124 introduces the PAWSA methodology and provides background information.
- Use of the Ports and Waterways Safety Assessment (PAWSA) MkII Tool Manual Annex A – Forms (separate document)
- Use of the Ports and Waterways Safety Assessment (PAWSA) MkII Tool Manual Annex B – Preparing for a PAWSA Workshop (separate document)
- PAWSA Spreadsheet Example IALA WWA 2022

The documents listed above, together with other publications can be found on the IALA website.





1. PURPOSE

The Manual, together with its annexes, provides the necessary information and materials to undertake a risk assessment using the Ports and Waterways Safety Assessment MkII (PAWSA) methodology. The PAWSA process helps to:

- Identify major waterway safety hazards.
- Estimate levels of risk.
- Gain a deeper understanding of why a certain phenomenon occurs, its associated consequences and the potential effectiveness of additional mitigation measures.
- Evaluate potential risk mitigation measures.
- Set the stage for implementation of selected measures to reduce risk.
- Engage stakeholders in the analysis and decision-making process.

2. INTRODUCTION

PAWSA provides a systematic approach to the identification of major waterway safety hazards, estimated levels of risk, and the evaluation of potential risk mitigation measures so that selected measures can be implemented to reduce such risk.

The output from PAWSA indicates whether the risk in a waterway is either:

- *acceptable* and that no further work is needed unless changes occur in significant criteria, such as the traffic pattern or types of vessels using that waterway; or
- *not acceptable* but the risk control options necessary to make the risk level of the waterway acceptable have been identified adequately; or
- *not acceptable* and more detailed study is necessary to enable the risk control options that will make the risk level of the waterway acceptable to be identified adequately.

3. OVERVIEW OF PAWSA MKII

3.1. METHODOLOGY OVERVIEW

The full title of the PAWSA methodology, PAWSA *MKII*, stems from the development of the methodology and the associated tools by the US Coast Guard (USCG).

The USCG associated PAWSA Workshop Guide upon which this Manual is based (with the kind permission of the USCG) was reviewed in 2014, and subsequently the suffix MKII was assigned to the methodology. Further information on the history of PAWSA development can be found on the USCG website.

3.1.1. METHODOLOGY EXPLANATION

PAWSA applies the Delphi¹ method to identify major waterway safety hazards, estimates risk levels, evaluates potential mitigation measures, and provides specific recommendations for selected measures to reduce risk. The Delphi method is a structured communication technique that converts the expert opinion of stakeholders into a quantitative appraisal of risk.

Delphi is based on the principle that predictions (or decisions) from a structured group of individuals are more accurate than those from unstructured groups.

PAWSA is undertaken by means of a structured, two-day workshop, evaluating risk and potential mitigation measures through expert inputs. Workshops are typically conducted with 30 participants (in 15 teams of two persons each), using the expertise of an experienced facilitator, supported by a note taker and a data entry team.

During the workshop, waterway users and stakeholders discuss and estimate risks levels for 24 different risk factors, organised into six risk categories, collectively termed the Waterway Risk model (see Figure 1).

The participants provide numerical values (using a scale of 1 to 9) to quantify their subjective assessments of the risk factors, and these values are organized in logical segments, referred to as “books”, providing a comprehensive but simple picture of the participants’ assessment.

As each book is completed, values are input in the PAWSA Excel workbook. An example Excel workbook has been prepared for general use and is held on the IALA website. The responses are recorded in aggregate form and the results are used in the appropriate subsequent phases of the PAWSA process, as a basis for discussion among the participants on the effectiveness of existing risk mitigation strategies and additional mitigation actions.

3.1.2. WATERWAY RISK MODEL

Since risk is defined as the product of the probability of a casualty and its consequences, the Waterway Risk model includes variables dealing with both the causes of waterway casualties and their effects. The six default risk categories used in the model are:

¹ see https://en.wikipedia.org/wiki/Delphi_method for further background on the Delphi method

- 1 **Vessel Conditions** – the quality of vessels and their crews that operate on a waterway.
- 2 **Traffic Conditions** – the number of vessels that use a waterway and their interactions.
- 3 **Navigational Conditions** – the environmental conditions that vessels must deal with in a waterway relating to wind, water movement (i.e., currents), and weather.
- 4 **Waterway Conditions** – the physical properties of the waterway that affect how easy it is to manoeuvre a vessel.
- 5 **Immediate Consequences** – the immediate impacts of a waterway casualty, for example, people can be injured or killed, petroleum and hazardous materials can be spilt and require response resources, and the marine transportation system can be disrupted.
- 6 **Subsequent Consequences** – the subsequent effects of waterway casualties that are felt hours, days, months, and even years afterwards, such as shore-side facility shut-downs, loss of employment, destruction of fishing areas, decrease or extinction of species, degradation of subsistence living uses, and contamination of drinking or cooling water supplies.

The diagram below shows the six risk categories and corresponding risk factors in the Waterway Risk model.

Waterway Risk Model					
Vessel Conditions	Traffic Conditions	Navigational Conditions	Waterway Conditions	Immediate Consequences	Subsequent Consequences
Deep draft vessel quality	Volume of commercial traffic	Winds	Visibility impediments	Personnel injuries	Health and safety
Shallow draft vessel quality	Volume of small craft traffic	Water movement	Dimensions	Petroleum discharge	Environmental
Commercial fishing vessel quality	Traffic mix	Visibility restrictions	Bottom type	Hazardous materials release	Aquatic resources
Small craft quality	Congestion	Obstructions	Configuration	Mobility	Economic

Figure 1 Waterway Risk Model

3.1.3. QUANTITATIVE ASSESSMENTS

Figure 2 below provides a simple overview of the five main steps used in the PAWSA process:

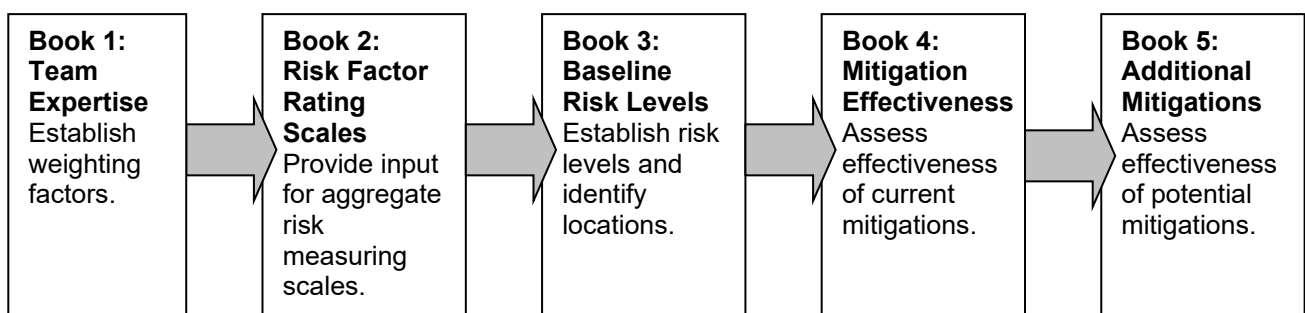


Figure 2 Overview of the PAWSA process

- **Book 1: Team Expertise** is used to capture the expertise of each team relative to the other teams in the workshop. The results from Book 1 are used to weigh each team's inputs for all other books.
- **Book 2: Risk Factor Rating Scales** develops a reference measurement scale for each risk factor by asking participants to compare specified qualitative descriptions to each other in a pair-wise manner². Those qualitative descriptions characterize the range of possible conditions that affect risk in a waterway for that factor.
- **Book 3: Baseline Risk Levels** is used by the participants to determine where their waterway falls on the risk scales developed in Book 2. What results is the risk level for each factor, *not taking into account* any actions already implemented to reduce risk in the waterway.
- **Book 4: Mitigation Effectiveness** is used for two purposes. After the participants describe the risk mitigation strategies that already exist to help reduce the risk level for their waterway, Book 4 is used to evaluate the effectiveness of those strategies in reducing the risk level for each factor in the model. What results from that evaluation is the present risk level, *taking into account* those existing mitigations.

Secondly, they decide whether the risk mitigation strategies already in place adequately balance the resulting risk level, or not. If for any given risk factor, there is a strong consensus among the participants that existing mitigations do adequately deal with those risks, then that risk factor could be dropped from further discussion.

- **Book 5: Additional Mitigations** provides the participants with an opportunity to offer ideas about specific risk mitigation actions that should be taken and to estimate how effective those actions would be in further reducing risk levels. Participants first discuss what else should be done only for those risk factors where the Book 4 results show that risk levels are not adequately balanced with existing mitigations. Following the discussion, participants decide which ideas have the most promise for each risk factor that was discussed and what mitigation category the ideas relate to. They write a short description of the action needed, that is, the idea with the most promise, and then evaluate how much risk reduction would result if that idea was implemented.

3.1.4. PAWSA EXCEL WORKBOOK

An Excel workbook is used to enter all quantitative data gathered during the workshop. This workbook contains spreadsheets for the data collected from each book.

The use of the PAWSA workbook is discussed in detail in section 4. Example forms used to gather data are included as Annex A to this manual.

An example Excel workbook can be obtained from the IALA website and is freely available to use. It is strongly recommended that appropriate training in the application of the PAWSA method is undertaken, prior to completing any PAWSA.

3.1.5. WORKSHOP OUTPUTS

Workshop outputs should include a participant list, workshop critique comments, and the PAWSA workshop report. The PAWSA workshop report includes the quantitative results from Books 1 – 5, discussion comments made during the workshop, and an in-depth analysis providing specific recommendations on what mitigation strategies could be implemented. Annex B to this Manual is a detailed guide to conducting a PAWSA workshop.

² see https://en.wikipedia.org/wiki/Pairwise_comparison for further information

4. THE PAWSA MKII PROCESS

4.1. PREAMBLE

For those not yet familiar with the PAWSA process, the following sections should assist with a general understanding of how the PAWSA process converts opinion into numerical values and facilitates a risk assessment. The detailed mathematics involved in the process, as implemented in the PAWSA Excel workbook, will be provided in the next version of this manual.

4.2. THEORY AND METHODOLOGY

The theoretical concept underlying the PAWSA process is the proven Delphi method of converting the opinions of local subject matter experts into quantified results. This method is used so that those quantified results can be compared both:

- *internally*, i.e., the results for one risk factor can be compared to those for other risk factors, and the results from one stage (e.g., Book 3) can be compared to the results from other stages (e.g., Book 4) during the workshop; and
- *externally*, i.e., the results from one waterway can be compared to the results from other waterways.

The strength of the PAWSA process derives from several sources:

- The participants are carefully selected because they are knowledgeable about a particular maritime interest, and to ensure that all important interests are represented within the group.
- Before converting their opinions into numbers, the participants thoroughly discuss the issues being judged.
- The same 1 to 9 scale is used repeatedly throughout the process.
- All quantified inputs are weighted by the relative expertise of each participant team, with respect to each risk category in the Waterway Risk model.

Validation of the PAWSA process (i.e., that it produces realistic results) comes from the internal consistency checks that are built into the results spreadsheets within the PAWSA Excel workbook and that are used to capture and analyse the participants' quantified inputs. Those consistency checks have repeatedly shown that workshop participants develop strong consensus about the levels of risk in the waterway and the effectiveness of various risk mitigation strategies.

This consensus emerges even though participants typically represent widely different interests within the overall maritime community, and although the quantitative 1 to 9 measurement scale used is correlated only loosely with qualitative descriptors for each value on that scale.

The sections below describe the process undertaken to complete Books 1 – 5. Understanding how each book is used, the methodology behind each book, and how the PAWSA software relates to each book, is critical to understanding the overall PAWSA process. The text is accompanied by icons indicating the tasks to be undertaken by the various roles of facilitator, participants and data entry team.

4.3. TEAM ALLOCATION

Team allocation is generally decided prior to the start of the workshop and perhaps modified on the day in the case of non-attendance or clarification of a particular attendee's skills set. The facilitator undertakes this task, advised by the workshop sponsor. The selection of participants and their allocation into pairs is described in detail in Annex B.



Facilitator

The facilitator assigns participants to teams. Each team should have two people with similar expertise and perspectives on waterway safety issues. For example, if there are two harbour pilots in the group, then they would be placed together into one team; likewise, if there are two environmentalists in the group, they would become one team. The intent is that each team ideally consists of two people with a similar perspective on waterway safety issues. Teams with one person with a unique area of expertise, or three persons with similar expertise, should be used as a last resort.

4.4. TEAM EXPERTISE (BOOK 1)

4.4.1. PURPOSE

The purpose of Book 1 is to establish weighting factors for each team's expertise for each of the six risk categories of the Waterway Risk model (see Figure 1). These weighting factors are used in calculations in each of the subsequent Books 2 to 5.

For example, as shown in the output from Book 1 in Figure 3, Team 1 has a weight value of 0.083 for "Vessel Conditions" and a value of 0.032 for "Immediate Consequences". This indicates a relatively higher expertise in Vessel Conditions than Immediate Consequences for Team 1. Therefore, the data they provide on the risk factors (within the respective "Vessel Conditions" and "Immediate Consequences" risk factors) during the PAWSA, will be multiplied by these respective expertise weight values throughout Books 2 to 5.

E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
Team Expertise -- Results																		
Risk Category	Team	Avg	Sum	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Vessel Conditions		2.4	36	0.083	0.083	0.056	0.083	0.083	0.083	0.056	0.083	0.083	0.056	0.056	0.028	0.056	0.083	0.028
Traffic Conditions		2.5	37	0.081	0.081	0.054	0.054	0.081	0.081	0.054	0.081	0.081	0.081	0.081	0.054	0.027	0.081	0.027
Navigational Conditions		2.4	36	0.083	0.056	0.056	0.083	0.083	0.083	0.083	0.083	0.083	0.056	0.083	0.056	0.028	0.056	0.028
Waterway Conditions		2.3	34	0.088	0.059	0.059	0.059	0.088	0.088	0.088	0.088	0.088	0.029	0.059	0.059	0.059	0.059	0.029
Immediate Consequences		2.1	31	0.032	0.065	0.097	0.032	0.065	0.097	0.065	0.097	0.097	0.065	0.065	0.097	0.065	0.032	0.032
Subsequent Consequences		2.1	32	0.031	0.063	0.094	0.031	0.063	0.094	0.063	0.094	0.094	0.063	0.063	0.094	0.094	0.031	0.031

Figure 3 Example of the output from Book 1 (refer to "Bk1 Results" in the spreadsheet)

Key point

The results of Book 1 reflect the strengths of each team (that is, their background, expertise, and experience) for each of the six risk categories relative to each of the other teams.

4.4.2. COMPLETING BOOK 1

4.4.2.1. Resources

Resources provided to complete Book 1 include:

1. Data Entry Form - Form 1 Team Expertise. This is used by participants to record their expertise for the six risk categories (see Annex A)
2. The following spreadsheets:
 - "Bk 1 Input" - used by the data entry person to enter the risk category scores from completed Form 1 forms.
 - "Bk 1 Calcs"- calculates the expertise level of each team, relative to the other teams. This spreadsheet should not be edited.
 - "Bk 1 Rslts" presents the results from Book 1.

4.4.2.2. Process

Book 1 – Establishing the weight factors is completed as a five-step process:

- *Step 1 - Teams introduction/familiarisation.* Workshop participants break into their individual teams as determined in 4.3 to introduce themselves and discuss how their background and experience aligns with each risk factor, in the waterway risk model.
- *Step 2 - Teams presentations to the Group.* A representative from each team then verbally presents to the entire panel of participants, the strengths, and weaknesses of their team, in relation to the six risk categories.
- *Step 3 - Expertise Evaluation.* Following the presentations, each team completes the Team Expertise PAWSA data entry form (Form 1), evaluating where they place themselves with respect to knowledge about each of the six risk categories. That is, in the top, the middle or lower third of the teams, noting the discussion from Step 2 above.
- *Step 4 – Enter data into the Bk1 Expertise spreadsheet.* The data entry person enters the scores from each team into the spreadsheet
- *Step 5 - Generating the weight factors.* The spreadsheet generates the weight factors for each team, for each of the six risk categories.

4.4.2.3. Step 1 – Team introduction/familiarisation



Teams

Workshop participants break into their individual teams as determined in 4.3 to introduce themselves and discuss how their background and experience aligns with each risk factor of the waterway risk model.

On conclusion of this step, each team nominates a representative to verbally present to the entire panel of participants, the strengths, and weaknesses of their team, in relation to the six risk categories.

4.4.2.4. Step 2 – Team presentations to the group



Teams

The representative nominated by each team in Step 1 verbally presents to the entire panel of participants, the strengths, and weaknesses of their team, in relation to the six risk categories

This presentation provides all teams with a broad understanding of where each individual team considers their expertise to be strong or perhaps not so strong with respect to each of the six risk categories.

4.4.2.5. Step 3 – Expertise evaluation

With the benefit of the individual team presentations and discussion in Step 2, the individual teams regroup to complete Form 1 for each of the six risk categories, entering the number which best describes their team, where:

- **1** = The team is probably in the top 1/3 of all the teams;
- **2** = The team is probably in the middle 1/3 of all the teams; or
- **3** = The team is probably in the lower 1/3 of all the teams.



Teams

The teams annotate Form 1 to indicate where they think they lie as a team, relative to other teams' expertise for the six risk categories. An example is shown in Figure 4:

APPENDIX 1 BOOK 1 – TEAM EXPERTISE

Ports and Waterways Risk Assessment [location] Team Number: 5

Compare each team's knowledge (level of expertise) about the factors that affect the probability and consequences of marine accidents with that of the other participant teams in this workshop. Please enter in each block the number which best describes each team, where:

- 1 = The team is probably in the UPPER THIRD of all the teams. (high level of expertise)
- 2 = The team is probably in the MIDDLE THIRD of all the teams. (medium level of expertise)
- 3 = The team is probably in the LOWER THIRD of all the teams. (low level of expertise)

Team / Risk Category	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Vessel Conditions						1									
Traffic Conditions						3									
Navigational Conditions					1										
Waterway Conditions					2										
Immediate Consequences					3										
Subsequent Consequences					3										

Step #	Description of the step
1	Fill in the number assigned to your team. For example Team Number: 5
2	Find the column which corresponds to the number assigned to your team. For example, column number 5
3	Fill in the number which best describes the level of expertise of your team, with respect to the level of expertise of all other teams on the panel.

Figure 4 Team Expertise data entry form, Form 1

4.4.2.6. Step 4 – Enter data into the Bk1 Expertise spreadsheet

The completed Form 1 forms are collected from each team and provided to the data entry team.



Data entry team

The scores from each team are entered into the grey-shaded cells of the “Bk 1 Input” spreadsheet, as shown below in Figure 5 and Figure 6:

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	
1	Team Expertise -- Scores																
2																	
3	Risk Category	Team 1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
4	Vessel Conditions																
5	Traffic Conditions																
6	Navigational Conditions																
7	Waterway Conditions																
8	Immediate Consequences																
9	Subsequent Consequences																
10																	
11	Risk Category	Team 2	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
12	Vessel Conditions																
13	Traffic Conditions																
14	Navigational Conditions																
15	Waterway Conditions																
16	Immediate Consequences																
17	Subsequent Consequences																
18																	
19	Risk Category	Team 3	1	2	3	4	Select the spreadsheet titled “Bk 1 Input”					10	11	12	13	14	15
20	Vessel Conditions																
21	Traffic Conditions																
22	Navigational Conditions																
		Previous PAWSA	Bk 1 Input	Bk 1 Calcs	Bk 1 Rslts	Bk 2 Input	Bk 2 Calcs	Bk 2 Disp	Bk 3 Input	Bk 3 Calcs							

Figure 5 Bk 1 Input spreadsheet

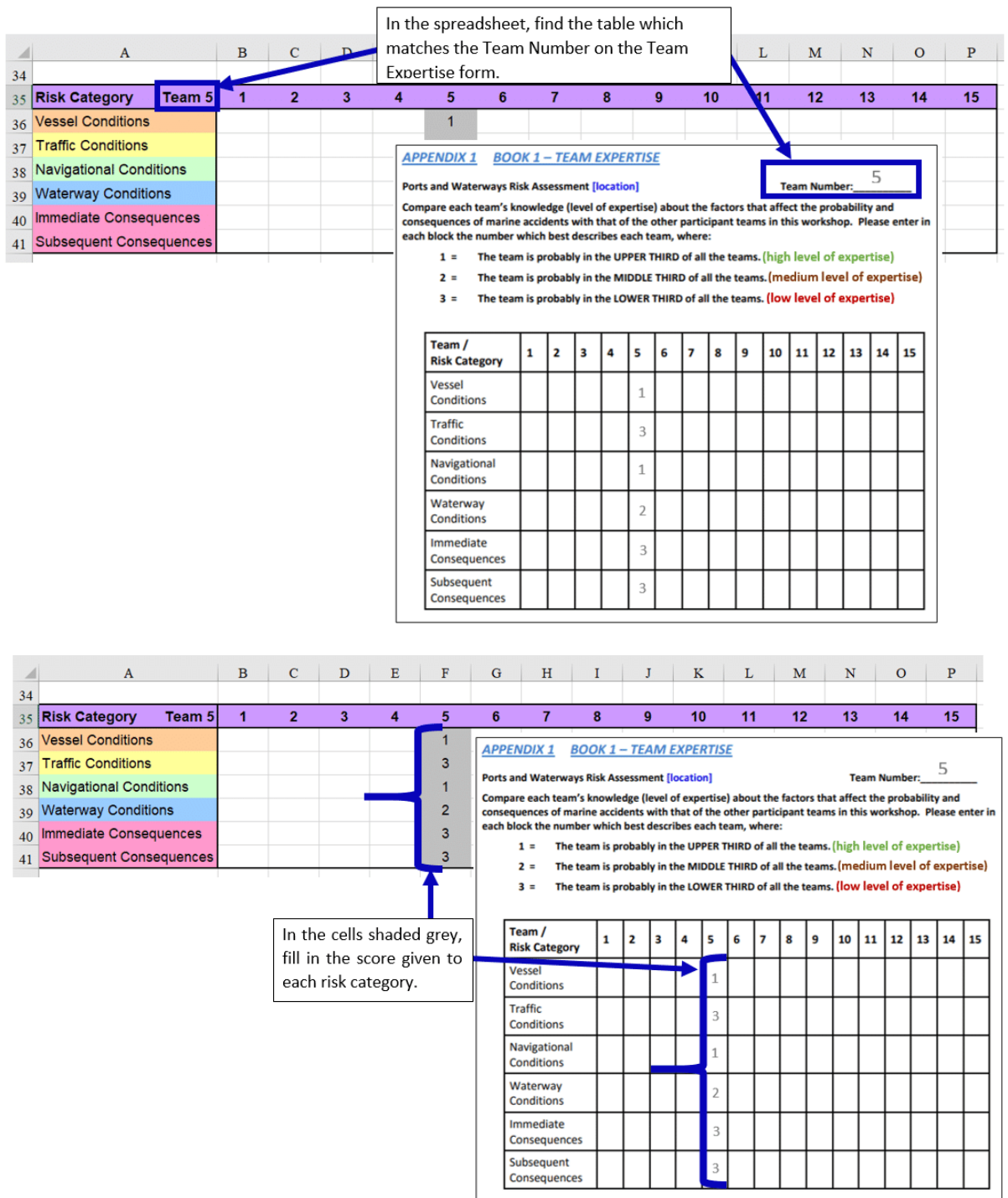


Figure 6 Entering data from Form 1 into the Bk1 Input spreadsheet

4.4.2.7. Step 5 – Generating the weight factors

The weight factors for each team, for each of the six risk categories, are generated by the spreadsheet as shown in Figure 7:

Team Expertise -- Inverted and Rearranged Scores

Input from: Concerning the expertise of Team:

Vessel Conditions	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	AVG
Team 1	1															1.0
Team 2		3														3.0
Team 3			3													3.0
Team 4				2												2.0
Team 5					3											3.0
Team 6						1										1.0
Team 7							3									3.0
Team 8								2								2.0
Team 9									2							2.0
Team 10										2						2.0
Team 11											3					3.0
Team 12												2				2.0
Team 13													1			1.0
Team 14														1		1.0
Team 15															2	2.0
SUM	1	3	3	2	3	1	3	2	2	3	2	1	1	2	31	

Select Bk 1 Calcs, to calculate the expertise level of each team, relative to the other teams.

The formulae in this sheet, are built into the spreadsheet to automatically calculate the results.

This spreadsheet should not be edited.

Figure 7 Bk1 Calcs spreadsheet – for information only, not to be edited by user

After the data from Form 1 are entered in the Bk 1 Input spreadsheet, the following results are displayed in the Bk 1 Results spreadsheet:

- “Team Expertise – Distribution” (Figure 8) - the spread of expertise of the teams in the workshop. Ideally, the distribution of expertise for the six risk categories should be 33%, 33%, 33%. Any imbalance shown in the team expertise distribution is highlighted in the cells in yellow and should be treated with caution.
- “Team Expertise – Results” (Figure 9) These provide a numerical weighting for the expertise of each team, relative to other teams in the workshop. These results are used to weight each team's input in all other books.

	A	B	C	D
1	Team Expertise -- Distribution			
2				
3	Risk Category	Top 1/3	Mid 1/3	Lower 1/3
4	Vessel Conditions	53%	33%	13%
5	Traffic Conditions	60%	27%	13%
6	Navigational Conditions	53%	33%	13%
7	Waterway Conditions	40%	47%	13%
8	Immediate Consequences	33%	40%	27%
9	Subsequent Consequences	40%	33%	27%
10				
11	All Categories Average	47%	36%	18%

Figure 8 Team expertise distribution

Team Expertise -- Distribution				Team Expertise -- Results																				
Risk Category	Top 1/3	Mid 1/3	Lower 1/3	Risk Category	Team	Avg	Sum	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
Vessel Conditions	53%	33%	13%	Vessel Conditions		2.4	36	0.083	0.083	0.056	0.083	0.083	0.083	0.056	0.083	0.083	0.056	0.056	0.028	0.056	0.083	0.028		
Traffic Conditions	60%	27%	13%	Traffic Conditions		2.5	37	0.081	0.081	0.054	0.054	0.081	0.081	0.054	0.081	0.081	0.054	0.081	0.081	0.054	0.027	0.081	0.027	
Navigational Conditions	53%	33%	13%	Navigational Conditions		2.4	36	0.083	0.056	0.056	0.083	0.083	0.083	0.083	0.083	0.056	0.083	0.056	0.083	0.056	0.028	0.056	0.028	
Waterway Conditions	40%	47%	13%	Waterway Conditions		2.3	34	0.088	0.059	0.059	0.059	0.088	0.088	0.088	0.088	0.029	0.059	0.059	0.059	0.059	0.059	0.029	0.059	0.029
Immediate Consequences	33%	40%	27%	Immediate Consequences		2.1	31	0.032	0.065	0.097	0.032	0.065	0.097	0.065	0.097	0.097	0.065	0.065	0.097	0.065	0.032	0.065	0.032	
Subsequent Consequences	40%	33%	27%	Subsequent Consequences		2.1	32	0.031	0.063	0.094	0.031	0.063	0.094	0.063	0.094	0.063	0.063	0.094	0.063	0.094	0.031	0.063	0.031	
All Categories Average				47%	36%	18%	Cell 14 here is 3/36																	

Select the 'Bk 1 Results' workbook.

Figure 9 Team expertise distribution and results

Facilitator



The facilitator should review the distribution of expertise and identify where the teams' distribution of expertise deviates significantly from the ideal 33% distribution. The preference is for this ideal distribution but technically the spreadsheet will process whatever scores are entered and will factor Books 1 to 5 accordingly.

The facilitator should be aware of the implications of a skewed expertise distribution and the effects that this could have on discussions and conclusions. Certain risk factors may require greater focus to tease out any issues that could affect the team's perception of risk.

Ideally, the workshop sponsors will ensure the appropriate participants are selected and the facilitator should only have to fine tune any gaps in expertise; representation is key for the qualitative model.

4.4.2.8. Re-evaluation of Book 1

Facilitator



As the workshop progresses, the participants better understand each team's true expertise. Book 1 is revisited during the workshop to allow participants to re-evaluate their expertise level and adjust input values for their team if necessary.

The point at which Book 1 re-evaluation takes place is determined by the Facilitator. If they are generally comfortable with the level of expertise demonstrated throughout the workshop, re-evaluation can take place after Book 4 or Book 5; re-evaluation earlier in the PAWSA may be required if Teams' expertise is in doubt or has been questioned

The facilitator discusses the *initial* overall results from Book 1, with the participants and returns the original Form 1 forms to the participants, asking the teams to re-evaluate their initial inputs for their relative levels of expertise (see Figure 10).

The spreadsheet regenerates the relative expertise score for each team for Book 1 and updates Books 2 to 5 accordingly.

APPENDIX 1 BOOK 1 – TEAM EXPERTISE

Ports and Waterways Risk Assessment [location] Team Number: 5

Compare each team's knowledge (level of expertise) about the factors that affect the probability and consequences of marine accidents with that of the other participant teams in this workshop. Please enter in each block the number which best describes each team, where:

- 1 = The team is probably in the UPPER THIRD of all the teams. (high level of expertise)
- 2 = The team is probably in the MIDDLE THIRD of all the teams. (medium level of expertise)
- 3 = The team is probably in the LOWER THIRD of all the teams. (low level of expertise)

Team / Risk Category	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Vessel Conditions	2	2	3	1	1	1	1	2	1	2	3	3	3	2	3
Traffic Conditions	3	3	2	1	3	2	3	1	1	1	3	2	2	2	3
Navigational Conditions	1	1	3	3	1	2	1	2	1	2	2	3	3	2	3
Waterway Conditions	3	3	2	2	2	1	3	1	1	1	2	2	3	1	3
Immediate Consequences	3	2	2	1	2	2	1	1	3	3	3	1	2	3	1
Subsequent Consequences	2	2	3	1	3	3	2	1	3	3	1	1	2	2	1

Team 5 changed their relative level of expertise in 'immediate consequences' from 3 to 2. They also evaluated the relative levels of expertise of all other teams.

Figure 10 Team expertise revaluation recorded on form

Data entry team



After the participants re-evaluate the Book 1 forms, the data entry person uses the Form 1s, to fill in the scores in "Bk 1 Input" as shown in Figure 11. These changes automatically update the calculations in all the other spreadsheets in the PAWSA software, thereby producing the final PAWSA quantitative results. The resulting weights are used to determine the final results of the workshop.

Using the 'Bk 1 Inputs' sheet, the data entry person should use the Team Expertise forms, to enter the scores in the corresponding tables.

This image shows how the scores from the Team Expertise form shown above, should be filled in the 'Bk 1 Inputs' sheet.

Risk Category	Team 5	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Vessel Conditions		2	2	3	1	1	1	1	2	1	2	3	3	3	2	3
Traffic Conditions		3	3	2	1	3	2	3	1	1	1	3	2	2	2	3
Navigational Conditions		1	1	3	3	1	2	1	2	1	2	2	3	3	2	3
Waterway Conditions		3	3	2	2	2	1	3	1	1	1	2	2	3	1	3
Immediate Consequences		3	2	2	1	2	2	1	1	3	3	3	1	2	3	1
Subsequent Consequences		2	2	3	1	3	3	2	1	3	3	1	1	2	2	1

Figure 11 Revaluation of teams' expertise with all values complete

4.5. RISK FACTOR RATING SCALES (BOOK 2)

4.5.1. PURPOSE

The purpose of Book 2 is to establish a reference scale for each of the 24 risk factors that reflect the inherent risks in the waterway, such as its geographical attributes, the volume of traffic, categories of vessels, etc.

The scale established for each risk factor provides the reference for determining:

- The baseline risk levels (that is, where the risk lies on the scale *without* whatever existing mitigation is in place) – *Book 3*.
- The effectiveness of current mitigation measures – *Book 4*.
- The effectiveness of potential mitigation measures – *Book 5*.

The output from Book 2 is a four-point scale for each risk factor, ranging from low risk (the A value) to high risk (the D value), with two intermediate values (C and D), as shown in Figure 12.

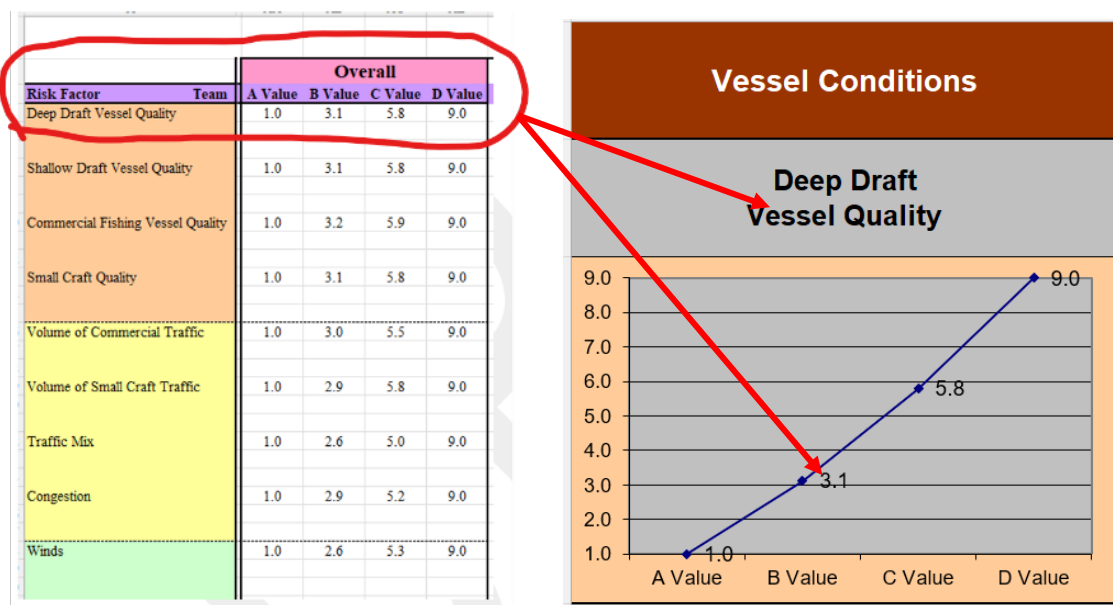


Figure 12 Example Book 2 output – reference scale points A to D shown numerically and graphically

4.5.2. COMPLETING BOOK 2

4.5.2.1. Resources

Resources provided to complete Book 2 include:

1. Data entry forms - Form 2 Risk Factor Rating Scales. There is one form for each of the 24 risk factors and they are used by participants to record their estimation of the reference scales (see Annex A).
2. The following spreadsheets:
 - “Bk 2 Input” – Input sheet for comparison results
 - “Bk2 Calcs”- Numerical display of results
 - “Bk 2 Disp” – Graphical display of reference scales

4.5.2.2. Process

Establishing the reference scale for each of the 24 risk factors in the waterway model to assist in completing Books 3 to 5, is completed as a five-step process:

- *Step 1 - Decide on the development of Book 2.* Decide on whether to develop individual waterway risk factor rating scales or pass over Book 2 and go straight to Book 3.
- *Step 2 – Compare risk descriptors.* If Book 2 is to be developed, the facilitator guides the participants to undertake a comparison of risk descriptors for each of the 24 risk factors using pre-defined forms (Form 2) and a scale using points A to D.
- *Step 3 – Enter data into workbook.* The results of the comparison are entered into the Book 2 input spreadsheet.
- *Step 4 – Present results.* The facilitator presents the Book 2 results to the participants for discussion.
- *Step 5 – Agree on reference scales.* The team reviews and agrees on the reference scale values (A to D) to be used in Books 3 to 5.

4.5.2.3. Step 1 - Decide on the development of Book 2 (or otherwise)

Completion of Book 2 ensures:

- The inherent risks of the waterway are adequately considered and understood by participants.
- The reference scales adopted are applicable to the waterway being considered.

Completion of Book 2 should be proactively considered, but it is recognized that available expertise, resourcing, etc. may make developing Book 2 difficult and potentially time-consuming.

The workshop can decide to either:

- complete Book 2 as described in steps 2 to 4 below, to establish the reference scales used in Books 3 to 5; or
- adopt a set of “generic” reference scales included in the Excel workbook. These generic reference scales have been derived from a sub-set of previous PAWSA workshops.

Where it is decided to use the generic reference scales, the “Bk2 Input” cells are left blank, the workbook will refer to the generic reference scales, and participants move to Book 3.

Facilitator



The facilitator should appraise the expertise of the participants (both together with the sponsor before the workshop and, following the outcome of Book 1) and consider if Book 2 completion is necessary or if the generic reference scales will be used.

4.5.2.4. Step 2 – Compare risk descriptors

Each of the 24 risk factors in the Waterway Risk model, is presented as comparative descriptors in a series of risk descriptor comparison forms (Form 2). The comparative descriptors are converted to values on a nine-point reference scale where:

- A value - Very benign, best-case risk (always 1 on the scale)
- B value - Relatively less risky, intermediate risk
- C value - Relatively more risky, intermediate risk
- D value - Highly dangerous, worst-case risk (always 9 on the scale)

The comparison process establishes the numerical intervals between A to B, B to C and C to D respectively (shown graphically in Figure 13). A is always 1.0 and D is always 9.0. C and D typically lie around 3 and 6 respectively.

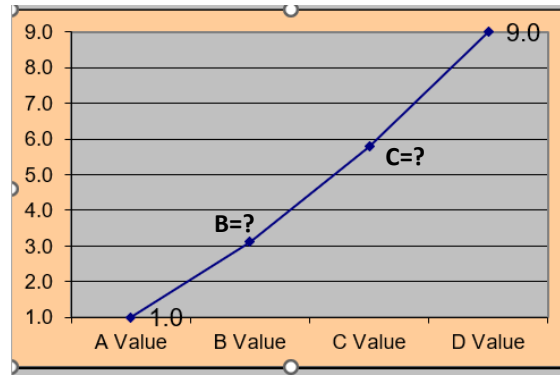


Figure 13 Graphical illustration of A to D values

Establishing the numerical relationship, helps participants reach a collective understanding of what the four values mean for each of the 24 risk factors in their waterway.

Teams



The teams consider what level of risks are descriptive of their waterway. For example, this picture shows Form 2 for the risk factor “Winds”, which is used to evaluate the increase in risk due to wind, when moving from the lower risk descriptor (left-hand column) to the higher risk descriptor (right-hand column).

Book 2: Risk Factor Rating Scales

How much riskier is the condition on the right than the condition on the left?

Navigational Conditions: Winds		
(Circle one number on each line)		
Strong winds occur LESS than twice a month AND well forecast A	1 2 3 4 5 6 7 8 9	Strong winds occur MORE than twice a month BUT well forecast B
Strong winds occur MORE than twice a month BUT well forecast B	1 2 3 4 5 6 7 8 9	Strong winds occur LESS than twice a month BUT without warning C
Strong winds occur LESS than twice a month BUT without warning C	1 2 3 4 5 6 7 8 9	Strong winds occur MORE than twice a month AND without warning D
Equally Risky → Somewhat More Risky → Much More Risky → Extremely More Risky		

Figure 14 Example of completed Risk Factor Rating Scales form (Form 2)

To complete the relevant Form 2, the participants should ask themselves, “how much riskier is the condition on the right than the condition on the left,” then, circle the relevant number on the 1 to 9 scale.

In the example in Figure 14, we can see that descriptor B is considered relatively lower in relative risk to descriptor A and so marked as 4, but descriptor C compared to descriptor B and descriptor D compared to descriptor C are considered relatively riskier so have been marked as 7.

The greater the difference between the values assigned to two descriptors (A:B, B:C, C:D), the greater the difference in their perceived effects on risk. This helps the teams establish a distribution of risk relevant to their specific waterway, over the nine-point scale.

4.5.2.5. Step 3 – Enter data into workbook

Data Entry



The Form 2s completed by each team, for each risk factor, are collected and given to the data entry person. Using the “Bk 2 Input” spreadsheet, the data entry person enters the circled numbers from Form 2, in the relevant cell on the spreadsheet, as shown in Figure 15.

Risk Factor Rating Scales -- Scores															
Book 2: Risk Factor Rating Scales															
Risk Factor	Team	1	2	3											
Deep Draft Vessel Quality		4	2	3											
Shallow Draft Vessel Quality		7	5	6											
		7	5	6											
Commercial Fishing Vessel Quality		3	2	4											
		6	4	5											
Small Craft Quality		6	4	5											
		7	8	6											
Volume of Commercial Traffic		7	8	5											
		6	4	5											
Volume of Small Craft Traffic		4	2	5											
		7	8	5											
Traffic Mix		6	4	5											
		7	8	6											
Congestion		5	7	5											
		6	4	6											
Winds		7	8	6											
		5	7	5											

How much riskier is the condition on the right than the condition on the left?															
Navigational Conditions: Winds															
Circle one number on each line)															
Strong winds occur LESS than twice a month AND well forecast	1	2	3	4	5	6	7	8	9	Strong winds occur MORE than twice a month BUT well forecast					
Strong winds occur MORE than twice a month BUT well forecast	1	2	3	4	5	6	7	8	9	Strong winds occur LESS than twice a month BUT without warning					
Strong winds occur LESS than twice a month AND without warning	1	2	3	4	5	6	7	8	9	Strong winds occur MORE than twice a month AND without warning					

	Equally Risky	→	Somewhat More Risky	→	Much More Risky	→	Extremely More Risky						
3	2	5	3	2	4	3	5	3	2	4	3	2	4
6	7	5	6	7	5	6	7	5	6	7	5	6	7
7	8	6	7	8	6	7	8	6	7	8	6	7	8
5	7	5	6	7	5	6	7	5	6	7	5	6	7
7	8	6	7	8	6	7	8	6	7	8	6	7	8
5	7	5	6	7	5	6	7	5	6	7	5	6	7
6	7	5	6	7	5	6	7	5	6	7	5	6	7
7	8	6	7	8	6	7	8	6	7	8	6	7	8
5	7	5	6	7	5	6	7	5	6	7	5	6	7
6	7	5	6	7	5	6	7	5	6	7	5	6	7
7	8	6	7	8	6	7	8	6	7	8	6	7	8
5	7	5	6	7	5	6	7	5	6	7	5	6	7
6	7	5	6	7	5	6	7	5	6	7	5	6	7
7	8	6	7	8	6	7	8	6	7	8	6	7	8

Figure 15 Form data is entered into spreadsheet “Bk 2 input”

4.5.2.6. Step 4 – Present results

Facilitator



The “Bk2 Calcs” spreadsheet combines the risk descriptor comparison values with the team expertise score, calculated in Book 1. The facilitator presents the Book 2 comparison A to D value results to the participants.

Risk Factor Rating Scales -- Calculations																															
Risk Factor	Team	Scores * Expertise															Pairwise Comparison	Team Sum	AB:CD Value	A Value	B Value	C Value	D Value	Overall							
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15								B-A	C-B	D-C	A Value	B Value	C Value	D Value	
Deep Draft Vessel Quality		0.33	0.17	0.17	0.42	0.33	0.42	0.22	0.25	0.33	0.11	0.17	0.14	0.11	0.25	0.08	AB	3.50	16.3	1.0	2.7	5.9	9.0	1.7	3.1	3.1	1.0	3.1	5.8	9.0	
		0.58	0.42	0.33	0.67	0.50	0.58	0.33	0.50	0.58	0.28	0.44	0.17	0.39	0.42	0.19	BC	6.39													
		0.58	0.42	0.33	0.67	0.50	0.58	0.39	0.42	0.67	0.28	0.44	0.17	0.33	0.42	0.22	CD	6.42													

Figure 16 "Bk2 Calcs" display - PAWSA-specific reference scale values A to D, and results when combined with the generic reference values A to D ("Overall")

The results from Book 2 are presented numerically in the "Bk2 Calcs" spreadsheet (Figure 16) and graphically in the "Bk2 Disp" spreadsheet (Figure 17).

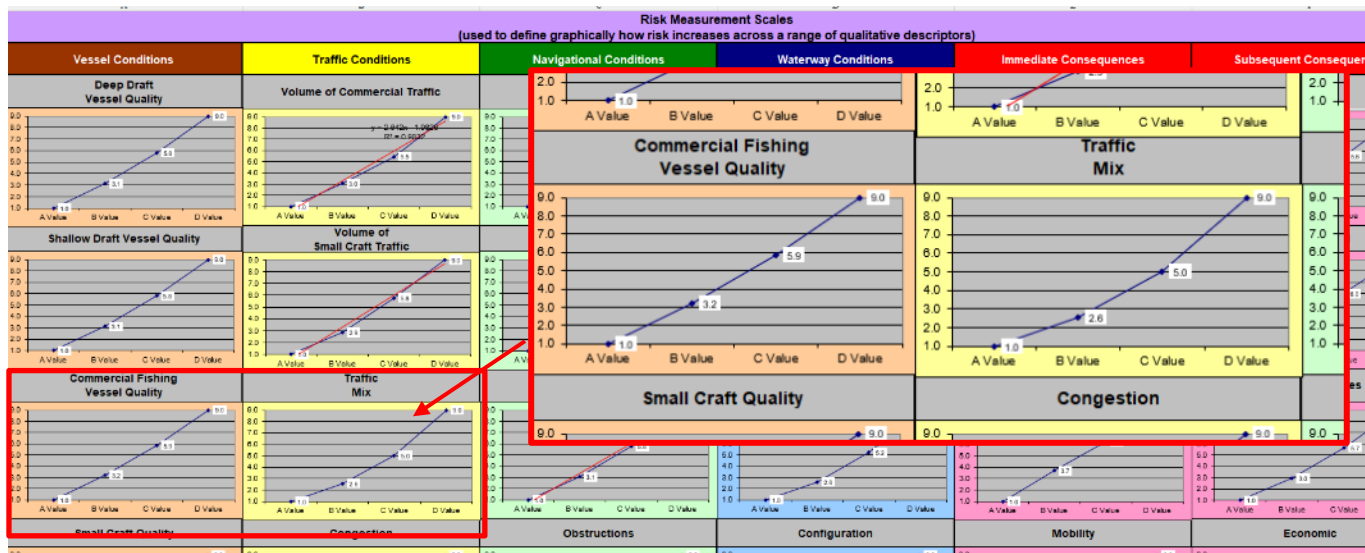


Figure 17 "Bk2 Disp" spreadsheet graphically displaying risk reference scales for the risk factors

Figure 17 illustrates how the risk is distributed differently across the 24 risk factors, between the reference scale points A to D and the intervals A:B, B:C, C:D. For example, the risk between the descriptors and values B to C is greater for "Traffic Mix" than "Vessel Quality", whereas there is a larger interval, indicating greater risk for "Traffic Quality" between the intervals described by that risk factor's descriptors C to D.

4.5.2.7. Step 5 – Agree reference scales

The specific PAWSA A to D values are compared to the generic values combined with the generic PAWSA values (the A to D values displayed under the "Overall" heading). This is the opportunity to re-consider if the specific PAWSA results should be either:

- used – alone, or in combination with the generic PAWSA results; or
- not used – and only the generic PAWSA results used.

Facilitator



The facilitator will decide whether the Book 2 values, as assessed by the specific PAWSA participants should be incorporated into the Excel workbook, or whether the generic PAWSA Book 2 values only should be used.

This decision will be influenced by a collective assessment of whether the assembled group have the relevant expertise to define the scales appropriately.

The facilitator will indicate to the data entry team what values should remain or be removed, as necessary, and the process moves to Book 3.

4.6. BASELINE RISK (BOOK 3)

4.6.1. PURPOSE

The purpose of Book 3 is to establish baseline risk values for each risk factor without considering any mitigation measures already implemented to reduce risk in the waterway, such as AtoN, pilotage, local port services, etc. That is, to establish where the risk factor level for the waterway sits on the Risk Factor Rating (reference) scales adopted in Book 2 for each of the 24 risk factors.

An example of the output from Book 3 is shown in Figure 18.

For example, 4.6 represents the baseline risk value associated with deep draft vessels in the waterway. That is, *without* considering any existing mitigation measures in place

Baseline Risk Levels					
Vessel Conditions	Traffic Conditions	Navigational Conditions	Waterway Conditions	Immediate Consequences	Subsequent Consequences
Deep Draft Vessel Quality	Volume of Commercial Traffic	Winds	Visibility Impediments	Personnel Injuries	Health and Safety
4.6	4.7	3.8	3.0	8.5	7.6
Shallow Draft Vessel Quality	Volume of Small Craft Traffic	Water Movement	Dimensions	Petroleum Discharge	Environmental
7.3	5.3	3.9	4.2	7.5	6.1
Commercial Fishing Vessel Quality	Traffic Mix	Visibility Restrictions	Bottom Type	Hazardous Materials Release	Aquatic Resources
7.8	4.3	4.2	3.1	6.4	4.5
Small Craft Quality	Congestion	Obstructions	Configuration	Mobility	Economic
7.0	2.6	3.2	5.6	6.8	8.3

Figure 18 Output from Book 3

Key point

The baseline risk values are determined *without* considering any mitigation measures already implemented to reduce risk in the waterway, such as visual AtoN, space allocation, local port services, etc. This can often be difficult to remember; the facilitation team should ensure the participants are reminded of this point.

4.6.2. COMPLETING BOOK 3

4.6.2.1. Resources

Resources provided to complete Book 3 include:

1. Read ahead material (see Annex B for further information)
2. Data Entry Forms – Form 3 Baseline Risk Levels. These are used by participants to indicate the descriptor that best describes the risk for the waterway risk factors. There are six forms, one for each risk category with the relevant risk factors included in each (see Annex A).
3. The following spreadsheets:
 - “Bk 3 Input” – Input sheet for baseline risk values
 - “Bk3 Calcs”- Numerical display of results
 - “Bk 3 Disp” – Summary of output from Book 3

4.6.2.2. Process

Steps in completing Book 3 include:

- *Step 1 - Discussion period* - Introduction to Book 3.
- *Step 2 - Complete the data entry form.*
- *Step 3 - Enter data into “Bk 3 input” spreadsheet.*
- *Step 4 - Spreadsheet calculations.*
- *Step 5 - Discussion period* – Output from Book 3.

4.6.2.3. Step 1 – Discussion period – Introduction to Book 3

Participants often have difficulty conceptualising the waterway without considering mitigation measures that may have been already implemented to reduce risk in the waterway such as, AtoN, pilotage, local port services, etc. Invariably the effects of existing mitigation measures tend to creep into the discussion.

Key to addressing this tendency and achieving consensus in establishing the baseline risk values is the discussion period that immediately precedes participants completing Form 3.

During that discussion period, the various perspectives concerning each risk factor are voiced, and sometimes debated with reference to the Waterway Profile Material provided in the read-ahead material (see Annex B for detailed information), particularly:

- Waterway characteristics/Navigational attributes
- Volume of traffic
- Categories of vessels
- Distribution of vessel transits by category of vessel
- Distribution of cargo tonnage
- Waterway casualty history
- Pollution spill history

Facilitator



In Step 1, the facilitator:

1. Introduces Book 3, highlighting:
 - Its purpose.
 - The importance for participants to not take into consideration any mitigation measures already implemented to reduce risk in the waterway; when establishing the baseline risk values.
 - The steps involved in completing Book 3.
2. Facilitates a period of general discussion on the waterway risk factors, encouraging active engagement by all participants, and guides participants to discuss (and sometimes debate) their perspectives about the risks associated with each risk factor to ensure all participants are conversant with:
 - The process of completing Book 3.
 - The perspectives of each team on the risk factors, noting their respective expertise base.

Once discussions have run their course and the facilitator is confident a collective understanding of the process has been achieved, participants move to Step 2.

4.6.2.4. Step 2. Complete data entry form.

Facilitator



In Step 2, the facilitator:

1. Introduces the Baseline Risk Level data entry form (Form 3):
 - Highlighting that the form uses the same four qualitative descriptors, A to D, as in Book 2:
 - Very benign, best-case scenario
 - Relatively less risky, intermediate descriptor
 - Relatively more risky, intermediate descriptor
 - Highly dangerous, worst-case scenario
 - Reiterating the importance for participants to not take into consideration any mitigation measures already implemented to reduce risk in the waterway in establishing the baseline risk values
 - Advising each Team to complete the Form by ticking the qualitative descriptor that best describes the condition in the waterway for each risk factor.
2. Assists individual Teams to complete the data entry form, where required.

Check the block that best describes the condition in this waterway

Vessel Conditions

Deep Draft Vessel Quality

- Nearly 100% of deep draft vessels operate safely
- 90% of deep draft vessels operate safely
- 80% of deep draft vessels operate safely
- 70% or fewer of deep draft vessels operate safely

Shallow Draft Vessel Quality

- Nearly 100% of shallow draft vessels operate safely
- 90% of shallow draft vessels operate safely
- 80% of shallow draft vessels operate safely
- 70% or fewer of shallow draft vessels operate safely

Commercial Fishing Vessel Quality

- Nearly 100% of commercial fishing vessels operate safely
- 90% commercial fishing vessels operate safely
- 80% of commercial fishing vessels operate safely
- 70% or fewer of commercial fishing vessels operate safely

Small Craft Quality

- Nearly 100% of small craft operate safely
- 90% of small craft operate safely
- 80% of small craft operate safely
- 70% or fewer of small craft operate safely

Figure 19 Example of completed Baseline Risk Level form (Form 3)



Teams

Each team then discusses the risks associated with each risk factor and completes the data entry form by checking the box next to the qualitative descriptor that best describes the risk level in the waterway.

4.6.2.5. Step 3. Enter data into “Bk 3 Input” spreadsheet

Once each team has completed Form 3 for each risk category, the data entry person enters the results from each team into the “Bk 3 Input” spreadsheet.



Data Entry

The data entry person enters the results from each team for each of the risk factors as follows:

- Where the first box is ticked (describing the best-case): **1** is entered into the spreadsheet
- Where the second box is ticked: **2** is entered into the spreadsheet
- Where the third box is ticked: **3** is entered into the spreadsheet
- Where the fourth box is ticked: (describing the worst-case): **4** is entered into the spreadsheet.

The output from Step 2 is a spreadsheet with the qualitative value recorded on the data entry form by each team for each of the 24 risk factors. For example, as shown in Figure 20 for the risk factor “Deep Draft Vessel Quality”, Team 1 ticked the third box, for “Shallow Draft Vessel Quality” they ticked the fourth box. For “Deep Draft Vessel Quality” Team 2 ticked the second box and Team 3 ticked the third box etc.

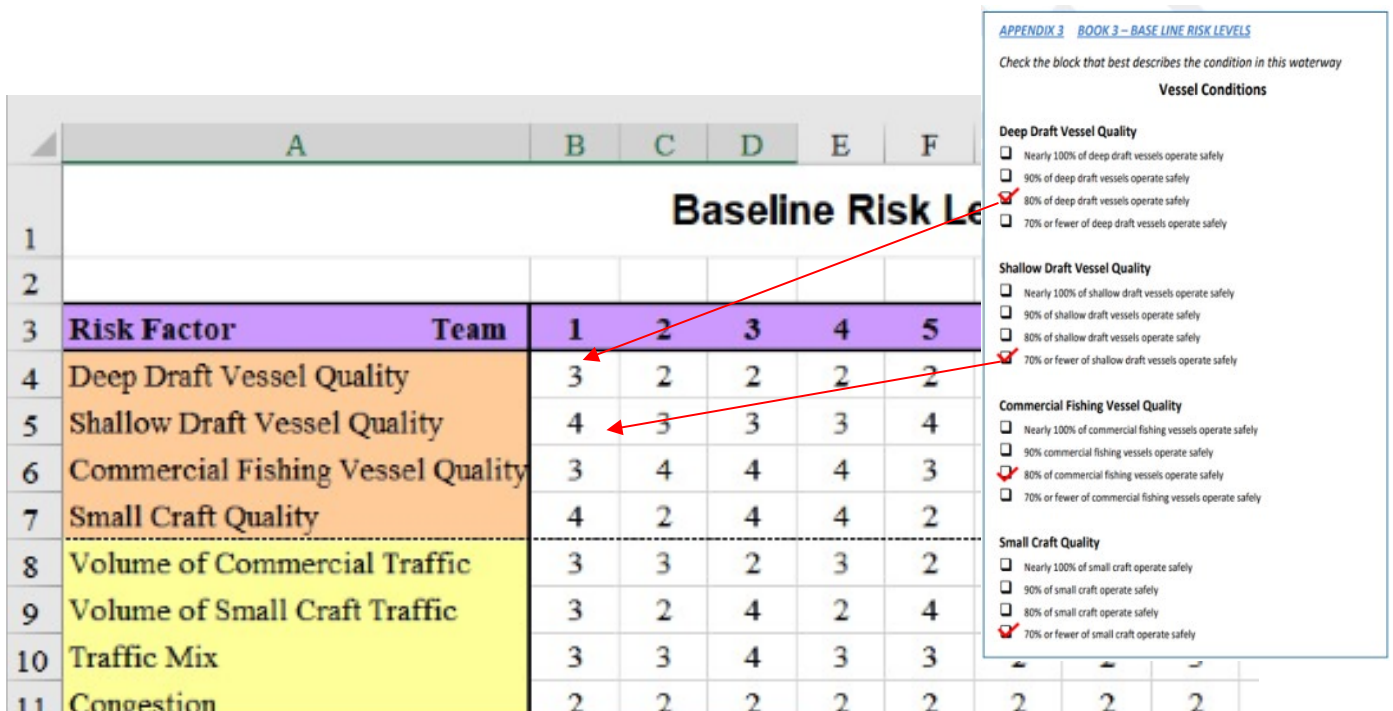


Figure 20 Example of team data entered into the “Bk3 Input” spreadsheet

4.6.2.6. Step 4. Spreadsheet Calculations

Once data entry is completed the spreadsheet generates:

1. The baseline risk value for each risk factor utilising:
 - The Baseline risk values recorded for each risk factor in Step 3 above.
 - The Teams Expertise value for each of the six risk categories established in Book 1
 - The Risk Factor Rating Scales established in Book 2

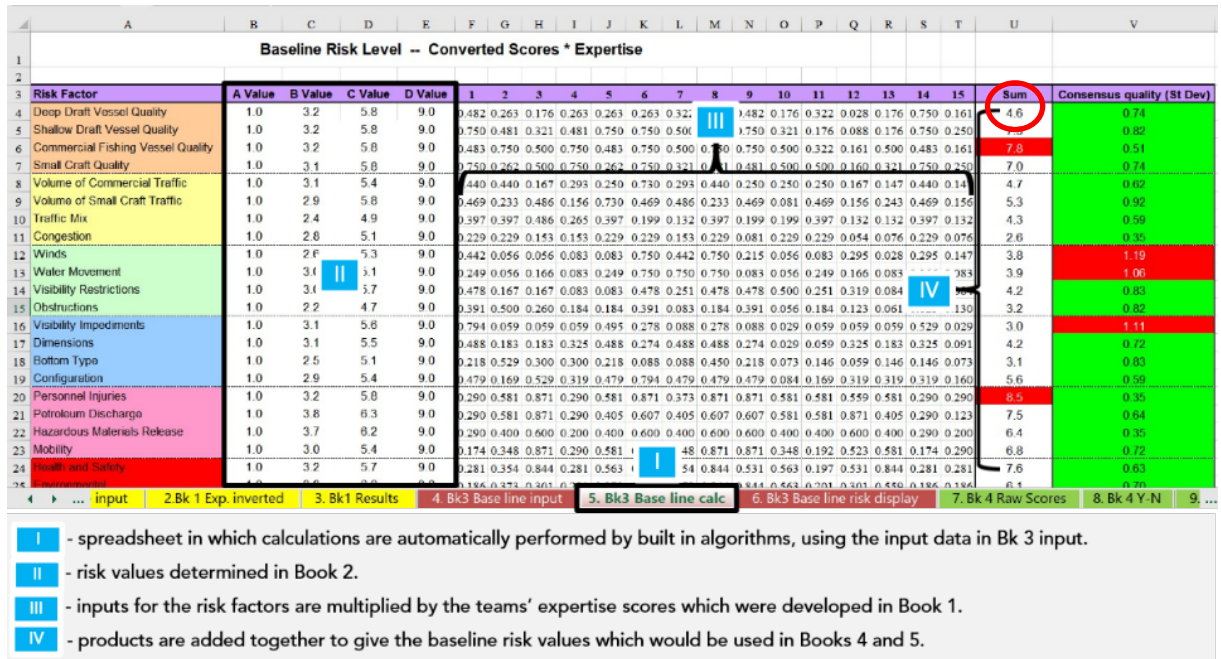


Figure 21 Example of “Bk 3 Calcs” spreadsheet indicating precedent and dependent links to other spreadsheets

For example, a baseline risk value of 4.6 was determined for “Deep Draft Vessel Quality” as shown in cell U4 in Figure 21. The values in Figure 21 are calculated by the “Bk3 Calcs” spreadsheet as described in Figure 22.

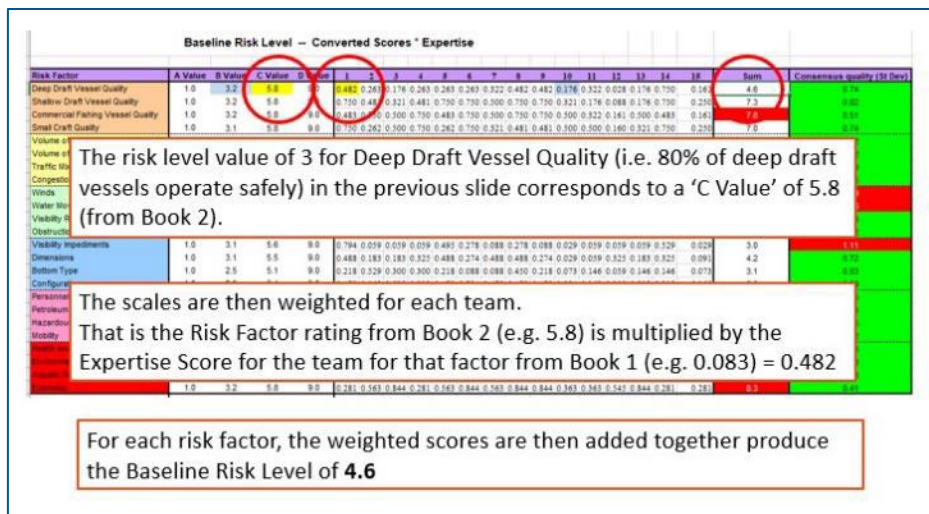


Figure 22 Explanation of “Bk3 Calcs” spreadsheet

2. The Baseline Risk Value for each risk factor, as shown in Figure 23. For example, the baseline risk level for Deep Draft Vessel Quality is 4.6.

Baseline Risk Levels					
Vessel Conditions	Traffic Conditions	Navigational Conditions	Waterway Conditions	Immediate Consequences	Subsequent Consequences
Deep Draft Vessel Quality	Volume of Commercial Traffic	Winds	Visibility Impediments	Personnel Injuries	Health and Safety
4.6	4.7	3.8	3.0	8.6	7.6
Shallow Draft Vessel Quality	Volume of Small Craft Traffic	Water Movement	Dimensions	Petroleum Discharge	Environmental
7.3	5.3	3.9	4.2	7.5	6.1
Commercial Fishing Vessel Quality	Traffic Mix	Visibility Restrictions	Bottom Type	Hazardous Materials Release	Aquatic Resources
7.8	4.3	4.2	3.1	6.4	4.5
Small Craft Quality	Congestion	Obstructions	Configuration	Mobility	Economic
7.0	2.6	3.2	5.6	6.8	8.3

Figure 23 Example of “Bk 3 Disp” spreadsheet output

4.6.2.7. Discussion Period – Output from Book 3

Facilitator

In Step 2, the facilitator briefs participants on the outcome from Book 3, highlighting:

- What the results mean:
 - 1.0 represents low risk (best-case)
 - 3.2 and 5.8 represent the mid-risk values (in the example in Figure 22)
 - 9.0 represents high-risk (worst-case)
- Drawing attention to the baseline risk values highlighted in red, that is, those risk factors which are closest to 9.0 (worst-case) and represent the risk factors which present the highest level of risk in the waterway, *not considering any action already implemented to reduce risks*.
- Opening discussion on the outcomes from Book 3 to ensure a common understanding of the results before proceeding to Book 4 – Existing Mitigation Effectiveness.

Interpreting the baseline risk levels:
4.6 represents the level of risk due to the quality of deep draft vessels in the waterway, not considering the actions already implemented to reduce this risk. 4.6 falls within the mid-risk values.

Baseline Risk Levels					
Vessel Conditions	Traffic Conditions	Navigational Conditions	Waterway Conditions	Immediate Consequences	Subsequent Consequences
Deep Draft Vessel Quality	Volume of Commercial Traffic	Winds	Visibility Impediments	Personnel Injuries	Health and Safety
4.6	4.7	3.8	3.0	8.5	7.6
Shallow Draft Vessel Quality	Volume of Small Craft Traffic	Water Movement	Dimensions	Petroleum Discharge	Environmental
7.3	5.3	3.9	4.2	7.5	6.1
Commercial Fishing Vessel Quality	Traffic Mix	Visibility Restrictions	Bottom Type	Hazardous Materials Release	Aquatic Resources
7.8	4.3	4.2	3.1	6.4	4.5
Small Craft Quality	Congestion	Obstructions	Configuration	Mobility	Economic
7.0	2.6	3.2	5.6	6.8	8.3

Figure 24 Example of Book 3

Output summary

Once discussions have run their course and the facilitator is confident a collective understanding of the process and the outcome from completing Book 3 has been achieved, participants move to Book 4.

4.7. EXISTING MITIGATION EFFECTIVENESS (BOOK 4)

4.7.1. PURPOSE

The purpose of Book 4 is to:

- Evaluate the effectiveness of risk mitigation measure already in place (such as AtoN, pilotage, local port services, etc) for each factor in the model; and
- Determine whether these measures alleviate, or at least reduce to an acceptable level, the baseline risk values determined in Book 3.

The output from Book 4 displays the Baseline Risk values from Book 3 and the Mitigation Effectiveness values generated by Book 4, as shown Figure 25. The Mitigation Effectiveness values are the risk values following the consideration of existing mitigation measures.

Book 4 output also includes a risk level “flag” that takes into account both the level of risk when existing mitigation is considered, and the level of consensus amongst the team participants.

	Vessel Conditions	Traffic Conditions	Navigational Conditions	Waterway Conditions	Immediate Consequences	Subsequent Consequences
Baseline risk	Deep Draft Vessel Quality	Volume of Commercial Traffic	Winds	Visibility Impediments	Personnel Injuries	Health and Safety
	4.6 3.5	4.7 3.9	3.8 3.2	3.0 2.6	6.5 7.4	7.6 7.2
	Balanced	Balanced	Balanced	Balanced	Maybe	Maybe
Mitigation effectiveness	Shallow Draft Vessel Quality	Volume of Small Craft Traffic	Water Movement	Dimensions	Petroleum Discharge	Environmental
	7.3 6.0	5.3 4.8	3.9 3.5	4.2 3.7	7.5 7.5	6.1 6.8
	Maybe	Maybe	Maybe	Maybe	NO	Rising
	Commercial Fishing Vessel Quality	Traffic Mix	Visibility Restrictions	Bottom Type	Hazardous Materials Release	Aquatic Resources
	7.8 6.8	4.3 4.1	4.2 3.2	3.1 3.0	6.4 6.8	4.5 4.8
	NO	Balanced	Balanced	Balanced	NO	Rising
	Small Craft Quality	Congestion	Obstructions	Configuration	Mobility	Economic
	7.0 5.8	2.6 2.3	3.2 2.7	5.6 5.5	6.8 6.2	8.3 7.8
	Maybe	Balanced	Balanced	Maybe	Maybe	NO

Baseline risk

Mitigation effectiveness

Mitigation reduces risk to acceptable level

No majority consensus on mitigation effectiveness but risk appears to be reduced

No majority consensus but current mitigation appears to increase risk

Consensus that mitigation is not effective

Figure 25 Book 4 output

For example, in the Book 4 output in Figure 25 “Deep Draft Vessel Quality”, Baseline Risk is shown as 4.6, and the level of risk considered with mitigation in place (Mitigation Effectiveness) is 3.5. The risk level is therefore calculated to be “Balanced”, that is, the current mitigation measures are considered by more than two thirds of the team participants to be reducing the risk level for that risk factor in the waterway. Depending on the relative values of the Baseline risk and mitigation effectiveness values, the risk levels considering mitigation levels can also be considered as:

- “Maybe” – that is the risk level considering mitigation measures for the individual risk factor is less than the baseline risk, but there is not 2/3rds consensus amongst the team participants.
- “No” – that is the risk level considering mitigation measures is greater than the baseline risk, and there is over 2/3rds consensus amongst the team participants.
- “Rising” –that is the risk level considering mitigation measures is greater than the baseline risk, but there is not 2/3rds consensus amongst the team participants.

It can be seen therefore that the PAWSA process considers not only the perceived level of risk but also the extent to which the group agrees on that level. Further discussion on interpretation of Book 4 output is provided in step 5 of “Completing Book 4” below.

4.7.2. COMPLETING BOOK 4

4.7.2.1. Resources

Resources provided to complete Book 4 include:

4. Read ahead Material (see Annex B for further information)
5. Data entry form – Form 4 Mitigation Effectiveness. This form is used by participants to indicate their opinion on the effectiveness of existing mitigation (see Annex A).
6. The following spreadsheets:
 - “Bk 4 Scores” – Input sheet for effect of current mitigation and combination with team expertise
 - “Bk 4 Y-N”- Input sheet for Team view of if current mitigation is adequate and combination with team expertise
 - “Bk 4 Rslts” – Display of output from Book 4
 - “Bk 4 Disp” – Summary of “Bk 4 Rslts” displayed with Book 3 Baseline Risk values

4.7.2.2. Process

Steps in completing Book 4 include:

- *Step 1. Prepare the data entry forms*
- *Step 2. Establish collective understanding of Book 4*
- *Step 2. Complete data entry forms.*
- *Step 3. Enter data into workbook*
- *Step 4. Spreadsheet calculations*
- *Step 5. Discussion period – Output from Book 4*

4.7.2.3. Step 1. Prepare the data entry forms

Facilitator



Form 4 – Mitigation Effectiveness displays a graduated scale from 1 to 9 for each risk factor. The facilitation team prepares the data entry form, Form 4, by marking a red vertical line representing the Baseline Risk value established in Book 3 on blank copies of Form 4 as shown in Figure 26 and providing these forms to each team:

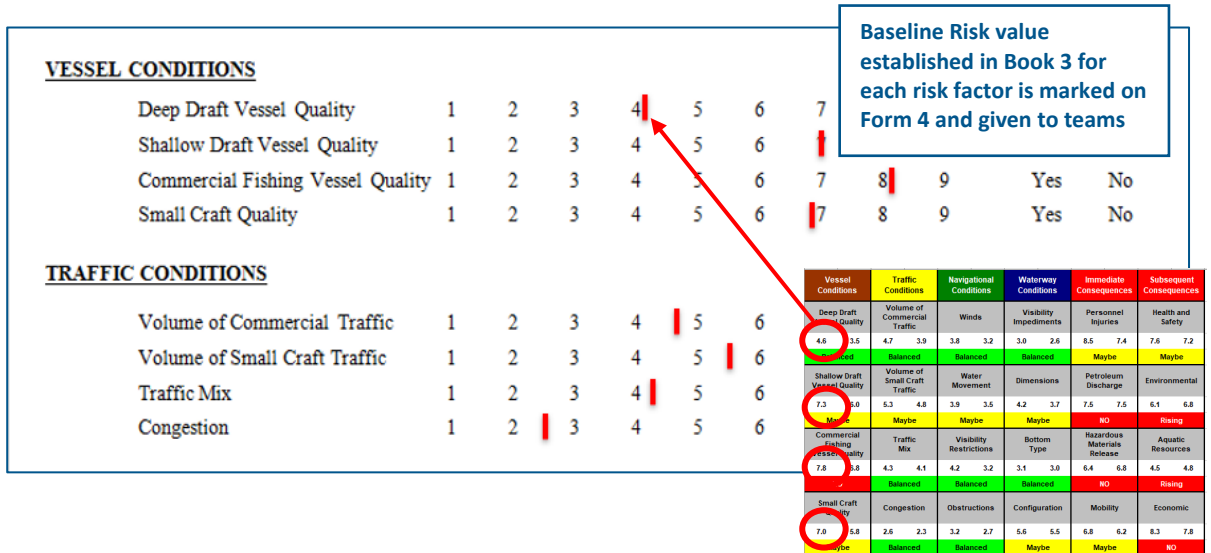


Figure 26 Example of how cores are marked on

On completion of this task, the completed Form 4s are provided to the Facilitator for use in Step 2.

4.7.2.4. Step 2 – Discussion Period – Introduction to Book 4

Key to achieving consensus in evaluating the effectiveness of existing mitigation measures is the discussion that immediately precedes participants completing Form 4. These discussions focus on:

- The specifics of what has been done to reduce the risk associated with a particular factor.
- The effectiveness of those mitigation actions.
- Whether existing mitigations reduce the baseline risk value to an acceptable level.

Again, participants will often refer to the Waterway Profile Material provided in the read-ahead material (see Annex B), particularly:

- Waterway Casualty history
- Pollution spill history
- Waterway characteristics / Navigational attributes
- Volume of traffic
- Categories of vessels
- Distribution of vessel transits by category of vessel
- Distribution of cargo tonnage



Facilitator

In Step 1, the facilitator:

1. Introduces Book 4, highlighting:
 - its purpose; and
 - the steps involved in completing Book 4.
2. Facilitates a period of general discussion on the on the waterway risk factors, encouraging active engagement by all participants, and guides participants to discuss (and sometimes debate) their perspectives about the existing mitigation measures and their effectiveness, focussing on:
 - the specifics of what has been done to reduce the risk associated with a particular factor;
 - the effectiveness of those mitigation actions; and
 - whether existing mitigations reduce the baseline risk value to an acceptable level.

Once discussions have run their course and the facilitator is confident a collective understanding of the process has been achieved, participants move to Step 3.

4.7.2.5. Step 3. Complete data entry form – Form 4

Each team discusses the effectiveness of existing mitigation measures and completes Form 4 for each of the four qualitative descriptors presented for the 24 risk factors.



Teams

In Step 3, the participants complete Form 4 by:

- Circling a number on the 1 to 9 scale presented on Form 4, which, in their opinion, reflects the effectiveness of existing mitigations in addressing the mitigating the baseline risk values established in Book 3 (That is, the red vertical line marked on Form 4 for each risk factor by the facilitation team in Step 2 above).

In particular it should be noted that:

- In most cases, participants will circle a number on the 1 to 9 scale to the left of the highlighter mark denoting the Book 3 result. That is, the baseline risk value has been reduced by existing mitigation measures.
- However, if they conclude that existing mitigation measures are having no effect on reducing the baseline risk value, they will circle the Book 3 result mark.
- Though unusual, participants might state (and then evaluate) that existing mitigations actually increase the risk for some factor(s). For example, while discussing the Dimensions risk factor, participants cite as an existing risk mitigation strategy that a range light has been established to help waterway users keep from running aground in a narrow channel, but state that the range is out of alignment with the channel, thereby increasing the risk of groundings. They then could evaluate the effect of that mitigation by circling a higher number (i.e., to the right) of the Book 3 result mark.
- Making a subjective evaluation as to whether they consider the baseline risks to be adequately balanced by the existing mitigation measures for each factor.

They do this by circling “Yes” or “No”, depending on whether they think risks the existing mitigations for each factor alleviate, or at least reduce the baseline risk to an acceptable level.

An example of the completed Form 4 is shown in Figure 27.

	Mitigation Effectiveness risk value				Baseline risk value						
VESSEL CONDITIONS											
Deep Draft Vessel Quality	1	2	3	4	5	6	7	8	9	Yes	No
Shallow Draft Vessel Quality	1	2	3	4	5	6	7	8	9	Yes	No
Commercial Fishing Vessel Quality	1	2	3	4	5	6	7	8	9	Yes	No
Small Craft Quality	1	2	3	4	5	6	7	8	9	Yes	No
TRAFFIC CONDITIONS											
Volume of Commercial Traffic	1	2	3	4	5	6	7	8	9	Yes	No
Volume of Small Craft Traffic	1	2	3	4	5	6	7	8	9	Yes	No
Traffic Mix	1	2	3	4	5	6	7	8	9	Yes	No
Congestion	1	2	3	4	5	6	7	8	9	Yes	No

Figure 27 Example of completed Form 4

4.7.2.6. Step 4. Data Entry

Once each team has completed Form 4, the data entry person enters the results from each team into the “Bk 4 Scores” spreadsheet.



Data Entry

The data entry person enters:

- The numbers circled by the teams for each risk factor into the “Bk 4 Scores” spreadsheet, with two exceptions:
 - If the Team circles the space between two whole numbers, the entry is invalid and the team is required to reassess providing a whole number entry; and
 - If the Team circles the Book 3 result mark, a lower case “e” is entered and the computer algorithms convert that entry into the Book 3 results value.
- The Yes/No answers as lower case “y” or “n” provided in response to whether they consider the existing mitigations for each factor alleviate, or at least reduce the baseline risk to an acceptable level, the

Mitigation Effectiveness -- Scores																
Risk Factor	Team	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Deep Draft Vessel Quality		5	4	3	3	3	6	4	8	3	3	3	4	3	3	3
Shallow Draft Vessel Quality		7	6	7	6	7	7	6	7	7	8	8	6	5	6	8
Commercial Fishing Vessel Quality		7	8	7	8	8	8	7	8	7	8	7	8	8	8	8
Small Craft Quality		8	6	7	6	6	7	7	7	6	7	6	6	6	6	7
Volume of Commercial Traffic		6	5	3	3	4	5	5	5	4	4	4	4	4	3	4
Volume of Small Craft Traffic		5	5	4	4	4	6	6	5	7	5	4	5	4	4	7
Traffic Mix		4	4	4	4	4	4	6	5	4	4	5	4	5	4	4
Congestion		4	2	3	2	2	3	5	2	3	2	2	2	3	2	2
Winds		4	3	3	2	3	6	5	4	3	3	3	3	3	2	3
Water Movement		6	3	3	3	4	7	5	5	3	3	3	3	3	3	3
Visibility Restrictions		4	4	4	2	3	4	5	4	3	3	3	3	4	2	3
Obstructions		4	4	3	2	2	3	4	3	3	2	2	3	3	2	2
Visibility Impediments		4	3	3	2	4	3	3	3	3	2	2	2	3	2	2
Dimensions		4	4	6	3	4	4	5	4	3	5	3	4	3	3	5
Bottom Type		3	6	4	3	2	3	3	3	3	2	3	3	3	3	2
Configuration		4	5	7	4	6	7	6	7	6	7	6	7	6	7	6
Personnel Injuries		8	4	8	6	9	9	9	9	9	9	9	9	9	9	9
Petroleum Discharge		8	7	8	7	8	8	8	8	8	8	8	8	8	8	8
Hazardous Materials Release		7	6	8	6	5	7	7	7	7	7	7	7	7	7	7
Mobility		7	7	7	6	7	7	7	7	7	7	7	7	7	7	7
Health and Safety		7	4	8	8	8	8	8	8	8	8	8	8	8	8	8

Mitigation Effectiveness -- Risks Balanced? Yes / No																
Risk Factor	Team	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Deep Draft Vessel Quality		Y	Y	Y	Y	N	N	Y	N	N	N	N	N	N	Y	Y
Shallow Draft Vessel Quality		Y	Y	N	Y	N	N	Y	N	N	N	N	N	N	Y	N
Commercial Fishing Vessel Quality		N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N
Small Craft Quality		N	Y	N	Y	Y	N	Y	N	Y	N	Y	N	Y	Y	Y
Volume of Commercial Traffic		Y	Y	Y	Y	N	Y	N	Y	N	Y	Y	Y	Y	Y	Y
Volume of Small Craft Traffic		N	Y	N	Y	Y	N	Y	N	Y	N	Y	Y	Y	Y	Y
Traffic Mix		Y	Y	N	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y
Congestion		Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Winds		Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y
Water Movement		Y	Y	Y	Y	N	N	N	N	Y	Y	Y	Y	Y	Y	Y
Visibility Restrictions		N	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Obstructions		Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y
Visibility Impediments		N	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Dimensions		N	Y	N	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y
Bottom Type		Y	N	Y	Y	N	Y	N	Y	N	Y	Y	Y	Y	Y	Y
Configuration		Y	Y	N	Y	N	N	N	N	N	Y	Y	N	Y	Y	Y
Personnel Injuries		N	Y	N	Y	Y	N	N	N	N	N	N	N	Y	Y	Y
Petroleum Discharge		N	Y	N	N	Y	N	Y	N	N	N	N	N	N	N	N
Hazardous Materials Release		N	Y	N	N	Y	N	Y	N	N	N	N	N	N	N	N
Mobility		N	Y	N	Y	Y	N	Y	N	Y	N	Y	Y	Y	Y	Y
Health and Safety		N	Y	Y	Y	N	N	Y	N	Y	Y	Y	Y	Y	Y	Y
Environmental		N	Y	Y	N	Y	N	Y	N	Y	N	Y	Y	Y	Y	N
Aquatic Resources		Y	Y	N	Y	Y	N	N	N	N	N	N	N	N	N	N
Economic		N	N	N	Y	N	N	Y	N	N	N	N	N	N	N	Y

Figure 28 Example of Mitigation Effectiveness risk values and “Balanced Y/N” data entry

The output from Step 4 is a spreadsheet capturing the qualitative values that were recorded on the Form 4 by each team for each of the 24 risk factors, see Figure 28. For example, for the risk factor “*Volume of Commercial Traffic*”, Team 1 circled the 4, Team 2 circled the 4 and Team 5 circled the 5; all teams circled “*Yes*” in answer to the “*Risks Balanced Yes/No?*” question.

4.7.2.7. Step 4. Spreadsheet calculations

Once the data entry is completed in Step 3, the spreadsheet:

- Generates the mitigation effectiveness value for each risk factor by:
 - Weighting the values each team circled on the 1 to 9 scale to the left of the highlighter mark denoting the Book 3 by multiplying the value by the Teams Expertise from Book 1.
 - Summing the weighted results for each team for each of the risk factors to provide the risk mitigation value.

as shown in Figure 29:

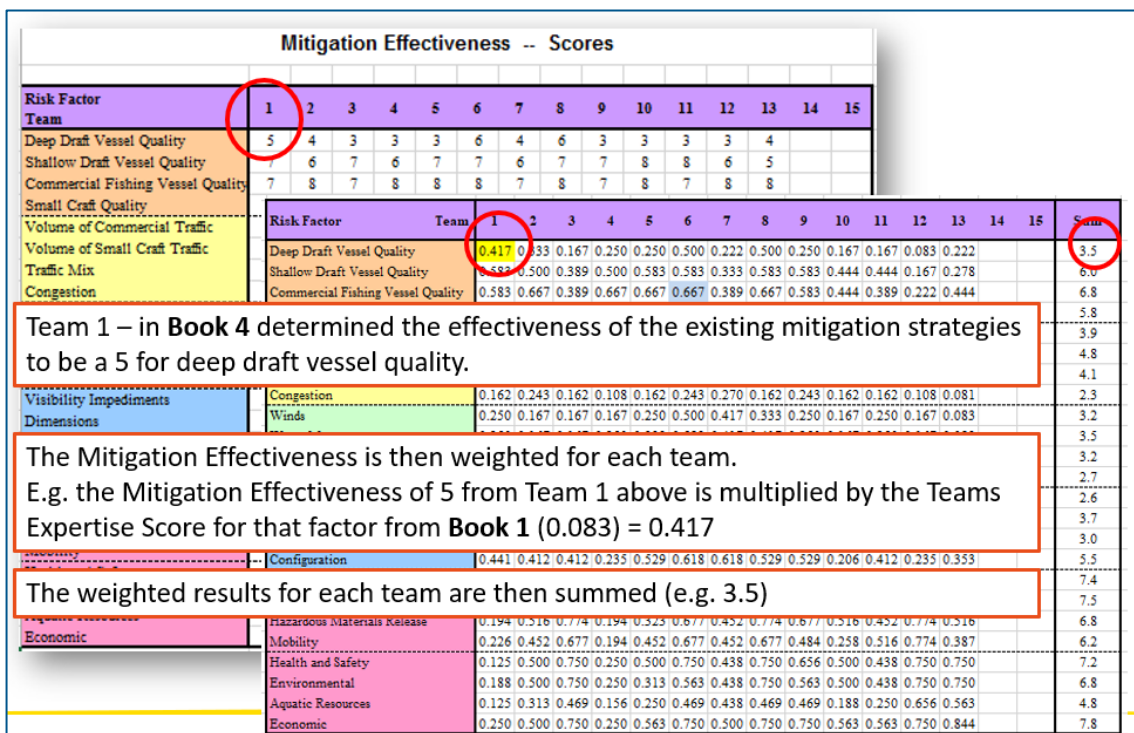


Figure 29 Example of Book 4 Mitigation Effectiveness risk value calculation

Mitigation Effectiveness -- Risks Balanced? Yes / No																					
Risk Factor	Team	1	2	3	Expertise * Risks Balanced? Yes / No										Expertise Sum						
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	YES	NO			
Deep Draft Vessel Quality	Y	Y	Y	Y	0.08	0.08	0.06	0.08	0.08	(0.08)	0.06	(0.08)	0.08	0.06	0.06	0.03	0.06	0.08	0.03	0.83	(0.17)
Shallow Draft Vessel Quality	Y	Y	N	N	0.08	0.08	(0.06)	0.08	(0.08)	(0.08)	0.06	(0.08)	(0.06)	(0.06)	(0.03)	0.06	0.08	(0.03)	0	(1)	
Commercial Fishing Vessel Quality	N	N	N	N	(0.08)	(0.08)	(0.06)	(0.08)	(0.08)	0.06	(0.06)	(0.08)	(0.06)	(0.06)	(0.03)	0.06	(0.08)	(0.03)	0	(1)	
Small Craft Quality	N	Y	N	N	(0.08)	0.08	(0.06)	0.06	0.06	(0.08)	0.06	(0.08)	0.06	(0.06)	0.06	0.03	0.06	0.06	(0.03)	1	(0)
Volume of Commercial Traffic	Y	Y	Y	Y	0.08	0.08	0.05	0.05	0.08	(0.08)	0.05	(0.08)	0.06	0.08	0.05	0.03	0.06	0.03	1	(0)	
Volume of Small Craft Traffic	N	Y	N	N	(0.08)	0.08	(0.05)	0.05	0.08	(0.08)	0.05	(0.08)	0.08	0.08	0.05	0.03	0.08	0.03	1	(0)	
Traffic Mix	Y	Y	N	N	0.08	0.08	(0.05)	0.05	0.08	(0.08)	0.05	(0.08)	0.08	0.08	0.05	0.03	0.08	0.03	1	(0)	
Congestion	Y	Y	Y	Y	0.08	0.08	0.05	0.05	0.08	(0.08)	0.05	(0.08)	0.08	0.08	0.05	0.03	0.08	0.03	1	(0)	
Winds	Y	Y	Y	Y	0.08	0.08	(0.05)	0.05	0.08	(0.08)	0.05	(0.08)	0.08	0.08	0.05	0.03	0.08	0.03	1	(0)	
Water Movement	Y	Y	Y	Y	0.08	0.08	0.05	0.05	0.08	(0.08)	0.05	(0.08)	0.08	0.08	0.05	0.03	0.08	0.03	1	(0)	
Visibility Restrictions	N	Y	Y	Y	0.08	0.06	0.06	0.08	0.08	(0.08)	0.08	0.08	0.06	0.08	0.06	0.03	0.06	0.03	1	(0)	
Obstructions	Y	Y	Y	Y	0.08	0.06	0.06	0.08	0.08	(0.08)	0.08	0.08	0.06	0.08	0.06	0.03	0.06	0.03	1	(0)	
Visibility Impediments	N	Y	Y	Y	(0.08)	0.06	0.06	0.08	0.08	(0.08)	0.08	0.08	0.06	0.08	0.06	(0.03)	0.06	0.03	1	(0)	
Dimensions	N	Y	Y	Y	(0.09)	0.06	0.06	0.06	0.09	(0.09)	0.09	0.09	0.03	0.06	0.06	0.06	0.06	0.03	1	(0)	
Bottom Type	Y	Y	N	N	(0.09)	0.06	(0.06)	0.06	0.09	(0.09)	0.09	(0.09)	0.09	0.03	0.06	0.06	0.06	0.03	1	(0)	
Configuration	Y	Y	N	N	0.09	(0.06)	0.06	0.06	0.09	(0.09)	0.09	(0.09)	0.09	0.03	0.06	0.06	0.06	0.03	1	(0)	
Personnel Injuries	N	Y	N	N	0.09	0.06	(0.06)	0.06	(0.09)	(0.09)	(0.09)	(0.09)	0.09	0.03	(0.06)	0.06	0.06	0.03	1	(0)	
Petroleum Discharge	N	N	N	N	(0.03)	0.06	(0.10)	0.03	0.06	(0.10)	(0.06)	(0.10)	(0.06)	(0.06)	0.10	0.06	0.03	(0.03)	0	(1)	
Hazardous Materials Release	N	Y	N	N	(0.03)	(0.06)	(0.10)	(0.03)	0.06	(0.10)	0.06	(0.10)	(0.06)	(0.06)	(0.10)	(0.06)	(0.03)	(0.03)	0	(1)	
Mobility	N	Y	N	N	(0.03)	0.06	(0.10)	(0.03)	0.06	(0.10)	0.06	(0.10)	(0.06)	(0.06)	(0.10)	(0.06)	(0.03)	(0.03)	0	(1)	
Health and Safety	N	Y	Y	Y	(0.03)	0.06	(0.10)	0.03	0.06	(0.10)	0.06	(0.10)	0.06	(0.06)	(0.10)	0.06	0.03	0.03	1	(0)	
Environmental	N	Y	Y	Y	(0.03)	0.06	0.09	0.03	(0.06)	(0.09)	0.06	(0.09)	0.06	(0.06)	(0.09)	(0.09)	0.03	0.03	0	(1)	
Aquatic Resources	Y	Y	N	N	(0.03)	0.06	0.09	0.03	0.06	(0.09)	0.06	(0.09)	0.09	(0.06)	(0.09)	(0.09)	0.03	(0.03)	0	(1)	
Economic	N	N	N	N	(0.03)	0.06	(0.09)	0.03	(0.06)	(0.09)	0.06	(0.09)	(0.09)	(0.06)	(0.09)	(0.09)	0.03	(0.03)	0	(1)	

TEAM	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Average	Consensus
Count: Yes	11	20	11	20	18	1	19	5	17	15	15	15	16	20	15	15	9.66
Count: No	13	4	13	4	6	23	5	19	7	9	9	9	8	4	9	9	13.40
Consensus Alert		Alert		Alert		Alert		Alert							Alert		

S4 to AG27 is a copy of Bk 1 results - but N gets a 0 value
 Alert if a team's number of Yes votes is more than 1 ST DEV away from average no. of all Yes votes.
 Good to know which teams have different views

Figure 30 Example of Book 4 Risks Balanced? Yes/No calculation

Similarly, as shown in Figure 30 the spreadsheet combines the Yes/No data entry with the expertise values and summarizes how well each team voted with respect to whether existing mitigations are well balanced with the risks for all 24 risk factors in the Waterway Risk Model.

A consensus alert shows a yellow highlight if a team's number of Yes votes is more than one standard deviation from the average number of Yes votes for all teams.

2. Produces the results and display tables

The results table:

- Displays the Baseline Risk value from Book 3.
- Displays the Mitigation Effectiveness values from Step 4 above.
- Displays the standard deviation of the mitigation effectiveness score for each risk factor and flags it as yellow where this is greater than one and red where it is greater than two.
- Flags whether the teams consider the existing mitigation measures are alleviating, or at least reducing the Baseline Risk values to an acceptable level, and indicates the level of consensus, by flagging the risk factors as:
 - **BALANCED** – That is, two thirds or more of the teams consider the risk to be adequately balanced (i.e., they entered “Yes”).
 - **NO** – That is, two thirds or more of the teams consider the risk NOT to be adequately balanced (i.e., they entered “No”).
 - **MAYBE** – Where there is less than two thirds consensus about the efficacy of existing mitigations BUT the current Mitigation Effectiveness risk is lower than the Baseline Risk value then a “Maybe” is displayed.
 - **RISING** – Where current Mitigation Effectiveness risk level is evaluated as being HIGHER than the baseline risk value from Book 3

An example of the results table from Book for is shown in Figure 31 (see also 4.7.1.).

Mitigation Effectiveness Results							
Risk Factor	Book 3	Book 4	Mitigation Effectiveness Scores Standard Deviation	Risks Balanced?		Consensus?	
	Baseline Risk Levels	Mitigation Effectiveness		Yes	No		
Deep Draft Vessel Quality	4.6	3.9	1.1	0.83	0.17	Balanced	
Shallow Draft Vessel Quality	7.3	6.7	0.9	0.44	0.56	Maybe	
Commercial Fishing Vessel Quality	7.9	7.7	0.5	0.08	0.92	NO	
Small Craft Quality	7.0	6.5	0.6	0.61	0.39	Maybe	
Volume of Commercial Traffic	4.7	4.2	0.7	0.84	0.16	Balanced	
Volume of Small Craft Traffic	5.3	5.3	1.1	0.70	0.30	Balanced	
Traffic Mix	4.4	4.6	0.8	0.78	0.22	RISING	
Congestion	2.6	2.5	0.9	0.92	0.08	Balanced	
Winds	3.8	3.4	1.1	0.92	0.08	Balanced	
Water Movement	4.0	3.8	1.2	0.67	0.33	Balanced	
Visibility Restrictions	4.3	3.4	0.8	0.83	0.17	Balanced	
Obstructions	3.4	2.8	0.9	0.89	0.11	Balanced	
Visibility Impediments	3.0	2.8	0.6	0.82	0.18	Balanced	
Dimensions	4.3	4.1	1.0	0.68	0.32	Balanced	
Bottom Type	3.1	3.2	1.0	0.76	0.24	RISING	
Configuration	5.6	6.0	1.2	0.53	0.47	RISING	
Personnel Injuries	8.5	7.9	1.6	0.35	0.65	Maybe	
Petroleum Discharge	7.5	8.0	0.8	0.13	0.87	RISING	
Hazardous Materials Release	6.4	7.3	1.0	0.19	0.81	RISING	
Mobility	6.8	6.5	1.3	0.52	0.48	Maybe	
Health and Safety	7.6	7.7	1.1	0.38	0.63	RISING	
Environmental	6.2	7.3	1.1	0.38	0.63	RISING	
Aquatic Resources	4.6	5.1	1.2	0.38	0.63	RISING	
Economic	8.3	8.3	0.5	0.19	0.81	NO	
			Balanced	Maybe	NO	RISING	
Averages & Counts		5.5	5.4	10	4	2	8

Figure 31 Example of Book 4 Mitigation Effectiveness results table

Book 4 also includes an additional sheet that produces a display table to mirror the Book 3 Baseline Risk table. This allows direct visual comparison between the Baseline risk levels and the Mitigation Effectiveness risk levels and displays the risk level status flags referred to above – see Figure 32.

Vessel Conditions	Traffic Conditions	Navigational Conditions	Waterway Conditions	Immediate Consequences	Subsequent Consequences
Deep Draft Vessel Quality	Volume of Commercial Traffic	Winds	Visibility Impediments	Personnel Injuries	Health and Safety
4.6 3.5	4.7 3.9	3.8 3.2	3.0 2.6	8.5 7.4	7.6 7.2
Balanced	Balanced	Balanced	Balanced	Maybe	Maybe
Shallow Draft Vessel Quality	Volume of Small Craft Traffic	Water Movement	Dimensions	Petroleum Discharge	Environmental
7.3 6.0	5.3 4.8	3.9 3.5	4.2 3.7	7.5 7.5	6.1 6.8
Maybe	Maybe	Maybe	Maybe	NO	Rising
Commercial Fishing Vessel Quality	Traffic Mix	Visibility Restrictions	Bottom Type	Hazardous Materials Release	Aquatic Resources
7.8 6.8	4.3 4.1	4.2 3.2	3.1 3.0	6.4 6.8	4.5 4.8
NO	Balanced	Balanced	Balanced	NO	Rising
Small Craft Quality	Congestion	Obstructions	Configuration	Mobility	Economic
7.0 5.8	2.6 2.3	3.2 2.7	5.6 5.5	6.8 6.2	8.3 7.8
Maybe	Balanced	Balanced	Maybe	Maybe	NO

Figure 32 Example of Book 4 display table

4.7.2.8. Step 5: Discussion Period – Output from Book 4

Facilitator

In Step 2, the facilitator briefs participants on the outcome from Book 4:

- Providing an overview of the output table, describing:
 - The baseline risk values, and the mitigation effectiveness values displayed for each risk factor.
 - The flags displayed with regards to the team consensus on the efficacy of the mitigation measures (Balanced, Maybe, No or Rising)

This often requires reiterating how the values were calculated on the basis of consensus (2/3) of the teams from the Y/N responses on the data entry form.
- Drawing attention to the four flags and what they mean:
 - **BALANCED** – Where 2/3 or more of the teams consider the baseline risk to be adequately mitigated by the existing mitigation measures (i.e., they entered “Yes” in Book 4) there is generally little further discussion on these factors for the remainder of the workshop.
 - **NO** – Where 2/3 or more of the teams consider the baseline risk to NOT be adequately mitigated (i.e. they entered “No”) and participants will be invited to discuss these risk factors further in Book 5.
 - **MAYBE** – Highlights there is not consensus regarding the efficacy of existing mitigation measures (i.e., less than 2/3 entered a “Yes” in Form 4) and participants will be invited to discuss these risk factors further in Book 5.
 - **RISING** – Highlights the present risk level is evaluated as being HIGHER than the baseline risk value from Book 3 OR where the Mitigation Effectiveness risk levels from a previous PAWSA are included and are less than the current PAWSA Mitigation Effectiveness risk levels.
- Opening discussion on the outcomes from Book 4 to ensure a collective understanding of the results, focussing on the risk factors the baseline risk value has not been alleviated, or at least reduced to an acceptable level. That is, those flagged as:
 - **NO**
 - **MAYBE**
 - **RISING**

Once discussions have run their course and the facilitator is confident a collective understanding of the process and the outcome from completing Book 4 has been achieved, participants move to Book 5 Additional Mitigations.

4.8. ADDITIONAL MITIGATIONS (POTENTIAL MITIGATION MEASURES) (BOOK 5)

4.8.1. PURPOSE

The purpose of Book 5 is to:

- Identify potential mitigation measures to address the risk factors identified in Book 4, where existing mitigation measures are not alleviating, or at least reducing, the risk to an acceptable level.
- Assess the effectiveness of the identified potential mitigation measures to reduce risk.

The output from Book 5 displays (Figure 33)

- Potential mitigation measures identified by participants to reduce risk in the waterway.
- The effectiveness of those measures in further reducing risk levels (by display of a revised figure)
- Identification where there may be a lack of consensus or agreement on the most effective mitigation figures (by display of a yellow caution flag).

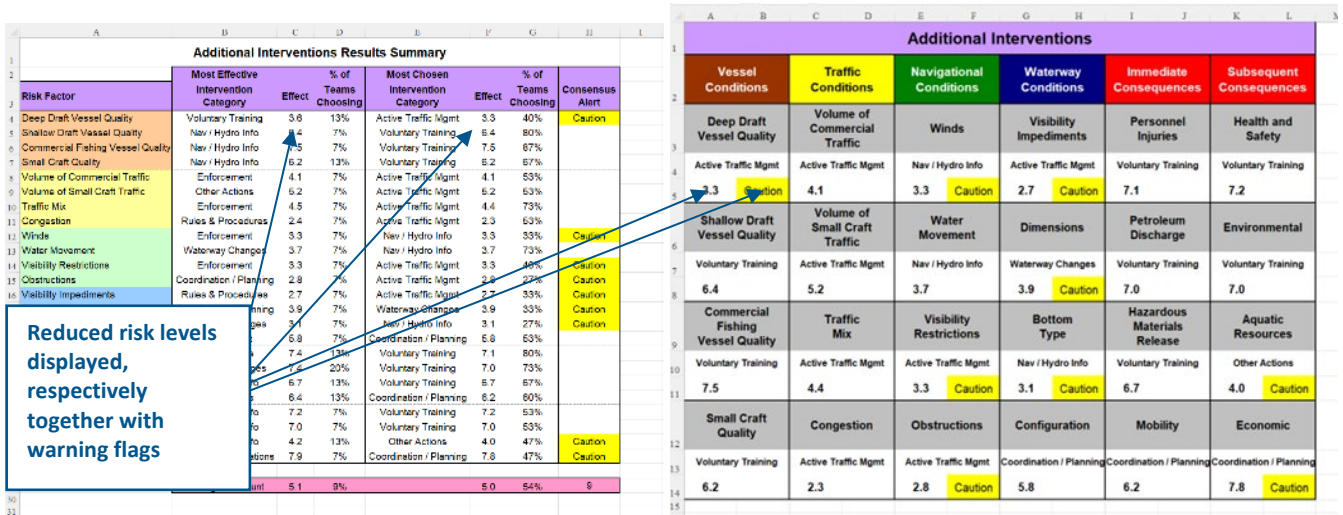


Figure 33 Example of Book 5 Results summary and output tables

4.8.2. COMPLETING BOOK 5

4.8.2.1. Resources

Resources provided to complete Book 5 include:

1. Read ahead Material (Refer to Annex B)
2. Data entry form Form 5 Additional Mitigations. This form provides participants a means of indicating which category of potential mitigation measure might be most effective to alleviating, or at least reducing, the risk to an acceptable level.
3. The following spreadsheets:
 - “Bk 5 Input” – Input sheet to score predicted efficacy of additional mitigation measures
 - “Bk 5 Calcs” - Numerical display of results including the “Most Chosen” and “Most Effective” risk mitigation measures
 - “Bk 5 Rslts” – Summary of “Bk 5 Calcs” with indication of where results should be treated with caution
 - “Bk 5 Disp” – Summary of “Most Chosen” additional risk mitigation measures with indication of where results should be treated with caution

4.8.2.2. Process

Steps in completing Book 5 include:

- Step 1 - Prepare the data entry forms
- Step 2 - Discussion period - Introduction to Book 5.
- Step 3 - Complete data entry form.
- Step 4 - Data entry
- Step 5 - Spreadsheet calculations
- Step 6 - Discussion period – Output from Book 5

4.8.2.3. Step 1 Prepare the data entry forms

Facilitation Team

The facilitation team prepares Form 5 by marking a vertical line to highlight the risk mitigation value for those risk factors identified in Book 4 where existing mitigation measures were not alleviating, or

at least reducing the risk to an acceptable level. That is, the risk factors flagged as “NO”, “RISING”, or “MAYBE”.

Vessel Conditions		Traffic Conditions		Navigational Conditions		VESSEL CONDITIONS								
Deep Draft Vessel Quality		Volume of Commercial Traffic		Winds		1	2	3	4	5	6	7	8	9
4.6	3.5	4.7	3.9	3.8	3.2	1	2	3	4	5	6	7	8	9
Balanced		Balanced		Balanced		1	2	3	4	5	6	7	8	9
Shallow Draft Vessel Quality		Volume of Small Craft Traffic		Water Movement		1	2	3	4	5	6	7	8	9
7.3	6.0	5.3	4.8	3.9	3.5	1	2	3	4	5	6	7	8	9
Maybe		Maybe		Maybe		1	2	3	4	5	6	7	8	9
Commercial Fishing		Traffic		Visibility		1	2	3	4	5	6	7	8	9

Shallow Draft Vessel Quality		VESSEL CONDITIONS								
Co-ordination / Planning	_____	1	2	3	4	5	6	7	8	9
Voluntary Training	_____	1	2	3	4	5	6	7	8	9
Rules & Procedures	_____	1	2	3	4	5	6	7	8	9
Enforcement	_____	1	2	3	4	5	6	7	8	9
Nav / Hydro Info	_____	1	2	3	4	5	6	7	8	9
Radio Communications	_____	1	2	3	4	5	6	7	8	9
Active Traffic Mgmt	_____	1	2	3	4	5	6	7	8	9
Waterway Changes	_____	1	2	3	4	5	6	7	8	9
Other Actions	_____	1	2	3	4	5	6	7	8	9

Commercial Fishing Vessel Quality		VESSEL CONDITIONS								
Co-ordination / Planning	_____	1	2	3	4	5	6	7	8	9

Figure 34 Example of Form 5 annotation with non-“Balanced” risk levels

An example of the annotated Form 5 together with the corresponding Book 4 output is shown in Figure 34

Once completed the Book 5 Data Entry Form is handed out to participants for use in Step 2.

4.8.2.4. Step 2. Discussion Period - Introduction to Book 5.

Key to identifying potential mitigation measures and achieving consensus on their effectiveness is the discussion that immediately precedes the teams completing Form 5. This discussion focus on:

- The risk factors identified in Book 4 where existing mitigation measures were not alleviating, or at least reducing, the risk to an acceptable level. That is, the risk factors flagged as “NO”, “RISING”, or “MAYBE”.
- Participants offering further ideas about what could be done to reduce risk for these factors and, in particular, what specific measures they consider could alleviate, or at least reduce the risk to an acceptable level.

As in Books 2, 3 and 4, participants will often refer to the Waterway Profile Material provided in the read-ahead material (see Annex B).



Facilitator

In step 2, the facilitator:

1. Introduces Book 5:
 - Highlighting its purpose.
 - Introducing Form 5, highlighting:

- The annotations provided by the facilitation team in Step 1 to highlight the risk factors where existing mitigation measures are not alleviating, or at least reducing the risks to an acceptable level. That is, those risk factors flagged in the Book 4 output as “NO”, “RISING”, or “MAYBE”.
 - The nine major categories of additional mitigation measures listed on the form for each of the risk factors (refer Figure 34 in step 1 above).
 - The line marked spaces adjacent to the major categories where, in Step 3, the teams are requested to enter specific measures that, in their opinion, would reduce risk.
 - The steps involved in completing Book 5.
2. Facilitates a period of general discussion on the highlighted risk factors:
- Asking participants why they believe the risks exist.
 - Asking participants to offer ideas about what should be done to reduce the risk level for each risk factor highlighted.

During the discussion period, the facilitator often needs to guide the participants through a root cause analysis by:

- Reminding participants about the specific nature of the risks that they described for a given risk factor (referring to the Book 3 discussions).
 - Reminding participants about how the risk factors highlighted on Form 5 where existing mitigation measures are not alleviating, or at least reducing the risks to an acceptable level. That is, those risk factors flagged in the Book 4 output as “NO”, “RISING”, or “MAYBE”.
 - Asking what is causing those risks, i.e., why do they exist?
 - By repeatedly asking “why?” during the discussions, participants should begin to identify the root cause of the risk scenario. Usually the root cause, when finally identified, points directly to the intervention needed to reduce the risk.
 - Summarising the risk mitigation ideas offers by participants for each of the categories on a flipchart (e.g., as 3-5 word “bullets”)
3. Once discussions have run their course and the facilitator is confident a collective understanding of the process has been achieved, participants move to Step 3.

4.8.2.5. Step 3. Complete data entry form.

Each team discusses the risk factors highlighted on Form 5 where existing mitigation measures are not alleviating, or at least reducing risk to an acceptable level, and what, in their opinion, should be done to reduce the risk, noting the discussions in Section 2 above.



Teams

In Step 3, the teams complete Form 5 by:

- Writing short phrases (3 to 5 word “bullets”) describing ideas with merit on the lines after the categories into which the ideas best fit.

For example, if the risk factor being discussed is “*Small Craft Quality*” and the idea being considered is “Mandatory boat operator licensing”, then the participants would write those words on the line next to the “*Rules & Procedures*” category under that risk factor.

- After recording each of their ideas on the form, evaluate what risk level would result from implementing their idea.

This is done by circling a number on the 1 to 9 scale next to the implementation category where the idea was written.

Note:

- The closer that circle is to 1, the more effective the team feels the idea to be.
- Where a team circles a number that incorporates the highlighter mark on the form, they will be asked to reconsider their input, as that indicates they do not expect any improvement from implementing their idea.
- An example of the completed Form 5 is shown in Figure 35.

VESSEL CONDITIONS

Deep Draft Vessel Quality

Coordination / Planning	<i>Specific action needed</i>	1	2	3	4	5	6	7	8	9
Voluntary Training		1	2	3	4	5	6	7	8	9
Rules & Procedures	<i>another action needed</i>	1	2	3	4	5	6	7	8	9
Enforcement		1	2	3	4	5	6	7	8	9
Nav / Hydro Info		1	2	3	4	5	6	7	8	9
Radio Communications		1	2	3	4	5	6	7	8	9
Active Traffic Mgmt		1	2	3	4	5	6	7	8	9
Waterway Changes		1	2	3	4	5	6	7	8	9
Other Actions		1	2	3	4	5	6	7	8	9

Shallow Draft Vessel Quality

Coordination / Planning		1	2	3	4	5	6	7	8	9
Voluntary Training	<i>Colregs, communication etc.</i>	1	2	3	4	5	6	7	8	9
Rules & Procedures		1	2	3	4	5	6	7	8	9
Enforcement	<i>action needed</i>	1	2	3	4	5	6	7	8	9
Nav / Hydro Info		1	2	3	4	5	6	7	8	9
Radio Communications		1	2	3	4	5	6	7	8	9
Active Traffic Mgmt		1	2	3	4	5	6	7	8	9
Waterway Changes		1	2	3	4	5	6	7	8	9
Other Actions		1	2	3	4	5	6	7	8	9

Figure 35 Example of completed Form 5

4.8.2.6. Step 4. Data entry



Data Entry

Once each team has completed the Form 5s, the data entry person enters the numbers circled by the teams for each risk factor into the “Bk 5” Input spreadsheet.

An example of the completed spreadsheet is shown at Figure 36.

VESSEL CONDITIONS

Deep Draft Vessel Quality

Coordination / Planning	<i>Specific action needed</i>	1	2	3	4	5	6	7	8	9
Voluntary Training		1	2	3	4	5	6	7	8	9
Rules & Procedures	<i>another action needed</i>	1	2	3	4	5	6	7	8	9
Enforcement		1	2	3	4	5	6	7	8	9
Nav / Hydro Info		1	2	3	4	5	6	7	8	9
Radio Communications		1	2	3	4	5	6	7	8	9
Active Traffic Mgmt		1	2	3	4	5	6	7	8	9
Waterway Changes		1	2	3	4	5	6	7	8	9
Other Actions		1	2	3	4	5	6	7	8	9

Shallow Draft Vessel Quality

Coordination / Planning		1	2	3	4	5	6	7	8	9
Voluntary Training	<i>Colregs, communication etc.</i>	1	2	3	4	5	6	7	8	9
Rules & Procedures		1	2	3	4	5	6	7	8	9
Enforcement	<i>action needed</i>	1	2	3	4	5	6	7	8	9
Nav / Hydro Info		1	2	3	4	5	6	7	8	9
Radio Communications		1	2	3	4	5	6	7	8	9
Active Traffic Mgmt		1	2	3	4	5	6	7	8	9
Waterway Changes		1	2	3	4	5	6	7	8	9
Other Actions		1	2	3	4	5	6	7	8	9

Additional Interventions -- Scores

Intervention Category	Team	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Coordination / Planning																
Voluntary Training		2	2						2							3
Rules & Procedures			2													3
Enforcement			3						1							3
Nav / Hydro Info																3
Radio Communications					2											3
Active Traffic Mgmt			2						2							3
Waterway Changes																3
Other Actions			2						2							2
Coordination / Planning		4										6		4		6
Voluntary Training			4	4	5			5	4	6	4	4	4	4		3
Rules & Procedures									4						6	4
Enforcement				4	5	4					6				4	4
Nav / Hydro Info																6
Radio Communications												4				6
Active Traffic Mgmt		3		4		3			4	5					3	4
Waterway Changes																5
Other Actions									5	5	4					2
Commercial Fishing Vessel Quality																5
Coordination / Planning																5
Voluntary Training		5	6	5	4	5			5	4	6	4	4	4	4	4
Rules & Procedures									5		4	6	4			4
Enforcement		4			5	4	4		5							4
Nav / Hydro Info																3
Radio Communications												3				4
Active Traffic Mgmt		2		5		4			4	5	4				3	3
Waterway Changes																4
Other Actions		5	5						4			5	4			2

Figure 36 Example of where circled figures from Form 5 are entered into spreadsheet

4.8.2.7. Step 5. Spreadsheet Calculations

Once the data entry is completed in Step 3, the spreadsheet:

- Generates the additional mitigation measures effectiveness value for each risk factor by:
 - Weighting the values that each team circled for the additional mitigation measures on the 1 to 9 scale by multiplying the value by the Teams Expertise from Book 1.
 - Summing the weighted results for each team for each of the risk factors to provide the additional mitigation measures effectiveness value.

as shown in Figure 37.

Mitigation Effectiveness -- Scores																	
Risk Factor	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		
Deep Draft Vessel Quality	5	4	3	3	3	6	4	6	3	3	3	3	4				
Shallow Draft Vessel Quality	7	6	7	6	7	7	6	7	7	8	8	6	5				
Commercial Fishing Vessel Quality	7	8	7	8	8	8	7	8	7	8	7	8	8				
Small Craft Quality																	
Risk Factor	Team	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Sum
Deep Draft Vessel Quality		0.417	0.333	0.167	0.250	0.250	0.500	0.222	0.500	0.250	0.167	0.167	0.083	0.222			3.5
Shallow Draft Vessel Quality		0.583	0.500	0.389	0.500	0.583	0.583	0.333	0.583	0.583	0.444	0.444	0.167	0.278			6.0
Commercial Fishing Vessel Quality		0.583	0.667	0.389	0.667	0.667	0.667	0.389	0.667	0.583	0.444	0.389	0.222	0.444			6.8
Volume of Commercial Traffic																	5.8
Volume of Small Craft Traffic																	3.9
Traffic Mix																	4.8
Congestion																	4.1
Visibility Impediments	Congestion		0.162	0.243	0.162	0.108	0.162	0.243	0.270	0.162	0.243	0.162	0.162	0.108	0.081		2.3
Dimensions	Winds		0.250	0.167	0.167	0.167	0.250	0.500	0.417	0.333	0.250	0.167	0.250	0.167	0.083		3.2
																	3.5
																	3.2
																	2.7
																	2.6
																	3.7
																	3.0
	Configuration		0.441	0.412	0.412	0.235	0.529	0.618	0.618	0.529	0.529	0.206	0.412	0.235	0.353		5.5
																	7.4
																	7.5
																	6.8
Economic	Hazardous Materials Release		0.194	0.516	0.774	0.194	0.325	0.677	0.452	0.774	0.677	0.516	0.452	0.774	0.516		6.2
	Mobility		0.226	0.452	0.677	0.194	0.452	0.677	0.452	0.677	0.484	0.258	0.516	0.774	0.387		6.2
	Health and Safety		0.125	0.500	0.750	0.250	0.500	0.750	0.438	0.750	0.656	0.500	0.438	0.750	0.750		7.2
	Environmental		0.188	0.500	0.750	0.250	0.313	0.563	0.438	0.750	0.563	0.500	0.438	0.750	0.750		6.8
	Aquatic Resources		0.125	0.313	0.469	0.156	0.250	0.469	0.438	0.469	0.469	0.188	0.250	0.656	0.563		4.8
	Economic		0.250	0.500	0.750	0.250	0.563	0.750	0.500	0.750	0.750	0.563	0.563	0.750	0.844		7.8

Figure 37 Example of how spreadsheet calculates mitigation effectiveness scores

The output from Book 5 (“Bk 5 Disp” spreadsheet) includes:

- A table, displaying:
 - The most effective additional mitigation measure
 - The most chosen additional mitigation measure
 - A consensus alert - a yellow Caution flag is displayed if the most chosen category is not the same as the most effective category AND either fewer than 50% of the teams chose the most chosen category or more than 50% of the teams chose the most effective category.
 - The presence of the yellow Caution flag for any risk factor indicates lack of consensus about the best way to achieve further risk reduction for that factor.

An example of the output table from Book for is shown in Figure 38.

Additional Interventions Results Summary							
Risk Factor	Most Effective Intervention Category	Effect	% of Teams Choosing	Most Chosen Intervention Category	Effect	% of Teams Choosing	Consensus Alert
Deep Draft Vessel Quality	Voluntary Training	3.6	13%	Active Traffic Mgmt	3.3	40%	Caution
Shallow Draft Vessel Quality	Nav / Hydro Info	6.4	7%	Voluntary Training	6.4	80%	
Commercial Fishing Vessel Quality	Nav / Hydro Info	7.5	7%	Voluntary Training	7.5	87%	
Small Craft Quality	Nav / Hydro Info	6.2	13%	Voluntary Training	6.2	67%	
Volume of Commercial Traffic	Enforcement	4.1	7%	Active Traffic Mgmt	4.1	53%	
Volume of Small Craft Traffic	Other Actions	5.2	7%	Active Traffic Mgmt	5.2	53%	
Traffic Mix	Enforcement	4.5	7%	Active Traffic Mgmt	4.4	73%	
Congestion	Rules & Procedures	2.4	7%	Active Traffic Mgmt	2.3	53%	
Winds	Enforcement	3.3	7%	Nav / Hydro Info	3.3	33%	Caution
Water Movement	Waterway Changes	3.7	7%	Nav / Hydro Info	3.7	73%	
Visibility Restrictions	Enforcement	3.3	7%	Active Traffic Mgmt	3.3	40%	Caution
Obstructions	Coordination / Planning	2.8	7%	Active Traffic Mgmt	2.8	27%	Caution
Visibility Impediments	Rules & Procedures	2.7	7%	Active Traffic Mgmt	2.7	33%	Caution
Dimensions	Coordination / Planning	3.9	7%	Waterway Changes	3.9	33%	Caution
Bottom Type	Waterway Changes	3.1	7%	Nav / Hydro Info	3.1	27%	Caution
Configuration	Enforcement	5.8	7%	Coordination / Planning	5.8	53%	
Personnel Injuries	Other Actions	7.4	13%	Voluntary Training	7.1	80%	
Petroleum Discharge	Waterway Changes	7.4	20%	Voluntary Training	7.0	73%	
Hazardous Materials Release	Nav / Hydro Info	6.7	13%	Voluntary Training	6.7	67%	
Mobility	Other Actions	6.4	13%	Coordination / Planning	6.2	60%	
Health and Safety	Nav / Hydro Info	7.2	7%	Voluntary Training	7.2	53%	
Environmental	Nav / Hydro Info	7.0	7%	Voluntary Training	7.0	53%	
Aquatic Resources	Nav / Hydro Info	4.2	13%	Other Actions	4.0	47%	Caution
Economic	Radio Communications	7.9	7%	Coordination / Planning	7.8	47%	Caution
Averages & Count		5.1	9%		5.0	54%	9

Figure 38 Example of additional intervention results summary

- A table summarising the output from Book 5, highlighting the proposed mitigation measures, their effect on reducing risk and a caution flag where there is a lack of consensus about the best way to achieve further risk reduction for that factor. An example of the output table from Book for is shown in Figure 39.

Additional Interventions					
Vessel Conditions	Traffic Conditions	Navigational Conditions	Waterway Conditions	Immediate Consequences	Subsequent Consequences
Deep Draft Vessel Quality	Volume of Commercial Traffic	Winds	Visibility Impediments	Personnel Injuries	Health and Safety
Active Traffic Mgmt 3,5	Active Traffic Mgmt 4,3	Coordination / Planning 3,4 Caution	Active Traffic Mgmt 2,8	Voluntary Training 7,1	Voluntary Training 7,0
Shallow Draft Vessel Quality	Volume of Small Craft Traffic	Water Movement	Dimensions	Petroleum Discharge	Environmental
Voluntary Training 6,4	Active Traffic Mgmt 5,2	Nav / Hydro Info 3,7	Active Traffic Mgmt 4,0 Caution	Voluntary Training 7,0	Voluntary Training 6,9
Commercial Fishing Vessel Quality	Traffic Mix	Visibility Restrictions	Bottom Type	Hazardous Materials Release	Aquatic Resources
Voluntary Training 7,5	Active Traffic Mgmt 4,5	Active Traffic Mgmt 3,3	Nav / Hydro Info 3,1 Caution	Voluntary Training 6,6	Other Actions 4,1
Small Craft Quality	Congestion	Obstructions	Configuration	Mobility	Economic
Voluntary Training 6,2	Active Traffic Mgmt 2,5	Active Traffic Mgmt 2,8 Caution	Coordination / Planning 5,9	Coordination / Planning 6,3	Coordination / Planning 7,7

Figure 39 Example of the display of risk levels with additional mitigation and "Caution"

4.8.2.8. Step 6: Discussion Period – Output from Book 5



Facilitator

In Step 5, the facilitator:

1. Briefs participants on the outcome from Book 5, highlighting:
 - The proposed additional mitigation measures identified
 - Risk factors where there is a lack of consensus about the best way to achieve further risk reduction for that factor, flagging it with a “CAUTION”
2. Opens discussion on for any risk factor flagged with “CAUTION” – a lack of consensus about the best way to achieve further risk reduction for that factor.

Additional Interventions					
Vessel Conditions	Traffic Conditions	Navigational Conditions	Waterway Conditions	Immediate Consequences	Subsequent Consequences
Deep Draft Vessel Quality	Volume of Commercial Traffic	Winds	Visibility Impediments	Personnel Injuries	Health and Safety
Active Traffic Mgmt 3,5	Active Traffic Mgmt 4,3	Coordination / Planning 3,4 Caution	Active Traffic Mgmt 2,8	Voluntary Training 7,1	Voluntary Training 7,0
Shallow Draft Vessel Quality	Volume of Small Craft Traffic	Water Movement	Dimensions	Petroleum Discharge	Environmental
Voluntary Training 6,4	Active Traffic Mgmt 5,2	Nav / Hydro Info 3,7	Active Traffic Mgmt 4,0 Caution	Voluntary Training 7,0	Voluntary Training 6,9
Commercial Fishing Vessel Quality	Traffic Mix	Visibility Restrictions	Bottom Type	Hazardous Materials Release	Aquatic Resources
Voluntary Training 7,5	Active Traffic Mgmt 4,5	Active Traffic Mgmt 3,3	Nav / Hydro Info 3,1 Caution	Voluntary Training 6,6	Other Actions 4,1
Small Craft Quality	Congestion	Obstructions	Configuration	Mobility	Economic
Voluntary Training 6,2	Active Traffic Mgmt 2,5	Active Traffic Mgmt 2,8 Caution	Coordination / Planning 5,9	Coordination / Planning 6,3	Coordination / Planning 7,7

Note:

- The yellow caution flags are generated when the most selected intervention category is *different* from the most effective intervention category *and* either:
 1. Less than 50% of the participant teams chose the most selected category – this indicates that the participants are undecided as to the best course of action with respect to further reducing risks for that factor.

or

 2. More than 50% of the participant teams chose the most effective category – this indicates there are two (most effective and most selected) strong risk mitigation approaches which should be further considered.
- The risk factors flagged with a Yellow Caution should also be investigated by examining the individual cells in the “Bk 5 Rslts” spreadsheet. If desired, even more detail can be gleaned from the “Intervention Effectiveness” and “% Teams Choosing” columns in the “Bk 5 Calcs” spreadsheet.

Following the discussion, participants decide which ideas have the most promise for each risk factor that was discussed and what mitigation category the ideas relate to. They write a short description of the action needed, that is, the idea with the most promise, and then evaluate how much risk reduction would result if that idea was implemented.

5. RESULTS REVIEW

5.1. WORKSHOP OUTPUT

The output from a PAWSA indicates whether the risk in a waterway across the 24 risk factors is either acceptable, not acceptable but with identified solutions, or not acceptable and further work is required to identify solutions (see section 2).

As described in section 3.1.5, the workshop recommendations are recorded in a report for the PAWSA sponsor and other sponsors. Further information on the content and format of the report can be found in Annex B. Annex B describes in detail how to facilitate a PAWSA workshop, including a description of the necessary read ahead materials and physical output.

A PAWSA workshop requires considerable planning and skilful execution by a trained facilitation team to ensure the output is valid and appropriate to potentially alleviate, or at least reduce waterway risk to an acceptable level.

5.2. RESULTS ANALYSIS SUMMARY

The next version of this manual will describe how the detailed calculations of the PAWSA Excel workbook spreadsheets operate. It will demonstrate the specific cells and their equations, and explains the underlying mathematical calculations and the significance of certain results.

Each of the sections referring to the respective books above, also discuss results that are of interest as the PAWSA progresses. In summary, however, the following paragraphs describe specific results that should be examined and scrutinised, during the workshop.

5.2.1. BOOK 1 RESULTS

The “Bk 1 Rslts” spreadsheet is used to analyse the team’s expertise evaluation results.

Particular results to note are displayed in the “*Team Expertise – Distribution*” table of that spreadsheet. Cells highlighted in yellow indicate that between a half and two thirds of the teams placed themselves in that third. This can sometimes be observed in the “*Top 1/3*” column because participants, invited to PAWSA workshops because of their acknowledged expertise, consequently, can tend to evaluate their expertise highly.

Any of those cells are highlighted in red should be closely examined; this indicates that two thirds or more of the teams placed themselves in that third. Given that the ideal distribution is 33% in each third, red highlights could denote an imbalance in workshop expertise. That imbalance could invite criticism that key interest groups were not adequately represented in the workshop, and by implication, possible bias in the overall workshop results.

5.2.2. BOOK 2 RESULTS

The “Bk 2 Input” worksheet records input from each workshop and combines these with the generic reference scales from previous PAWSA. Results of interest from that evaluation are found in the “Bk 3 Calcs” spreadsheet. The “*Baseline Risk Level – Converted Scores*Expertise*” table displays the average differences in intervals A:B, B:C and C:D for the workshop waterway and the average results from all other workshops. Typically, there is very little variance between each workshop.

5.2.3. BOOK 3 RESULTS

Using Form 3, Baseline Risk Levels, the PAWSA participants decide which of four qualitative descriptors for each risk factor best fits the waterway being studied. While strong consensus in those decisions is expected, particularly for risk factors that can be directly quantified (e.g., “*Wind Conditions*”), sometimes that does not occur.

The “*Consensus*” column in the “Bk 3 Calcs” spreadsheet presents the standard deviation in the scores that were entered into the “Bk 3 Input” spreadsheet. Red highlights in that column denote a standard deviation greater than

1.0, warranting a close inspection of the raw inputs to determine which teams see the waterway's risks radically differently than the other teams.

5.2.4. BOOK 4 RESULTS

As in "Bk 3 Calcs", the "Consensus" column in the "Bk 4 Rslts" spreadsheet gives the standard deviation for the "Bk 4 Scores" inputs from the Book 4 Mitigation Effectiveness evaluations. Not as much consensus is expected in those scores because the 1 to 9 scale used for that evaluation is more open to interpretation. Therefore, standard deviations between 1.0 and 2.0 are highlighted yellow and should not be cause for too much concern. However, cells highlighted red (standard deviation greater than 2.0) should be investigated to see which teams see the effectiveness of existing risk mitigations radically differently than the other teams.

The "Expertise*Risks Balanced? Yes/No" table in the Bk 4 Y-N spreadsheet summarise how each team voted with respect to whether existing mitigations are well balanced with the risks for all 24 risk factors in the Waterway Risk Model. The "Consensus Alert" line shows a yellow highlight if a team's number of "Yes" votes is more than one standard deviation from the average number of "Yes" votes for all teams. Again, knowing which teams see things much differently than the others can provide important insight into the workshop dynamics and the issues raised during the sessions.

5.2.5. BOOK 5 RESULTS

Yellow Caution flags that appear on the "Bk 5 Disp" spreadsheet should be investigated by examining the "Bk 5 Rslts" spreadsheet. Further information can be obtained from the "Intervention Effectiveness" and "% Teams Choosing" columns in the "Bk 5 Calcs" spreadsheet.

As explained in section 4.8.2.8, those yellow caution flags occur when the most selected intervention category is different from the most effective intervention category and a) either less than 50% of the participant teams chose the most selected category or b) more than 50% of the participant teams chose the most effective category. The first case is an indicator that the participants are undecided as to the best course of action with respect to further reducing risks for that factor. The second case shows that there are two strong risk mitigation approaches which should be considered.



6. REFERENCES

- [1] IALA. Recommendation R1002 Risk Management for Marine Aids to Navigation
- [2] IALA. Standard 1010 AtoN Planning and Service Requirements
- [3] IALA. Guideline G1018 Risk Management
- [4] IMO. MSC-MEPC.2/Circ.12/Rev.2 Formal Safety Assessment (FSA)
- [5] ISO. 31000 Risk Management
- [6] IMO. SN.1/Circ.296 Degree of Risk Evaluation
- [7] IMO. Resolutions A.1158(32) Guidelines for Vessel Traffic Services
- [8] IALA. Guideline G1124 The Use of Ports and Waterways Safety Assessment (PAWSA MkII)
- [9] IALA. PAWSA Spreadsheet Example IALA WWA 2022