**Paper for Consideration by TSMAD and DIPWG**

**Safety Depth Contour & Safety Depth**

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| **Submitted by:** | DIPWG Chair |
| **Executive Summary:** | Mariners have flexibility in how they set the values for safety depth and safety contour depth in ECDIS.  Therefore, the following three options are available:<br><br>1.  Safety Depth is set to the *same value* set for the Safety Contour Depth<br>2.  Safety Depth is set *shoaler* than the value set for the Safety Contour Depth<br>3.  Safety Depth is set *deeper* than the value set for the Safety Contour Depth<br><br>This paper explores these scenarios and a few additional conditions that branch from these three scenarios depending on how the ECDIS selects the actual safety contour used by the system.<br><br>Graphics are presented that illustrate the resulting ECDIS display for various conditions and the implications for navigational safety are discussed. |
| **Related Documents:** | S-52, S-57, S-100, S-101 |
| **Related Projects:** | |

## Introduction

There are two "safety contours" described in S-52.  This paper uses the term "Safety Contour Depth" to mean the depth value set by the mariner and "Safety Contour" to mean the actual ENC depth contour selected by ECDIS.  The term "Safety Depth" refers to the value set by the mariner that is used in the portrayal of soundings and is unrelated to depth contours.

S-52 specifies no link between the values set by the mariner for safety depth (used by ECDIS to highlight or dim soundings shoaler or deeper than the safety depth) and the safety contour depth (used by ECDIS to select an equal or the next deeper depth contour as the safety contour).

The sole purpose of the safety depth is to portray soundings either in gray for deeper depths or black for shoaler depths. The safety depth value has no affect on alarms or any other aspect of ECDIS.

In contrast, the safety *contour* depth has several purposes, including:

- ECDIS designates a safety contour that is equal to or deeper than the safety contour depth. ECDIS makes this selection from the depth contours available in the ENC being displayed at the ship's position.
- IMO ECDIS Performance Standards specify that "ECDIS should give an alarm if the ship, within a specified time set by the mariner, is going to cross the safety contour."
- The safety contour demarks the boundary between "safe-water" and shallow water with an extra wide isoline.
- Deep-water and shallow-water tints are shown on the respective sides of the safety contour (either in two or four shades)

- The option to "show isolated dangers" will display isolated dangers on the shoaler side of the safety contour (isolated dangers are always shown on the "safe-water" side).

### Analysis/Discussion

Mariners have flexibility in how they set the values for safety depth and safety contour depth in ECDIS. Therefore, the following three options are available:

1. Safety Depth is set to the same value set for the Safety Contour Depth
2. Safety Depth is set shoaler than the value set for the Safety Contour Depth
3. Safety Depth is set deeper than the value set for the Safety Contour Depth

The graphics in Annex A explore these scenarios and a few additional conditions that branch from these three scenarios depending on how the ECDIS selects the actual safety contour used for the system.

The IMO Performance Standards in MSC.282(82) state in paragraph 5.8 that, "It should be possible for the mariner to select a safety contour from the depth contours provided by the SENC" and that the ECDIS should "default to the next deeper contour" if the contour value entered by the mariner is not available. Paragraph 5.9 states, "It should be possible for the mariner to select a safety depth" to use to emphasize soundings of equal or lesser depth. Although these parameters are specified individually, there is nothing in the IMO performance standards or IEC 61174 that prohibit them from being linked.

### Conclusions:

1. The Safety Contour Depth set by the mariner should always be set to the "Vessel Safety Draft," which is commonly calculated as:

$$\underline{Vessel\ Safety\ Draft} = \underline{Vessel\ Draft} + \underline{Dynamic\ Squat} + \underline{Safety\ Margin}$$

2. There is merit in ECDIS prohibiting the mariner from setting the Safety Depth shoaler than the Safety Contour Depth. Allowing this could lead to ambiguous displays of soundings and potentially dangerous interpretations.

3. The mariner may want flexibility in selecting a Safety Depth deeper than the Safety Contour Depth for the reasons described in Scenario 3 in the attachment. However, this benefit may be small compared with the advantage of always setting the Safety Depth and the Safety Contour Depth to the same value. That is, there will never be any ambiguity on the bridge over how these parameters are set and the real meaning of the gray and black soundings if the Safety Depth and the Safety Contour Depth are always set to the same value.

### Recommendations:

For the sake of simplicity and safety, it is recommended that ECDIS should always use the same value for the Safety Depth and the Safety Contour Value; essentially limiting the mariner to only entering one or the other, but not both. This approach would logically lead to combining these values into a single parameter.

Another option, endorsed by a few, is to allow the mariner to set the Safety Depth to a value shoaler than the depth entered for the Safety Contour Value. Although this practice is not inherently unsafe, it requires a greater level of sophistication, training and vigilance by the crew to interpret the ECDIS display.

# Use of the Safety Depth and the Safety Contour in ECDIS

Prepared for DIPWG-4

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# Terms

- Safety Depth:  Value set by the mariner that is used by ECDIS to portray soundings as black if they are equal to or shoaler than the value and gray if they are deeper.

- Safety Contour Depth:  Value set by the mariner that is used by ECDIS to select a "Safety Contour" from among the depth contours available in the SENC that is equal to or deeper than the value.

- Safety Contour:  A specific depth contour set by ECDIS.  It demarks the boundary between "safe-water" and shallow water with an extra wide isoline and is used to give an alarm if the ship, within a time specified by the mariner, is going to cross the safety contour.  It is also used to determine the tints used for depth areas and for other purposes.

# Assumptions

The following assumptions were made in
creating the scenarios described in these slides.

1. ECDIS allows the mariner to set the Safety Depth and the Safety Contour Depth independently.

2. The mariner sets the Safety Contour Depth equal to the "Vessel Safety Draft," which is calculated as:
   Vessel Safety Draft  =  Vessel Draft  +  Dynamic Squat  +  Safety Margin

3. Depths are considered "safe" if they are equal to or deeper than the Safety Contour Depth.

4. Depths shoaler than the Safety Contour Depth are considered "unsafe."

# 3 Ways to Set Safety Depth and Safety Contour Depth

- IMO Performance Specifications and S-52 provide flexibility in how the safety depth and safety contour depth may be set by the mariner.

- The affect on the portrayal of soundings and contours from the use of each of these three options are described in the following slides
  - 1. Safety Depth equals Safety Contour Depth
  - 2. Safety Depth is shoaler than Safety Contour Depth
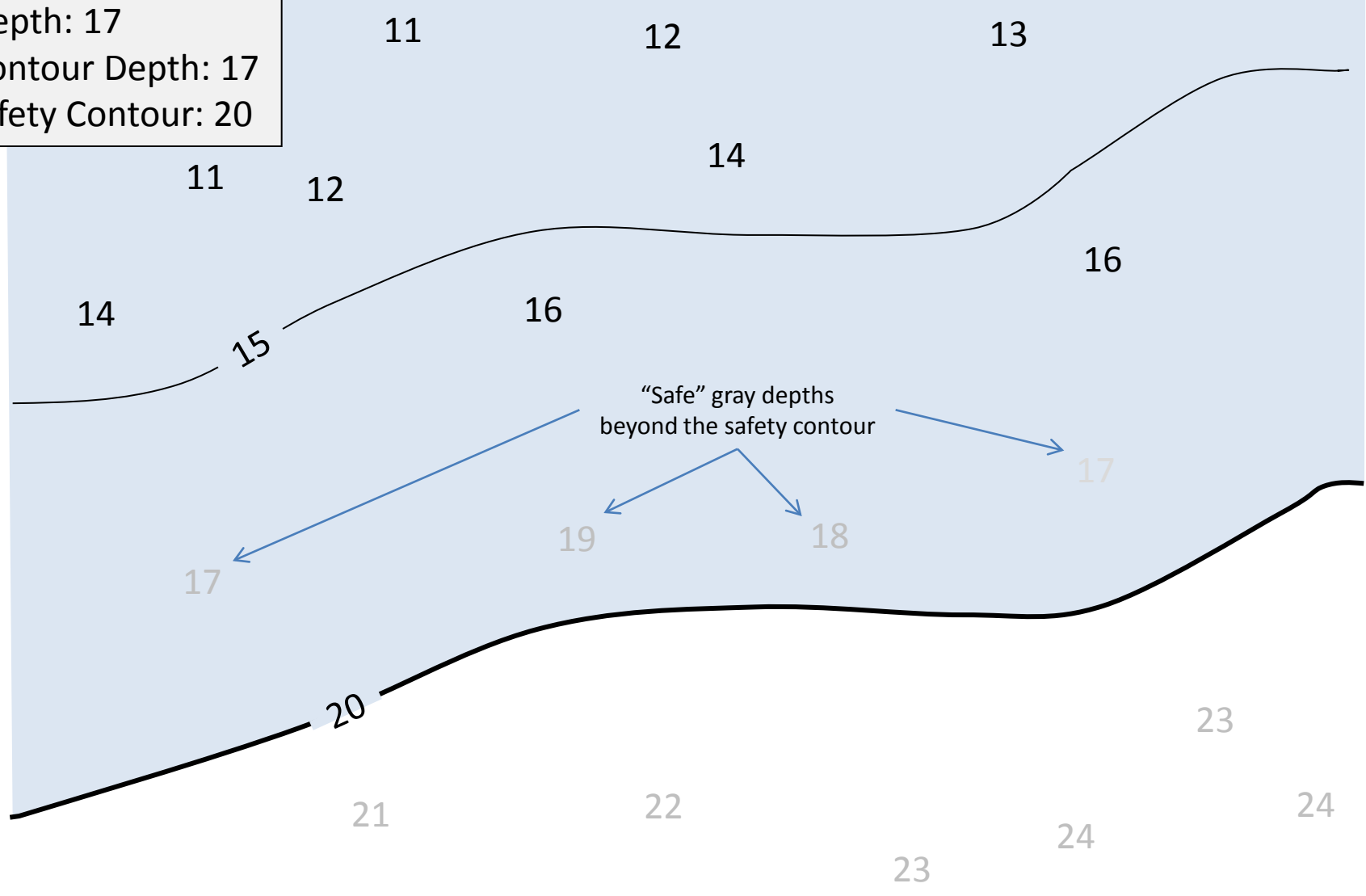  - 3. Safety Depth is deeper than Safety Contour Depth

11    12    13

11    12    14

14    16

15    16

17

19    18

17

20    23

21    22    24    24

23
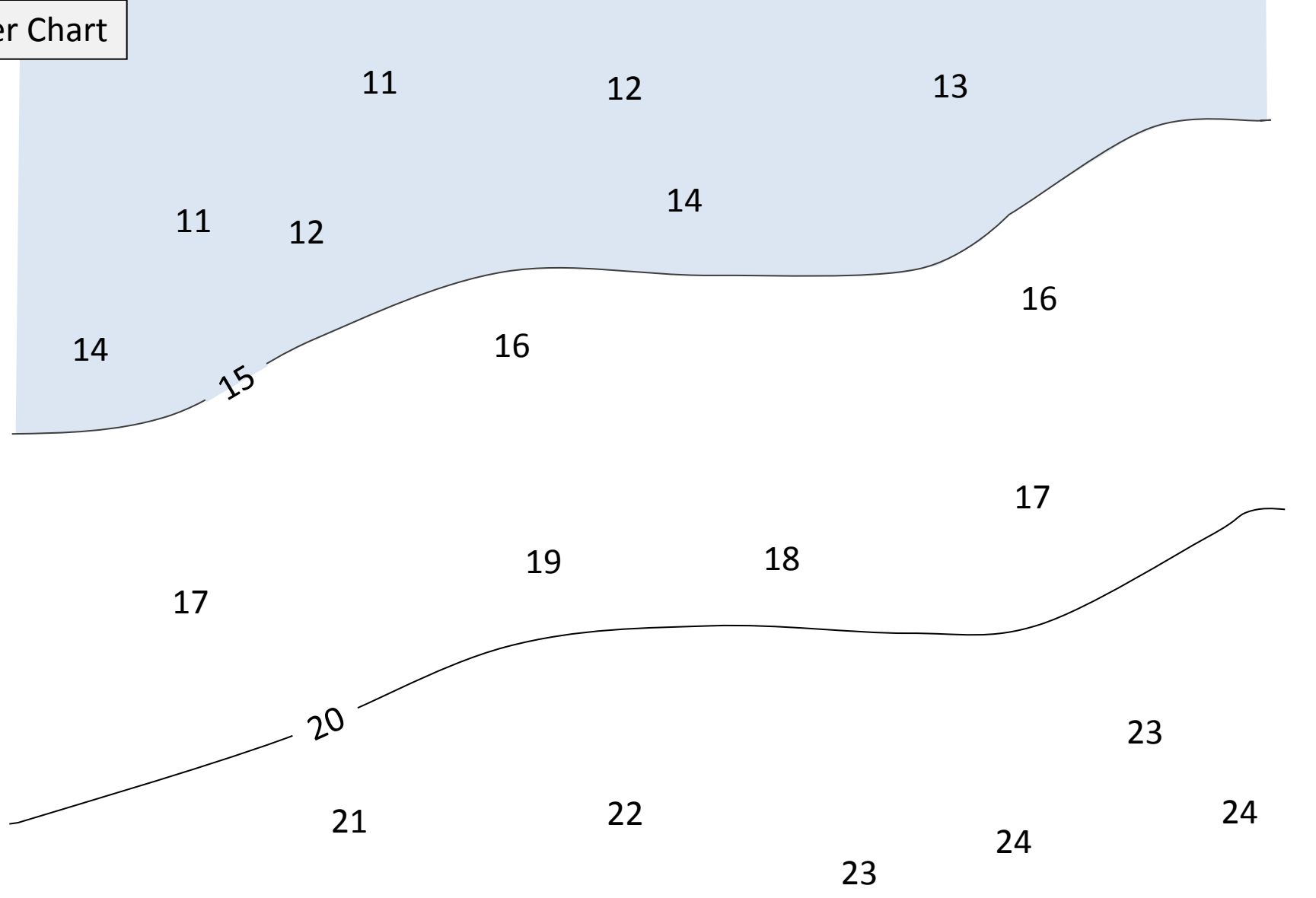
Scenario 1.a
Safety Depth: 20
Safety Contour Depth: 20
ECDIS Safety Contour: 20

11    12    13

14

11    12

16

14

15

16

16

17

17    19    18

20

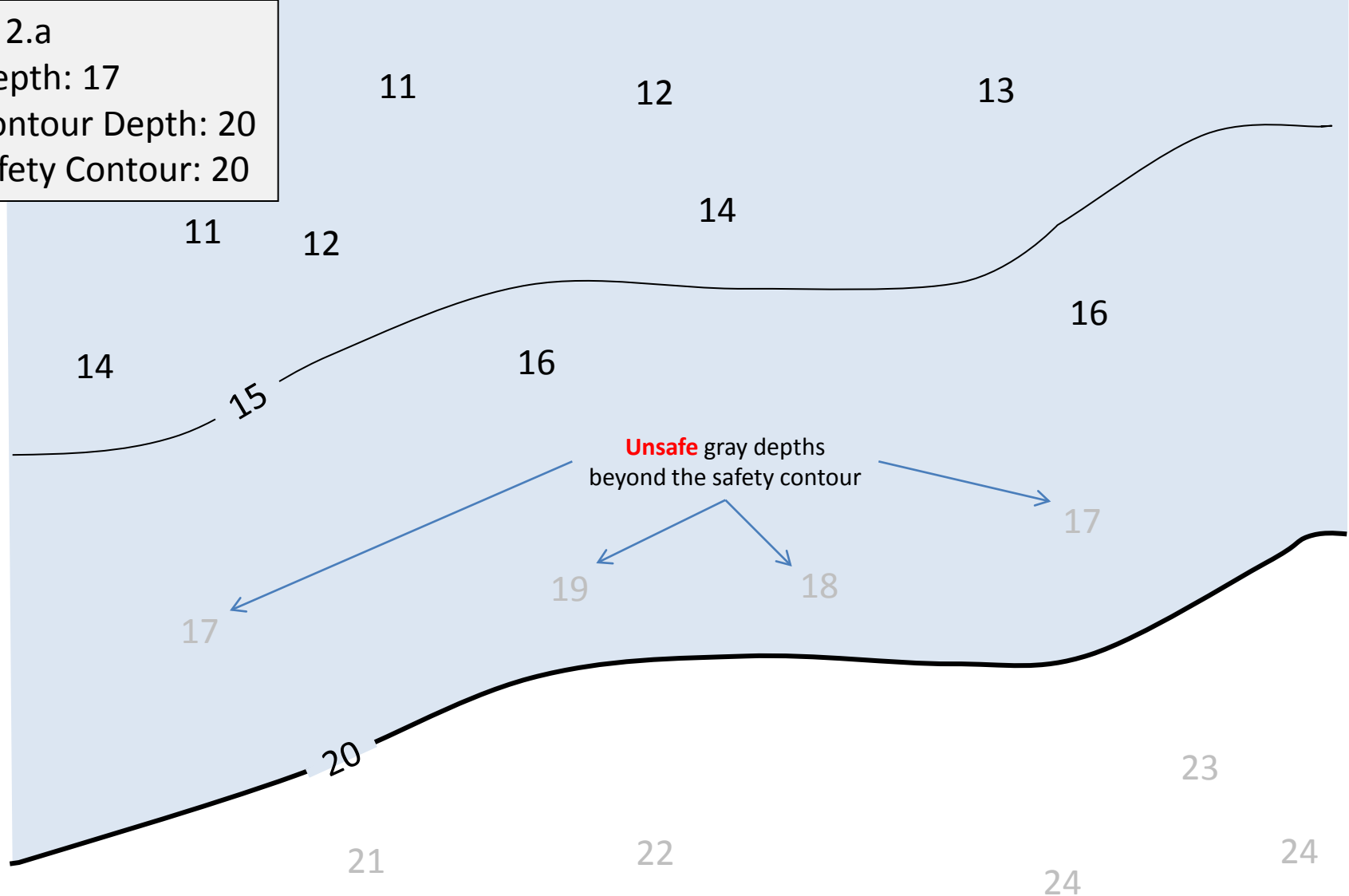23

21    22    24

24

23
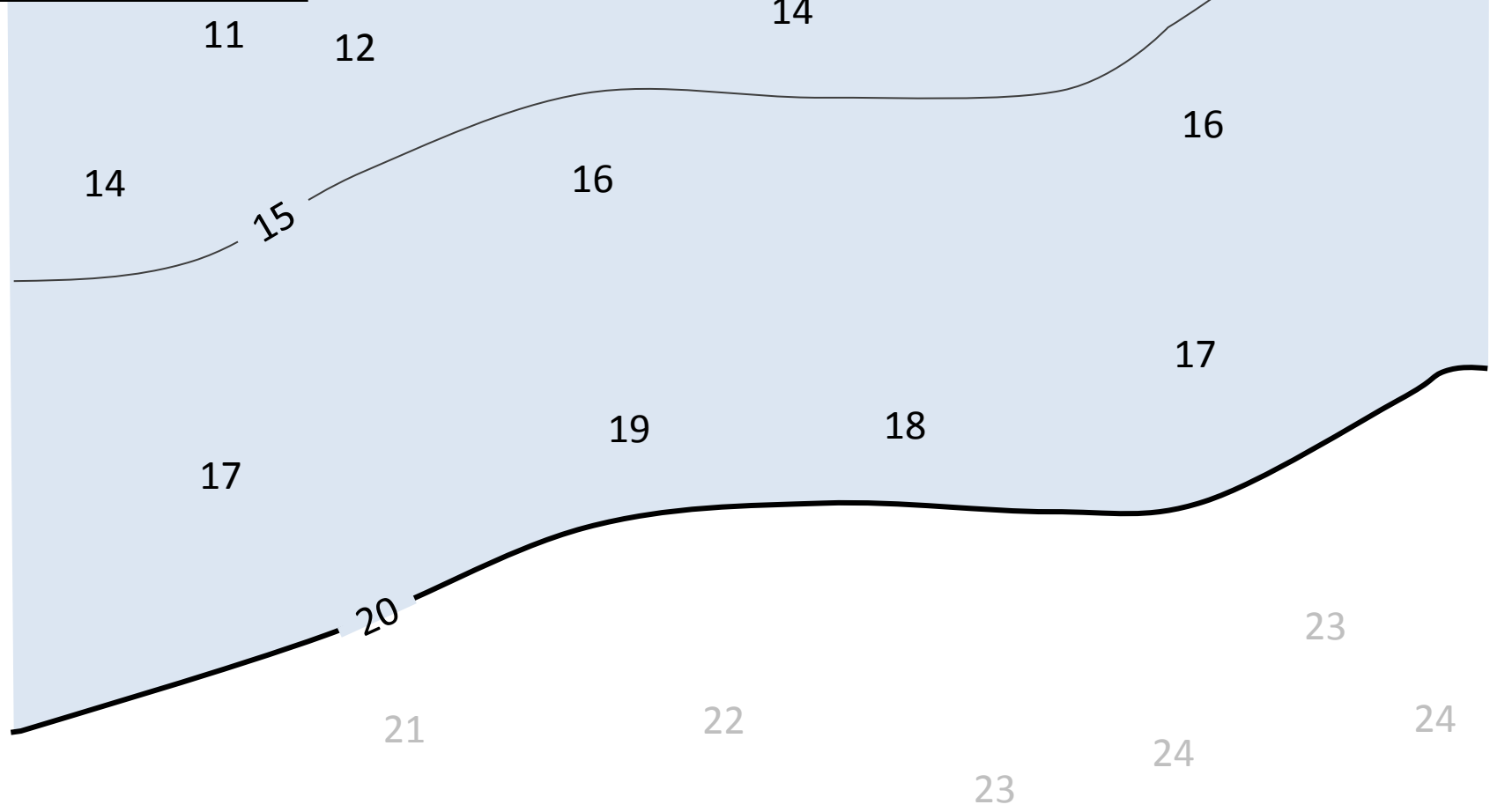
**Scenario 1:    S*ame Value* set for both Safety Depth and Safety Contour Depth**
Condition:    1.a – ECDIS finds a depth contour equal to the safety contour depth
Display:    Soundings on either side of the safety contour will either be all gray or all black.
Impact:    The shade used for the soundings provides information that is redundant with the safety contour.

Scenario 1.b
Safety Depth: 17
Safety Contour Depth: 17
ECDIS Safety Contour: 20

11    12    13

14

11    12

16

14

15

16

"Safe" gray depths
beyond the safety contour

17

19    18

17

20

23

21    22    24

24

23

**Scenario 1:** *Same Value* **set for both Safety Depth and Safety Contour Depth**

Condition:    1.b - ECDIS selects a safety contour deeper than the safety contour depth and the safety depth set by the mariner

Display:    Some soundings on the shoaler side of the safety contour will be gray, because they are deeper than the safety depth set by the mariner, but shoaler than the safety contour selected by ECDIS.

Impact:    This provides the mariner with additional information about where the ship could most safely pass if crossing the safety contour is required (an alarm will still sound). This could provide additional maneuvering room in narrow passages where the safety contour selected by ECDIS is much shoaler than the safety contour depth set by the mariner.

Scenario 2.a
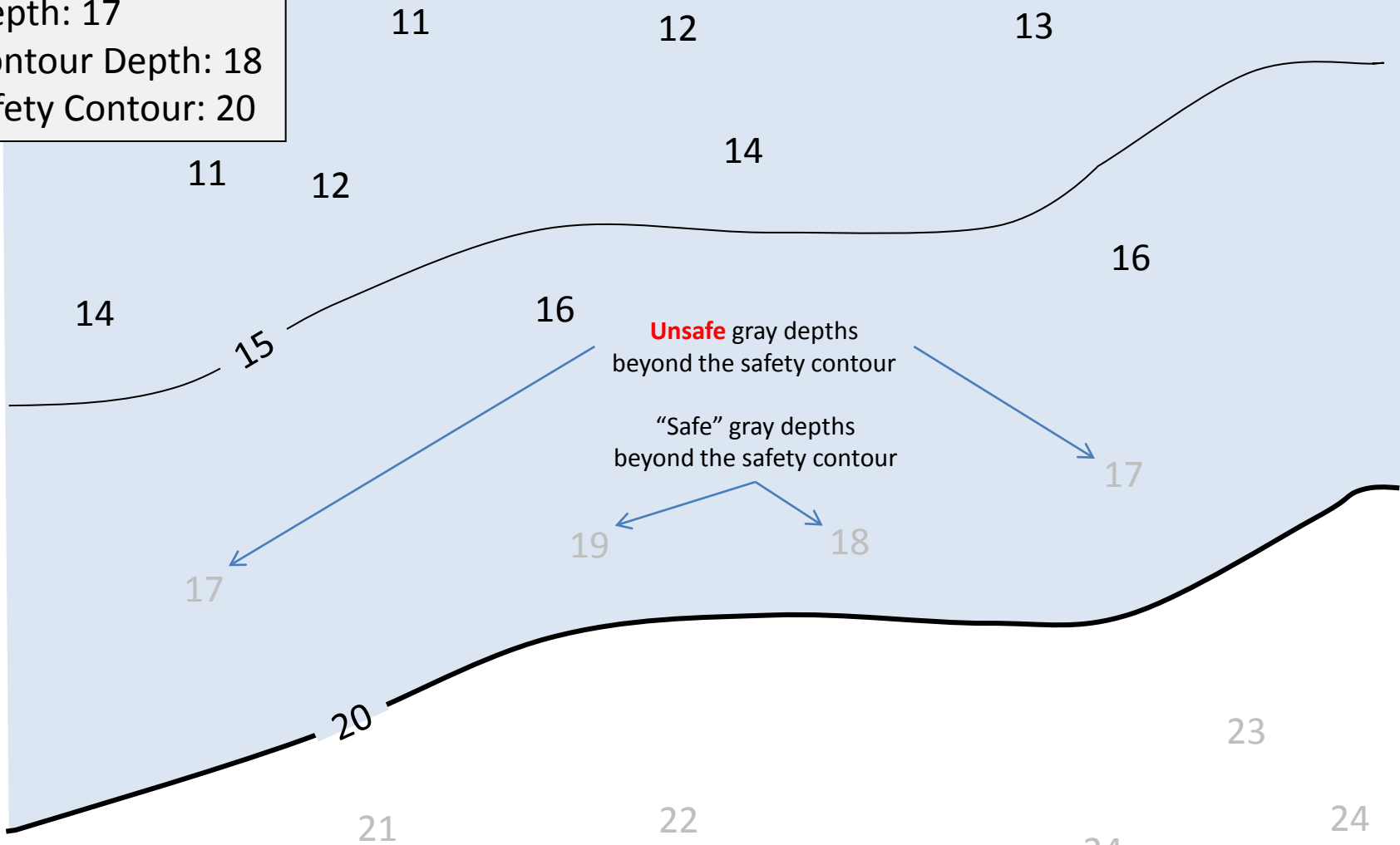Safety Depth: 17
Safety Contour Depth: 20
ECDIS Safety Contour: 20

11    12    13

14

11    12

16

14

15    16

**Unsafe** gray depths
beyond the safety contour

17

19    18

17

20

23

21    22    24

24

23

**Scenario 2:**    **Safety Depth is set *Shoaler* than the value set for the Safety Contour Depth**
Condition:    2.a - ECDIS selects a depth contour equal to the safety contour depth set by the mariner.
Display:    All soundings on the "safe-water" side of the safety contour will be gray. These gray soundings are deeper than both the safety depth and the safety contour). No real additional information is provided by these.
Some additional soundings on the shoaler side of the safety contour (mostly adjacent to the safety contour, but also in other areas) will be gray. These additional soundings are deeper than the safety depth, ***but shoaler than the safety contour depth.***
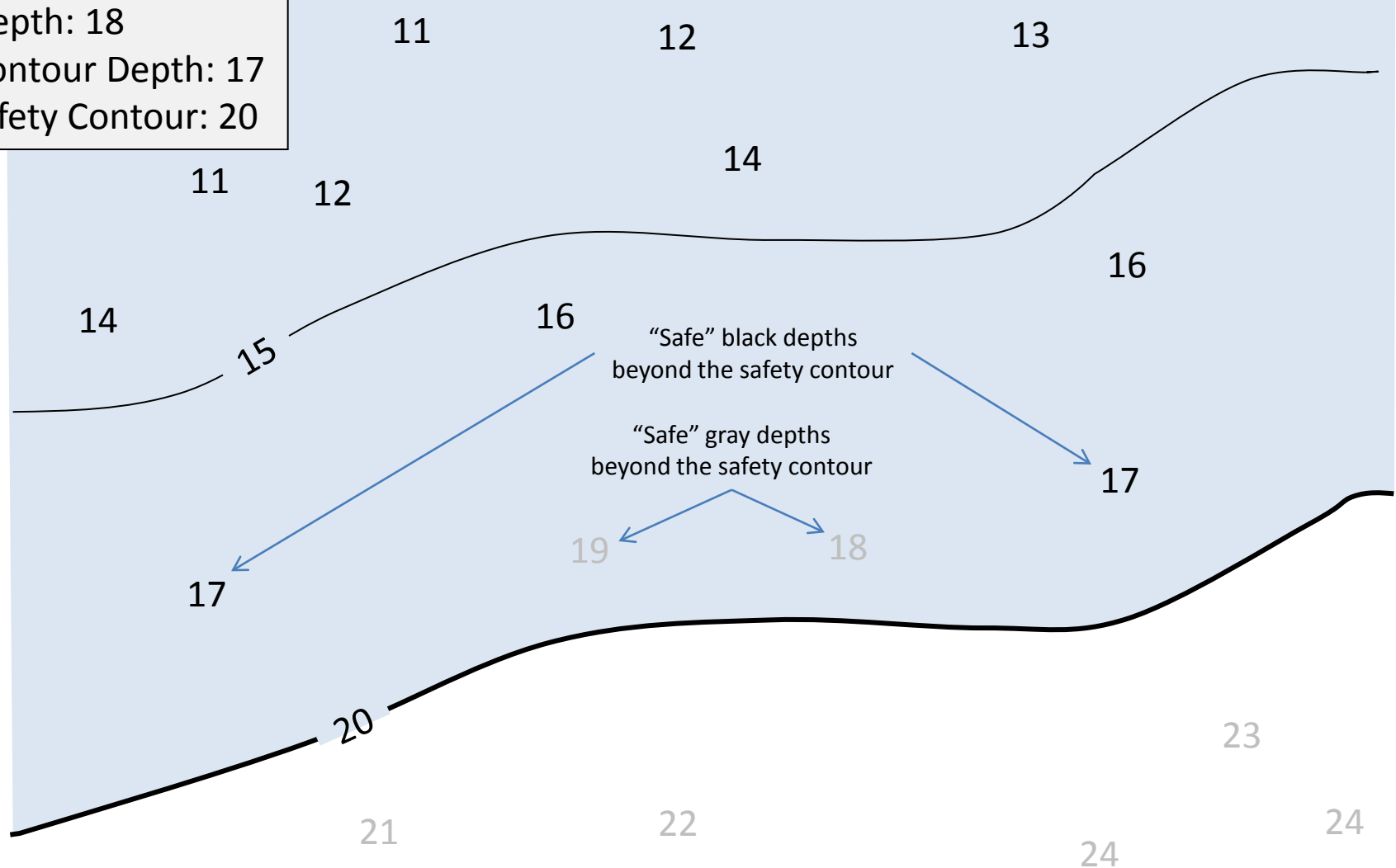Impact:    Unlike scenario 1.b, these gray soundings may ***not be safe to pass over***. They are outside the safety contour, not because the ECDIS has selected a shoaler contour than the safety contour depth, but because the mariner set ECDIS to portray soundings shoaler than the safety contour as safe when in fact they may not be.

Scenario 2.b
Safety Depth: 17
Safety Contour Depth: 18
ECDIS Safety Contour: 20

11    12    13

14

11    12

16

14

15    16

**Unsafe** gray depths
beyond the safety contour

"Safe" gray depths
beyond the safety contour

17

19    18

17

20

23

21    22    24

24

23

**Scenario 2:** **Safety Depth is set *Shoaler* than the value set for the Safety Contour Depth:**
Condition:   2.b - ECDIS selects a depth contour deeper than the safety contour depth.
Display:     All soundings on the "safe-water" side of the safety contour will be gray. These gray soundings are deeper than both the safety depth and the safety contour).  No real additional information is provided by these.
             Some additional soundings on the shoaler side of the safety contour (mostly adjacent to the safety contour, but also in other areas) will be gray. These additional soundings are deeper than the safety depth, *but may or may not be shoaler than the safety contour  depth.*
Impact:      This case is similar to scenario 2.a. However, some of the gray soundings on the shoaler side of the safety contour will be safe (because they are deeper than the safety contour depth selected by the mariner), while others *will not be safe to pass over*  (because they are shoaler than the safety contour depth selected by the mariner).  *The portrayal of both the safe and unsafe depths on the shoaler side of the safety contour is the same!*

Scenario 3.a
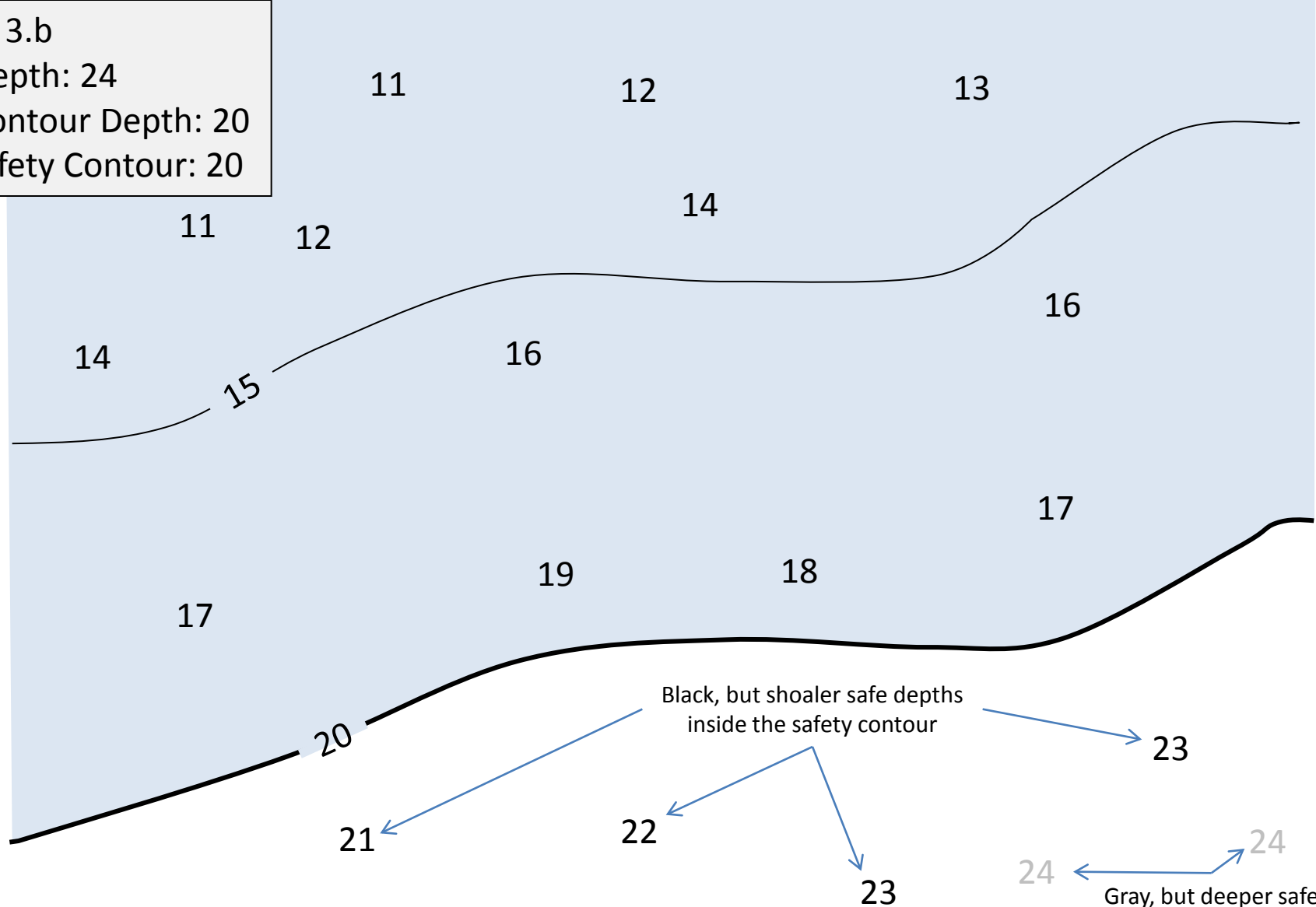Safety Depth: 18
Safety Contour Depth: 17
ECDIS Safety Contour: 20

11          12              13

14

11      12

16

14

15

16        "Safe" black depths
beyond the safety contour

"Safe" gray depths
beyond the safety contour

17

19          18

17

20

23

21          22                    24

24

**Scenario 3:     Safety Depth is set *Deeper* than the value set for the Safety Contour Depth**
Condition:     3.a. – ECDIS selects a depth contour equal to or shoaler than the safety contour depth, *which is deeper than the safety depth*
Display:       All soundings on the "safe-water" side of the safety contour will be gray.
               Some additional soundings on the shoaler side of the safety contour (mostly adjacent to the safety contour, but also in other areas) will be gray.
               Some "safe" soundings equal to or deeper than the safety contour depth selected by the mariner, but shoaler than the safety depth will be
               shown in black on the shoaler side of the safety contour.
Impact:        Additional gray soundings on the shoaler  side of the safety contour provide information about additional maneuvering room, similar to scenario
               1.b.  However, because the safety depth is set deeper than the safety contour depth, some "safe" soundings will be shown in black, so less
               extra "safe" space will be shown with gray soundings than in 1.b.

Scenario 3.b
Safety Depth: 24
Safety Contour Depth: 20
ECDIS Safety Contour: 20

11          12          13

14

11          12                                              16

14

15          16

16

17

19          18

17

20

Black, but shoaler safe depths
inside the safety contour

23

21          22

23                              24          24

Gray, but deeper safe
depths inside the
safety contour

**Scenario 3:**    **Safety Depth is set *Deeper* than the value set for the Safety Contour Depth:**
Condition:    3.b. – ECDIS selects a depth contour equal to or shoaler than the safety contour depth, *but shoaler than the safety depth.*
Display:    Soundings on the safe-water side of the safety contour that are shoaler than the safety depth (mostly adjacent to the safety contour, but also in other areas) will be black. Soundings on the safe-water side of the safety contour that are deeper than the safety depth will be gray.
Impact:    The gray soundings on the safe-water side of the safety contour will show the deepest portion of the safe-water, possible highlighting the safest portion of a narrow passage.