Human Health SQO Tier I Assessment Example

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October 1, 2013

Summary

This document describes the calculations used to conduct a Tier I SQO assessment, as illustrated in a companion Excel file (TierIAssessment_Example_09_30_2013.xlsx). The Excel file shows the Tier I analysis of the same example data set included with the Tier II Decision Support Tool (DST version 10.6.5). The specialized analyses involved in conducting separate Tier I evaluations of fish tissue and sediment contaminant concentration data are described in this document. Please note that this document does not describe the data preparation steps needed to summarize the data prior to conducting the assessment. Prior to conducting the analyses described in the following sections, the user must compile relevant data for the site and calculate means and upper 95% confidence limits (UCL).

Organization of the Excel File

The Tier I assessment example file contains two worksheets for data evaluation and an additional worksheet that contains a summary of the evaluation results. The "Tissue Evaluation" and "Sediment Evaluation" worksheets describe the tissue and sediment evaluation calculations, respectively. The sediment and tissue calculations can be done in any order desired.

The data evaluation worksheets contain formulas to illustrate the calculations or populate summary tables. These worksheets can be adapted for analysis of other data sets by copying and pasting data into the relevant cells and manually updating some formulas. However, unlike the draft DST for Tier II, these worksheets are not intended to be fully functional data analysis tools. There are intended primarily to illustrate in detail the various calculations in the proposed Tier I assessment framework.

Only one type of evaluation is required to complete the Tier I assessment, but it is recommended that both evaluations be conducted if sediment and tissue data are available. The "Tier I Summary" worksheet contains the outcomes of both the sediment and tissue evaluations and describes the overall conclusions of the Tier I assessment with respect to the need for further assessment.

User Input Data

The Tier I SQO assessment is currently limited to chlordanes, dieldrin, DDTs, and PCBs. Table 1 summarizes the data needed to conduct the Tier I assessment on tissue. The health risk thresholds used in the tissue evaluation are specified in the program guidance.

Table 1. Information needed for Tier I tissue evaluation.

Parameter	Description
Tissue Contaminant Concentration (ng/g)	Mean and upper 95% confidence limit for each fish species evaluated
Health Risk Thresholds (ng/g)	Cancer and noncancer thresholds as specified in program guidance

Data for a larger number of parameters is needed to conduct the Tier I sediment assessment (Table 2). Sediment contaminant concentration and TOC are determined from site-specific data; values for the other parameters are specified in the program guidance.

Table 2. Information needed for Tier I sediment evaluation.

Parameter	Description
Sediment Contaminant Concentration (ng/g)	Mean and upper 95% confidence limit for all stations within site
Sediment TOC (%)	Mean of all sediment samples
Fish Dietary Guild	Dietary guild category for each fish species included in the assessment
Health Risk Thresholds (ng/g)	Cancer and noncancer thresholds as specified in program guidance
Guild-Specific Bioaccumulation Factor	BAF corresponding to each dietary guild type in the assessment and the site TOC

A list of recommended fish species and corresponding dietary guild types is included in Table 3. Data for the preferred indicator species within each guild should be used if possible.

Table 3. Appropriate finfish species for use in SQO Tier I assessment and the corresponding guild. Preferred guild indicator species are underlined.

Guild species	Dietary guild
Barred sand bass	Benthic diet with piscivory
Barred surfperch	Benthic diet without piscivory
Bat ray	Benthic diet with piscivory
Black perch	Benthic and pelagic diet without piscivory
Black rockfish	Benthic and pelagic diet with piscivory
Blue rockfish	Benthic and pelagic diet with piscivory
Bonefish	Benthic diet with piscivory
Brown rockfish	Benthic diet with piscivory
Brown smoothhound	Benthic diet with piscivory
Cabezon	Benthic diet with piscivory
California halibut	**Piscivore**
Channel catfish	Benthic diet with piscivory
Common carp	**Benthic diet with herbivory**
Dwarf perch	Benthic and pelagic diet without piscivory
English sole	Benthic diet with piscivory
Fantail sole	Benthic diet without piscivory
Grass rockfish	Benthic diet with piscivory
Kelp bass	Benthic and pelagic diet with piscivory
Leopard shark	Benthic diet with piscivory
Lingcod	Piscivore
Monkeyface prickleback	Benthic diet with herbivory
Other	Any
Pacific angel shark	Piscivore
Pacific sanddab	Benthic diet with piscivory
Pile perch	Benthic diet without piscivory
Queenfish	**Benthic and pelagic diet with piscivory**
Redtail surfperch	Benthic diet with piscivory
Rubberlip seaperch	Benthic diet without piscivory
Sargo	Benthic diet without piscivory
Señorita	Benthic diet with herbivory
Shiner perch	**Benthic and pelagic diet without piscivory**
Spotfin croaker	Benthic diet without piscivory
Spotted sand bass	**Benthic diet with piscivory**
Starry flounder	Benthic diet with piscivory
Striped mullet	**Pelagic diet with benthic herbivory**
Striped seaperch	Benthic diet without piscivory
Topsmelt	**Benthic and pelagic diet with herbivory**
Walleye surfperch	Benthic diet without piscivory
White catfish	**Benthic diet with piscivory**
White croaker	**Benthic diet without piscivory**
White seabass	Benthic diet with piscivory
White seaperch	Benthic diet without piscivory
Yellowfin croaker	Benthic diet with piscivory

Tissue Evaluation

The Tier I tissue evaluation is illustrated in the "Tissue Evaluation" worksheet. For each contaminant group, the data are summarized by species and a 95% UCL is calculated (Figure 1, cells D12-26). Next, the average UCL is calculated for all species within each contaminant group (column E).

	A	B	C	D	E	F	G
1	**Tissue Evaluation**						
2		SQO Parameter	Chlordane (ng/g)	Dieldrin (ng/g)	DDT (ng/g)	PCB (ng/g)	
3		Tissue concentration	7	1.5	36	133	
4		Cancer Risk	56	4.6	214	36	
5		Noncancer Hazard	103	156	1563	63	
6		Tissue Outcome	Meets SQO	Meets SQO	Meets SQO	Proceed to Tier II	
7	Assessment:						
8	Fish from the site potentially exceed SQO health risk thresholds for PCBs cancer risk and noncancer hazard.						
9	Tier II analysis is needed for site assessment.						
10							
11	Common Name	Analyte(s)	Mean (ng/g)	Upper 95% CI (ng/g)	95% UCl Average		
12	Leopard shark	Chlordanes	1.1	1.4			
13	White croaker	Chlordanes	9.8	12.1	7		
14	Shiner perch	Chlordanes	5.6	6.7			
15							
16	Leopard shark	Dieldrin	0.2	0.7			
17	White croaker	Dieldrin	1.8	2.2	1.5		
18	Shiner perch	Dieldrin	1.3	1.6			
19							
20	Leopard shark	DDTs	7.3	10.5			
21	White croaker	DDTs	58.8	70.4	36		
22	Shiner perch	DDTs	24.5	27.4			
23							
24	Leopard shark	PCBs	20.6	25.3			
25	White croaker	PCBs	213.1	251.4	133		
26	Shiner perch	PCBs	105.6	121.9			
27							

Tissue Evaluation / Sediment Evaluation / Tier I Summary

Ready   90%

Figure 1. Data used in Tier I tissue evaluation example worksheet.

The tissue evaluation is completed by comparing the average UCLs to their respective threshold values for cancer risk and noncancer hazard. The thresholds used in the example are provisional values; final thresholds will be specified by the Water Board. If the 95% UCL for a contaminant is equal to or exceeds the threshold value, then the tissue assessment outcome is to **Proceed to Tier II**. When the value is below the threshold, then the tissue outcome is that the SQO has been met. The 95% UCLs calculated for the example tissue data set exceed only the PCB thresholds (Figure 1, cells B2-F6). Therefore the tissue assessment outcome is to proceed to Tier II analysis for PCBs. The tissue evaluation also indicates that the SQO is met for chlordanes, dieldrin, and DDTs.

Sediment Evaluation

The Tier I sediment evaluation is conducted in three steps, as illustrated in the "Sediment Evaluation" worksheet. First, the sediment contamination data are summarized and a 95% UCL is calculated for each contaminant group (Figure 2, cells A25-D29). The average sediment TOC is also calculated (cell B30). The TOC should be expressed as a percent (%) value.

	A	B	C	D	E	F	G
1	**Sediment Evaluation**						
2		SQO Parameter	Chlordane (ng/g)	Dieldrin (ng/g)	DDT (ng/g)	PCB (ng/g)	
3		Sediment Concentration	0.20	0.07	2.58	7.44	
4		Cancer Risk	6.3	4.7	21.2	0.4	
5		Noncancer Hazard	11.6	8.3	154.8	14.7	
6		Sediment Outcome	Meets SQO	Meets SQO	Meets SQO	Proceed to Tier II	
7	Assessment:						
8	The site contains sediment concentrations that potentially could result in an exceedance of the SQO for PCBs.						
9	Tier II analysis is needed for site assessment.						
10							
11	Sediment Threshold Calculation Table						
12			Leopard shark	White croaker	Shiner perch		
13	Compound/Hazard Type	Tissue threshold (ng/g)	Benthic / Piscivory BAF	Benthic without Piscivory BAF	Average Guild BAF	Sediment threshold calculation	Sediment Threshold (ng/g)
14	Chlordanes cancer	56	6.7	8.9	6.8	56 / 8.9 =	6.3
15	Chlordanes noncancer	103	6.7	8.9	6.8	103 / 8.9 =	11.6
16	Dieldrin cancer	36	4.3	7.6	5.2	36 / 7.6 =	4.7
17	Dieldrin noncancer	63	4.3	7.6	5.2	63 / 7.6 =	8.3
18	DDTs cancer	214	7.5	10.1	7.3	214 / 10.1 =	21.2
19	DDTs noncancer	1563	7.5	10.1	7.3	1563 /10.1 =	154.8
20	PCBs cancer	4.6	7.7	10.6	7.4	4.6 / 10.6 =	0.4
21	PCBs noncancer	156	7.7	10.6	7.4	156 / 10.6 =	14.7
22							
23							
24	Data Summary Table						
25	Analyte(s)	Mean (ng/g)	Std Error (ng/g)	Upper 95% CI (ng/g)			
26	Chlordane (ng/g)	0.18	0.009	0.196			
27	Dieldrin (ng/g)	0.07	0.002	0.075			
28	DDTs (ng/g)	2.36	0.11	2.585			
29	PCBs (ng/g)	6.78	0.33	7.435			
30	TOC (%)	1.30					
31							

Tissue Evaluation | Sediment Evaluation | Tier I Summary | Sheet1

Figure 2. Data used in Tier I sediment evaluation example worksheet.

In the second step of the sediment analysis, site-specific sediment evaluation thresholds are calculated. Both cancer risk and noncancer hazard thresholds are calculated, using the corresponding tissue evaluation thresholds, sediment TOC, and guild-specific bioaccumulation factors values (BAFs). The sediment threshold is calculated as:

$$T_{Sed} = (T_{Tis})/(BAF)$$

Where:

T_{Sed} = sediment screening threshold (ng/g dw)

T_{Tis} = tissue screening threshold in nanograms per gram wet weight (ng/g ww)

BAF = bioaccumulation factor (BAF)

The BAFs vary as a function of sediment TOC, guild, and contaminant type. The worksheet contains tables of BAF values for selected feeding guilds and TOC values. BAFs should be selected for the same guilds represented by the tissue data.

The threshold calculations for the data example are illustrated in cells A13 to G21 of the worksheet (Figure 2). Guild specific BAFs are determined by reference to the tables provided in rows 34 to 109 of the sediment evaluation worksheet (Figure 3). The user should select the BAFs corresponding to the average sediment TOC at the site and dietary guilds of interest. If the site TOC value cannot be found in the provided tables, BAFs for the next lowest TOC value in the table should be used (or calculated directly using the DST). In the example provided, BAFs for 1.2% TOC were used since no values were given for the site average of 1.3% TOC.

	A	B	C	D	E	F	G
32							
33							
34			Bioaccumulation factor for Chlordanes				
35	TOC (%)	1- Piscivore	2 - Benthic / Piscivory	4 - Benthic without Piscivory	5 – Benthic / Herbivory	Average guild[a]	
36	0.1	55.9	62.5	79.1	71.3	64.2	
37	0.2	28.3	32.1	40.9	36.8	32.9	
38	0.3	19.2	22	28.2	25.2	22.5	
39	0.4	14.6	16.9	21.8	19.5	17.3	
40	0.6	10	11.8	15.4	13.7	12	
41	0.8	7.7	9.3	12.1	10.8	9.4	
42	1	6.3	7.7	10.2	9	7.8	
43	1.2	5.4	6.7	8.9	7.8	6.8	
44	1.4	4.7	6	7.9	7	6	
45	1.6	4.2	5.4	7.2	6.3	5.4	
46	1.8	3.8	5	6.7	5.8	5	
47	2	3.5	4.6	6.2	5.4	4.6	
48	2.5	2.9	4	5.4	4.6	3.9	
49	3	2.5	3.5	4.8	4.1	3.5	
50	3.5	2.3	3.2	4.4	3.7	3.2	
51	4	2	2.9	4	3.4	2.9	
52							

Tissue Evaluation | Sediment Evaluation | Tier I Summary | Sheet1

Figure 3. Bioaccumulation factor tables for chlordanes in the "Sediment Evaluation" worksheet. BAF values corresponding to the data example are highlighted in yellow.

Two of the species evaluated, leopard shark and white croaker, belong to dietary guilds included in the BAF tables. The dietary guild for shiner perch is not listed in the BAF tables; the BAFs listed in the "Average guild" column are used for this species or other fish species from guilds that are not represented in the tables provided. The BAFs selected for the species and contaminants are shown in cells C14 to E21 of the worksheet (Figure 2). The sediment thresholds are calculated using the highest BAFs for each contaminant group. In the example, the white croaker BAFs are larger than those for shiner perch or leopard shark and are used in the analysis. The calculated sediment thresholds are shown in cells G14 to G21.

In the third and final step of the sediment evaluation, the measured sediment concentrations (95% UCL) are compared to the calculated sediment thresholds. The results for the data example are shown in cells B2 to F6 (Figure 2). The worksheet contains formulas that automatically update the comparison table with the calculated UCL and sediment threshold values previously calculated.

If the 95% UCL value is equal to or exceeds the recommended threshold values, the sediment evaluation outcome is to **Proceed to Tier II**. When the value is below the threshold, the sediment contaminant concentration is classified as **Meets the SQO**. In the example shown in the worksheet, the sediment PCB UCL exceeds both the cancer risk and noncancer hazard thresholds, indicating a need for Tier II analysis. No other sediment thresholds are exceeded, so chlordanes, dieldrin, and DDTs at the site are classified as meeting the SQO.

Tier I Assessment Summary

The outcomes of the tissue and sediment evaluations are summarized for comparison in the "Tier I Summary" worksheet. The final outcome of the Tier I assessment is based on a comparison of both types of evaluation, if available. A separate comparison is made for each contaminant group. Either a sediment or tissue evaluation outcome of **Proceed to Tier II** is sufficient to determine the Final Outcome (cells E3 to E6) as Proceed to Tier II for that contaminant.

The results of the example data tissue and sediment evaluations agree for each contaminant group (Figure 4). The results indicate a potential exceedance of the SQO for PCBs and therefore a need for Tier II assessment. No additional assessment is needed for chlordanes, dieldrin, or DDTs.

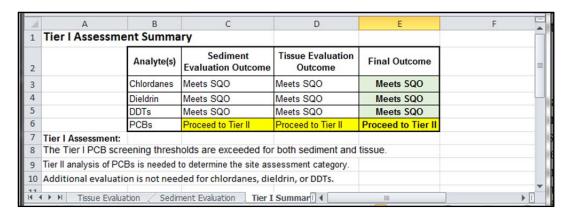|	A	B	C	D	E	F
1	**Tier I Assessment Summary**					
2		Analyte(s)	Sediment Evaluation Outcome	Tissue Evaluation Outcome	Final Outcome	
3		Chlordanes	Meets SQO	Meets SQO	**Meets SQO**	
4		Dieldrin	Meets SQO	Meets SQO	**Meets SQO**	
5		DDTs	Meets SQO	Meets SQO	**Meets SQO**	
6		PCBs	Proceed to Tier II	Proceed to Tier II	**Proceed to Tier II**	
7	**Tier I Assessment:**					
8	The Tier I PCB screening thresholds are exceeded for both sediment and tissue.					
9	Tier II analysis of PCBs is needed to determine the site assessment category.					
10	Additional evaluation is not needed for chlordanes, dieldrin, or DDTs.					
11						

Tissue Evaluation / Sediment Evaluation / Tier I Summary

Figure 4. Tier I assessment summary for example data.