Proper Sizes for Disc Golf Island Greens

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Description of Island Holes

One particular hole design in disc golf is to create an in-bounds area around the target which is itself surrounded by out of bounds.

- The In-bounds area is called the "Island" – whether the area is actually surrounded by water or not.
- For the most extreme version of an island hole, all the world is out of bounds except the island, and players must keep throwing from the tee until they land on the island.
- Often, when the only in-bounds is the island, a drop zone is provided so that players who fail to reach the island make their next throw from a closer spot for a much higher chance of landing in-bounds.
- Other island holes have areas other than the island where the player can land. Usually, this involves a shorter throw to a spot where the next throw to the island is easier.
- The island itself is not always a true island. Any shape of extensive out-of-bounds areas near the green can make a hole act somewhat like an island hole.
- The appeal of island holes is two-fold: The psychological impact of the "do or die" throw, and the higher scores that can be generated in a short space.

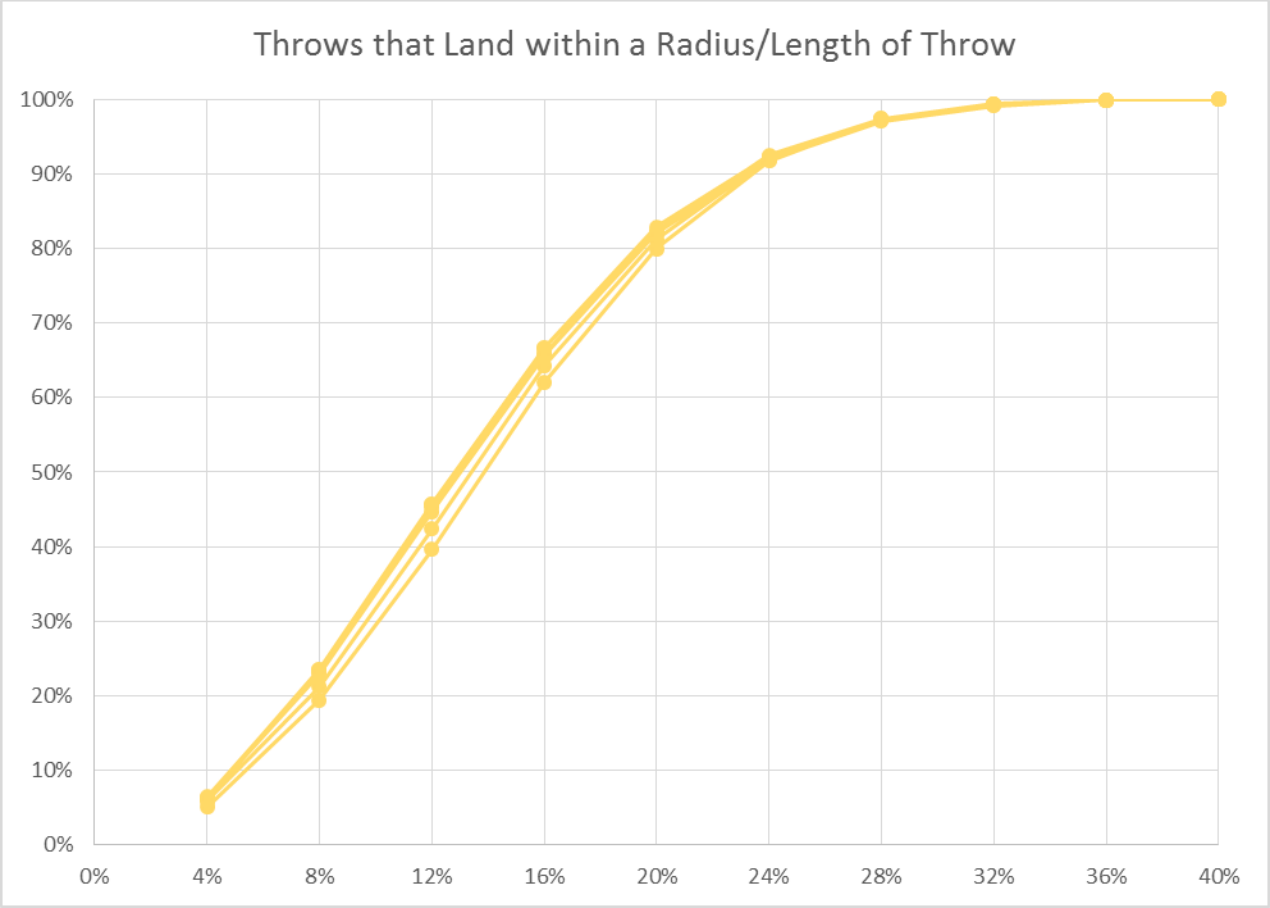
This paper will explore the effects on scoring distributions of different sizes of disc golf greens, both islands and near-islands. The size of the green is defined by the percent of throws that would land on the green.

Model

To determine where throws would land, I used my Throw Model which was developed by measuring actual throws in competition and applying a statistical model to the results. The Throw Model was based on mostly long drives and may not represent the types of throws players make when they are within range of the target.

So, the throw model was calibrated using the scoring data from the more straightforward island holes. With a reachable island and no other in-bounds areas, the scoring distribution can be predicted from the percent of players that land in bounds. With this knowledge, it was found that the distance discs land from the target is only 72% of that in the Throw Model. Or, approach shots are 140% as accurate as long drives.

The calibrated Throw Model gives us a calculated estimate of how many throws land within a certain radius of the target.



Each line in this chart represents a different hole length – from 120 feet to 420. According to the throw model, longer throws make nearly proportionately bigger spray patterns. So, if the size of the island is expressed relative to the length of the throw, the percent of throws that land on the island will be about the same for all lengths of throws that are within the range of the players.

For the general rule of thumb that 66% of players ought to be able to execute a challenge, this chart shows that an island with a radius of 16% (or one-sixth) of the length of the throw should catch about 2/3s of the throws.

A couple of examples:

- For a 300 foot hole, the island should have a radius of at least 50 feet or 15 meters.
- For an island that is 33 feet or 10 meters in radius, the hole should be no longer than about 200 feet.

Size of Irregularly Shaped Islands

Most islands (or other kinds of OB near the target) are not circular and are not centered on the target. For irregularly shaped greens, the effective size is based on the percent of throws that would land in-bounds (or "caught"). Greens that would catch the same percent of throws have the same effective radius.

For example, on a reachable hole where the target is set at the corner of a parking lot (so that one-fourth of the area around the target is OB), then 75% of all throws would land in-bounds. From the chart on the previous page, we see that a circular green with a radius of about 18% of the length of the throw would also catch about 75% of all throws. So, a large green that has one-fourth of its area OB has an effective radius of 18% of the length of the throw.

Because greens can catch, at most, 100% of all throws, there is an upper limit to the effective size of a green. Circular greens with a radius of about one-third of the length of the throw are going to catch virtually all the throws, so that's essentially the maximum effective size for any green.

Therefore, any parts of the green that are father from the target than about one-third of the length of the throw are not going to see many throws. Those areas don't add significantly to the effective size of the green.

Some OB areas may be designed to encourage the thrower to aim somewhere other than the target. For these greens, the effective size is determined by how many throws the green can catch based on where the players are actually aiming.

Effect of Island Sizes on Scoring Distributions

Scoring data and accurate graphics of OB areas for 35 holes were examined. The in-bounds areas on the graphics were translated into mathematical shapes. The Throw Model then generated the spray pattern of throws, and counted how many landed within the in-bounds shapes. The percent of throws that landed in-bounds determined the effective radius of the green.

Also examined were the rules related to OB on the hole, and whether there was a place to safely lay up near the green.

The scoring distribution of each hole was examined in two ways:

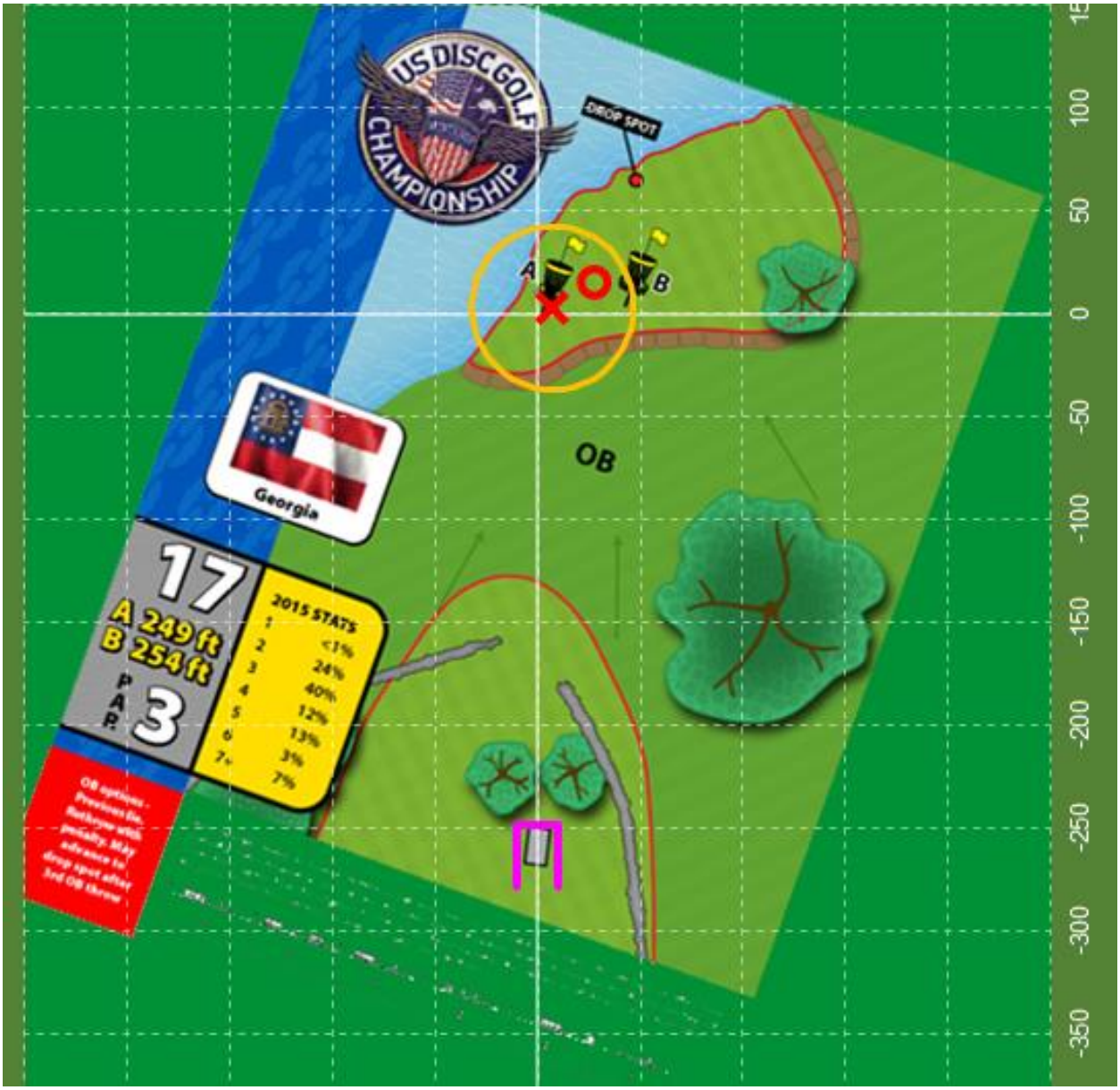
- First, by comparing the mix of 2s, 3s, etc. to a typical mix for a hole with the same average score. The absolute differences were totaled for a Weirdness score.
- Second, the scores near the most common score were examined for local minimums. It is unusual for a score that is +1 or -1 relative to the most common score to be less frequent than a score of +2 or -2. For example, if the most common score is 4, there are usually more 3s than 2s. However, the signature of island holes is that they create a two-humped or saw tooth scoring distribution because of the double punishment of the OB penalty plus not progressing down the fairway.

Extreme Example

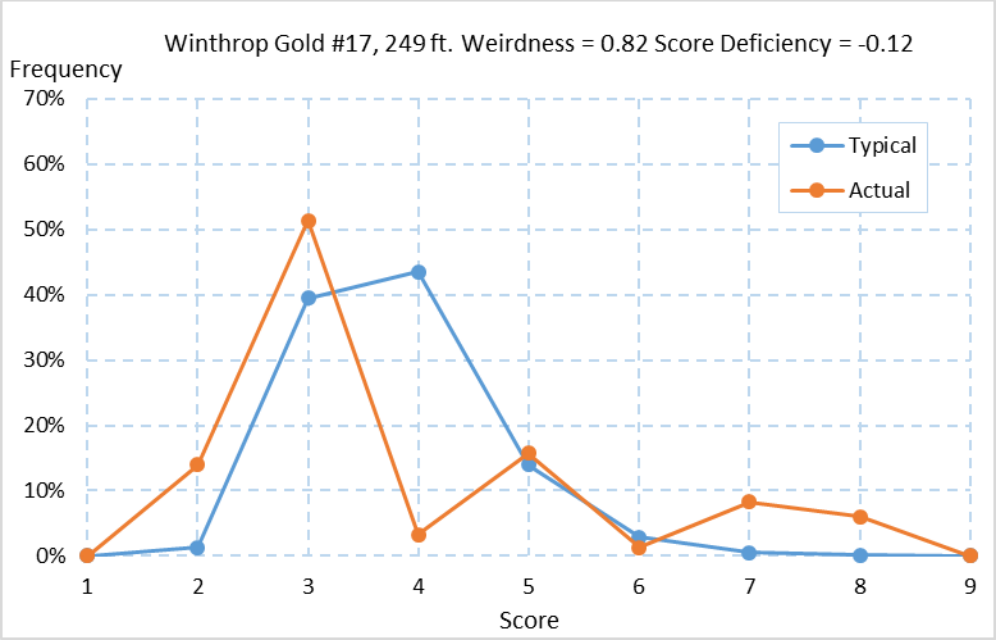
Hole 17 at Winthrop Gold is the most notorious island hole in disc golf. See the graphic below.

For 1000-rated players, it was calculated geometrically that in the A position, the green has an effective radius of 16% of the length of the throw (40 feet or 12 meters). This is shown as the Gold Circle on the graphic. We would expect about 66% of players to land on the green, and based on the number of 2s and 3s, it appears 65% of players did land there.

This hole uses Throw and Distance rules and is a true island in that it does not offer a continuous place to lay up to safely approach the target. The hole offers a Drop Zone, but it does not come into play until the 3rd OB throw, so the DZ is essentially meaningless.



The scoring distribution of Winthrop Gold #17 is shown in the graph below, along with the typical distribution for a hole with the same average score of 3.88.

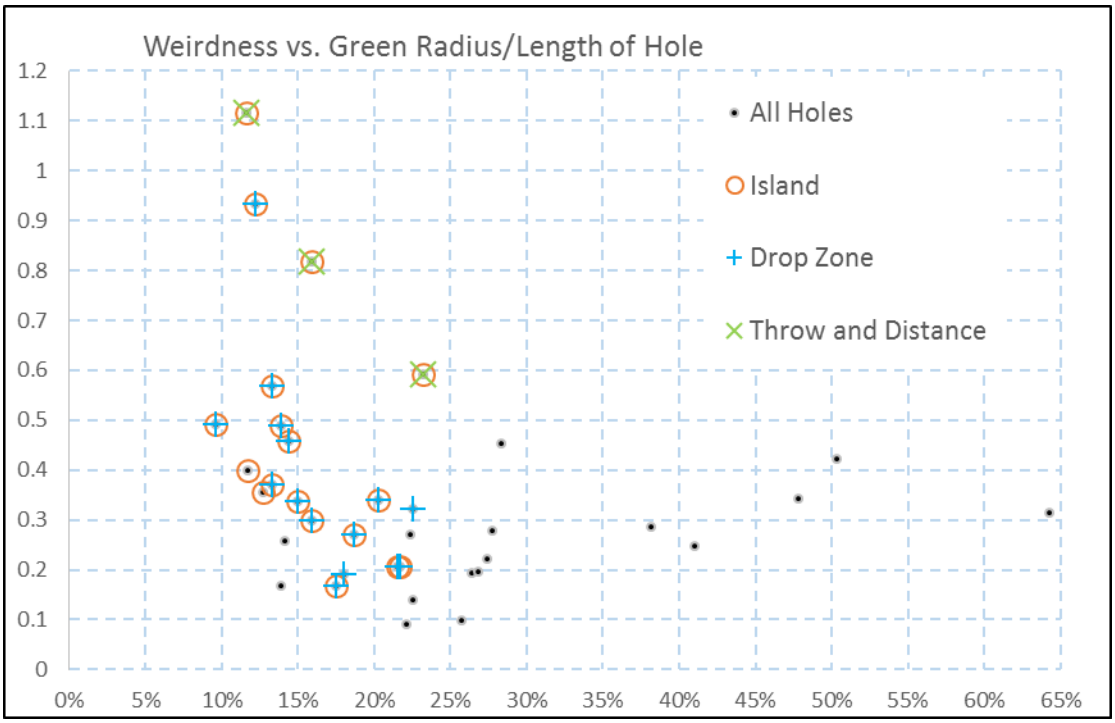


The typical hole with a 3.88 average generates mostly 3s and 4s with a few 5s. This hole pumps up the average by turning 4s into 7s and 8s. The differences between typical and actual add up to a Weirdness of .82 throws, which is a lot.

A different anomaly is that the frequency of 4s is lower than the frequency of either 3s or 5s. This Scoring Deficiency is -0.12.

Results for all Holes - Weirdness

This chart shows the Weirdness of holes, based on the effective size of the green and the rules that apply.



Look first at the dots that indicate a relatively large green – bigger than 33% of the length of the throw. These greens catch almost all throws and therefore should not be causing any weirdness on their own. We can see that Weirdness up to about 0.45 throws seems like it is within the range of "normal" holes.

Notice that there aren't many holes with small (< 16%) greens that are not islands. This is true despite looking at all 442 holes and hand-picking those with small non-island greens as a control group. The few holes that have greens as small as the islands do not seem to exhibit a high degree of Weirdness.

For the moderate island holes (those that have Drop Zones or places to layup near the island), most do not exhibit a high degree of Weirdness, even for islands as small as 10% of the length of the throw. However, all the moderate island holes that have high Weirdness also have greens smaller than a radius of about 16% of the length of the throw.

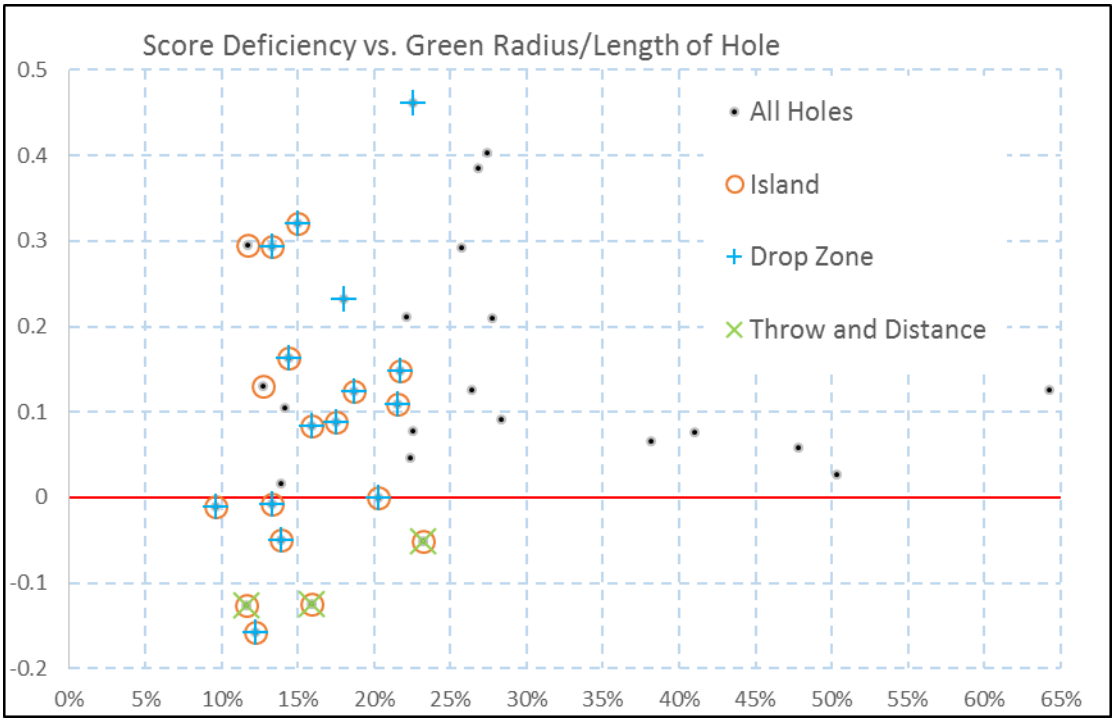
The extreme islands (those that use Throw and Distance with no Drop Zone or safe path to the target) all exhibit a high degree of Weirdness. There may not be any size of island large enough to eliminate a high degree of Weirdness for Throw and Distance Island holes, but if there is, it's probably a radius of 25% of the length of the throw or more.

Results for all Holes – Score Deficiency

While Weirdness measures the departure from typicality across all scores, Score Deficiency focuses on a specific characteristic: too few of a particular score which is next to the most common score. The scores which are next to the most common score are typically more frequent than scores which are farther from the most common score.

The advantage of this test is that it provides a bright line. The measure is the frequency of a score which is 1 different from the most common score, minus the frequency of a score which is 2 different from the most common score.

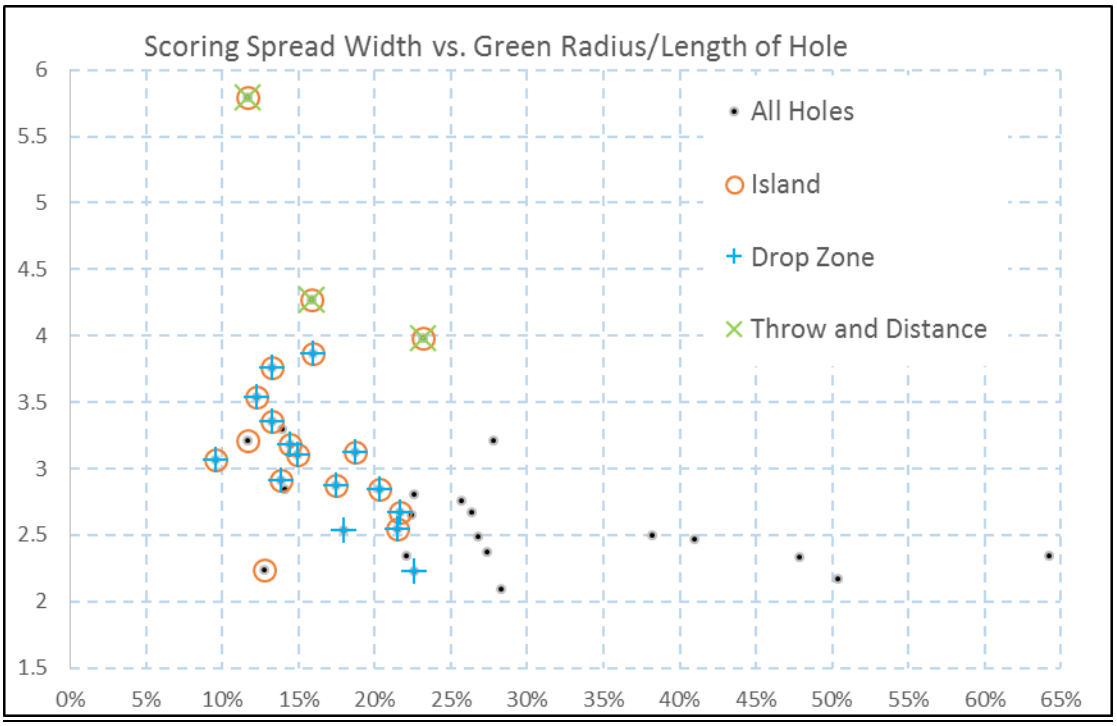
A negative result (below the red line) puts the hole into the atypical category. This is also called a two-humped, or saw tooth, distribution. See the Winthrop graph at scores 3, 4, and 5.



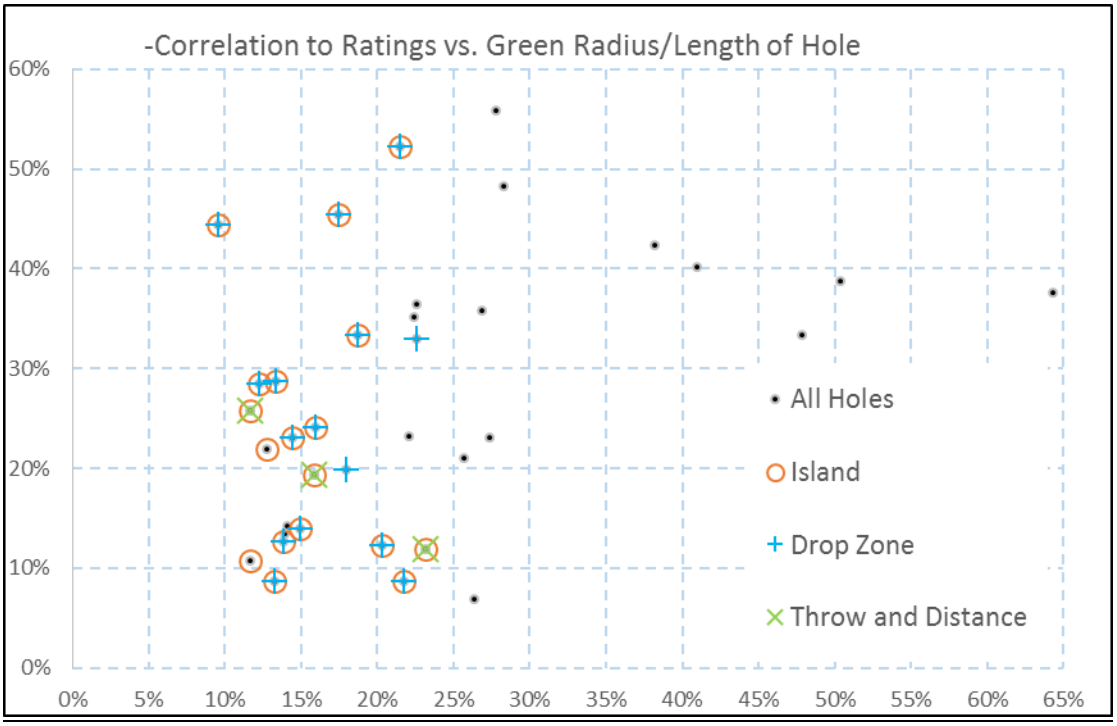
All holes that exhibited a Score Deficiency were island holes. However, many island holes did not exhibit Score Deficiency, even for small islands.

Although no holes that were not islands exhibited a Score Deficiency, there were not enough small-green non-island holes to determine whether a hole needs to be a true island to exhibit a score deficiency.

Scoring Spread Width



-Correlation to Ratings



How to Measure the Size of an Irregularly Shaped Green for a One-Drive Hole

1. Determine the point where the players will be trying to land. Most often, this is the target. Call this the Center.

2. Find the length of the throw to the Center. Measure from the tee to the center.

3. From the Center, measure the radius to the nearest out of bounds in 8 different directions. Use the compass points, N, NE, E, etc. For any direction where there is no out of bounds within a radius of 33% of the length of the throw, use 33% of the length of the throw.

4. For any radius that is greater than 20% of the length of the throw, the effective radius needs to be discounted. Reduce the radius by 2/3rds of the excess of the radius over 20%. For example, if the radius is 29% of the length of the throw, the effective radius is 23%.

5. Take the average of all 8 effective radiuses. That is the size of the green.

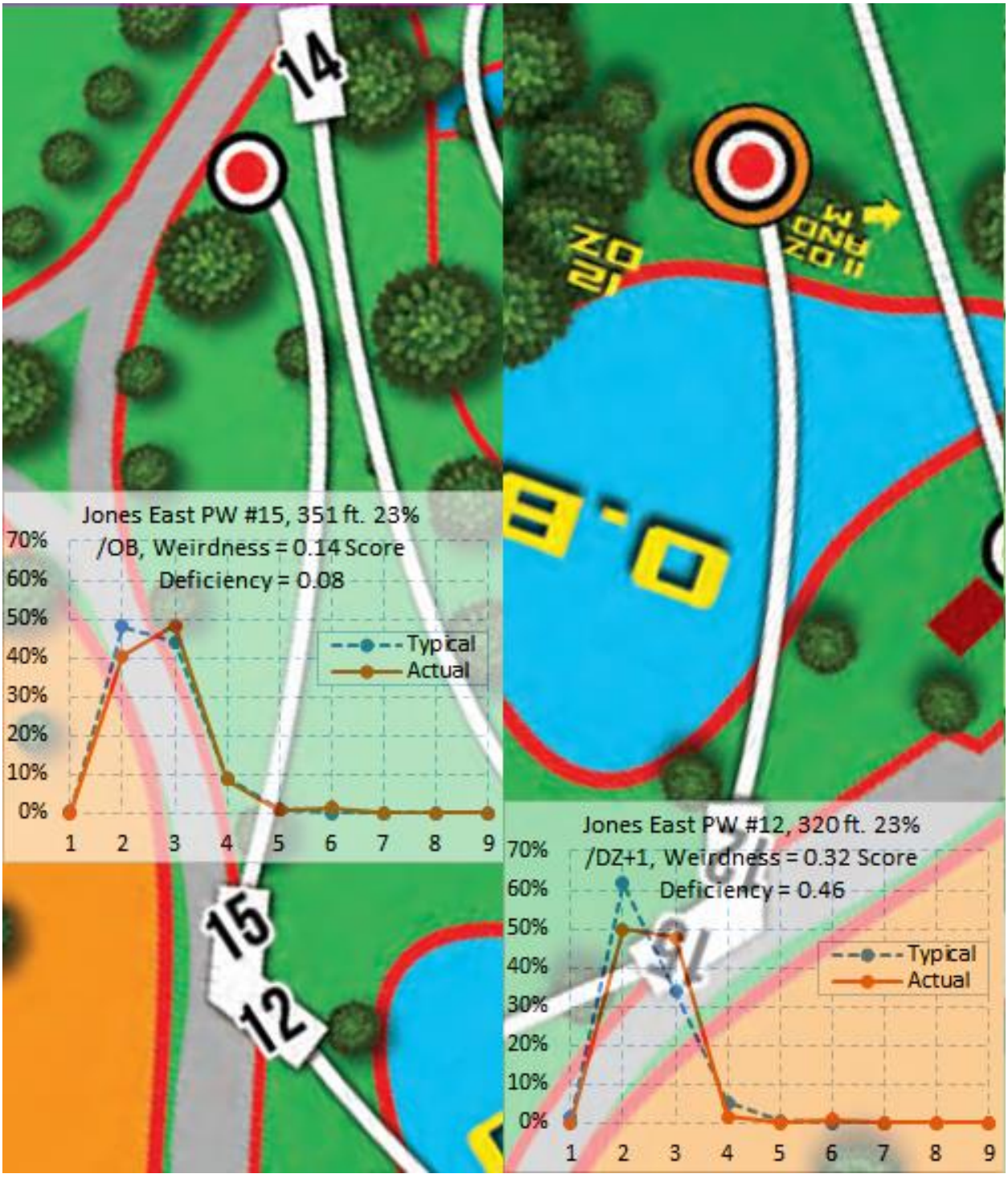
Conclusions for One-Drive Holes and 1000-rated Players

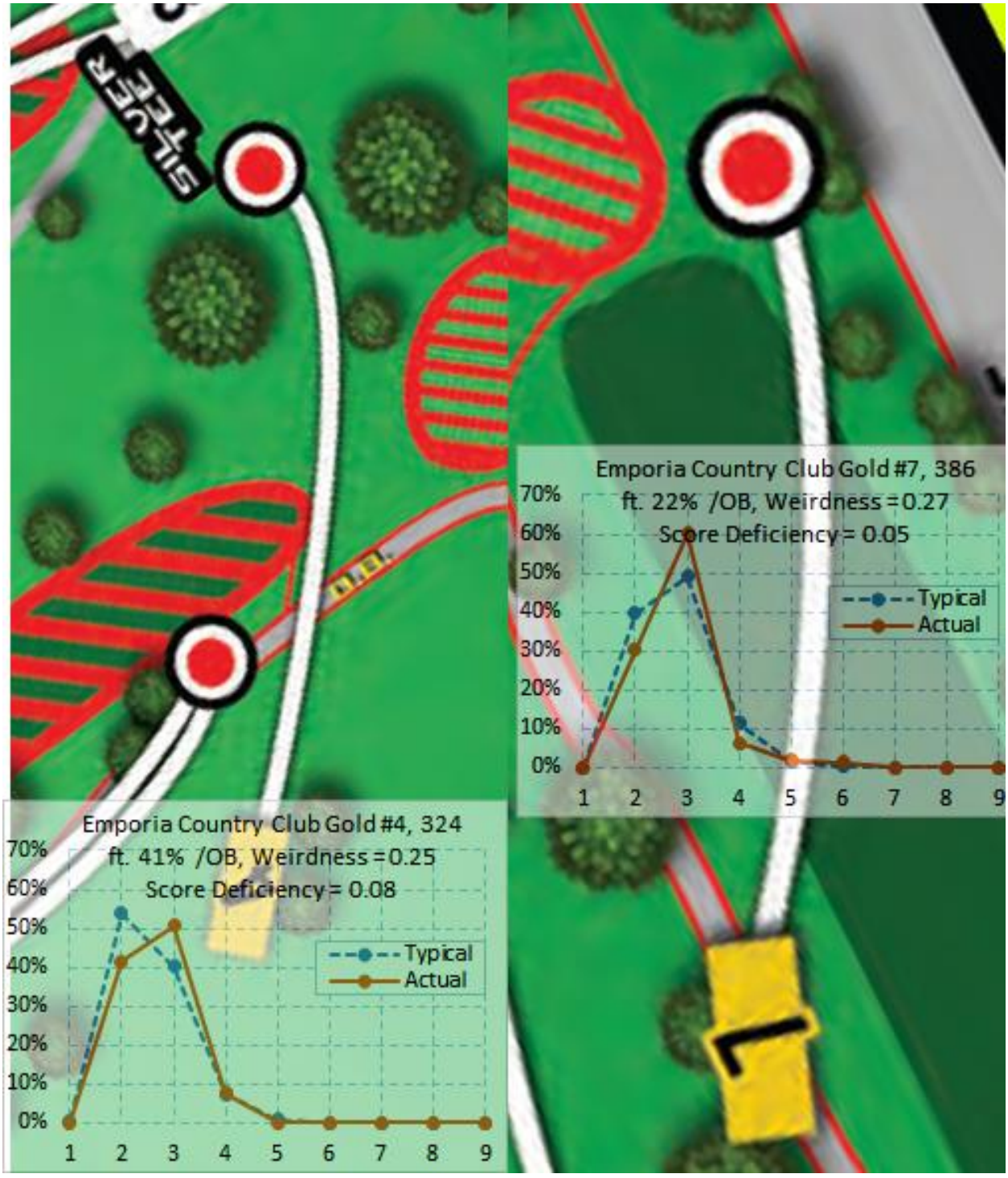
Island holes that offer layup routes or drop zones and have an island with an effective radius greater than 16% of the length of the throw can be expected to produce typical scoring distributions. Smaller islands may cause non-typical distributions and should be tested before being used in competition.

Islands with an effective radius smaller than 12% of the length of the throw are unlikely to be able to produce typical scoring distributions.

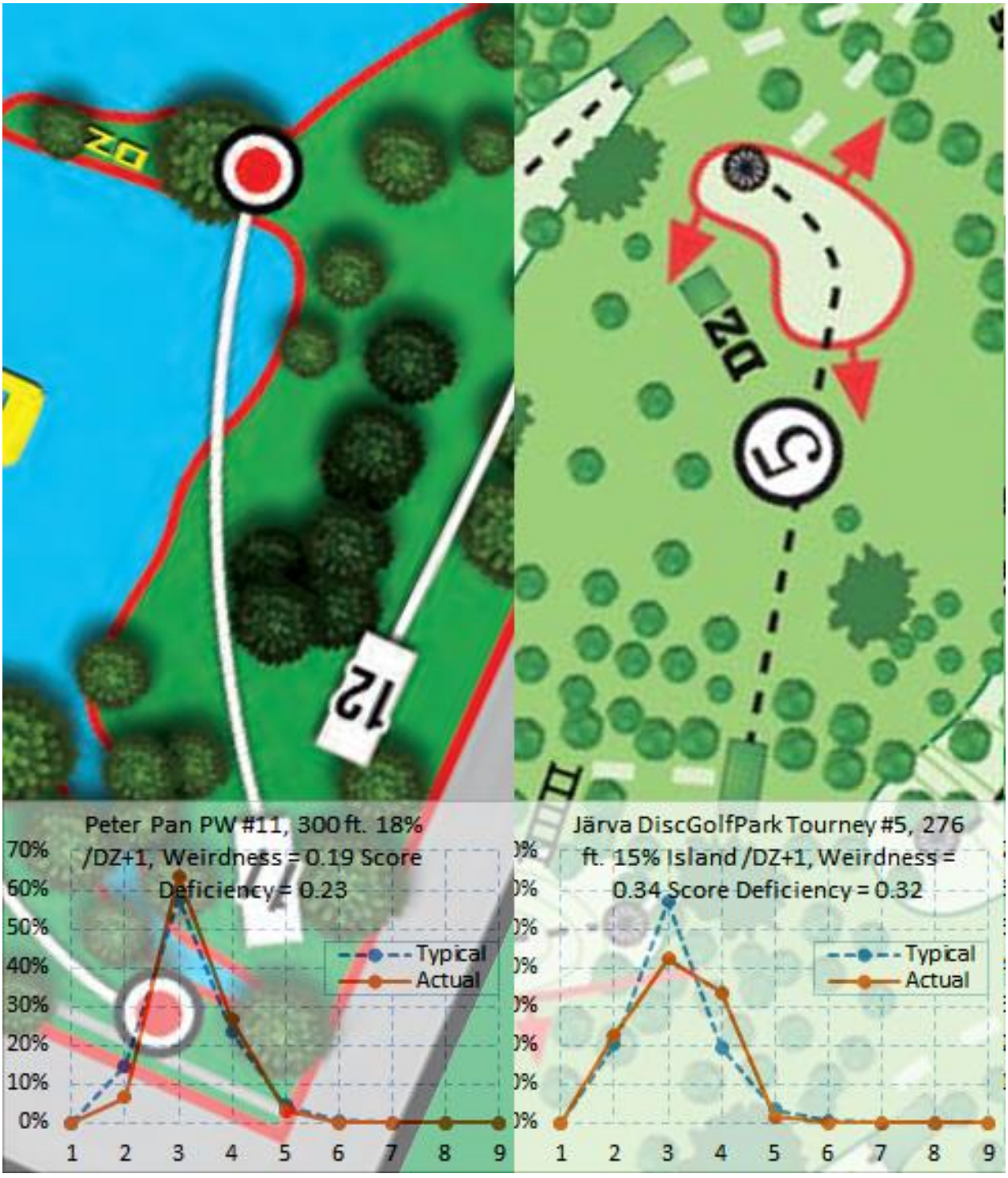
Holes with greens that are not true islands but have extensive OB near the target may also produce non-typical scoring distributions. Greens with an effective radius smaller than 16% of the length of the throw to the target should be tested before being used in competition.

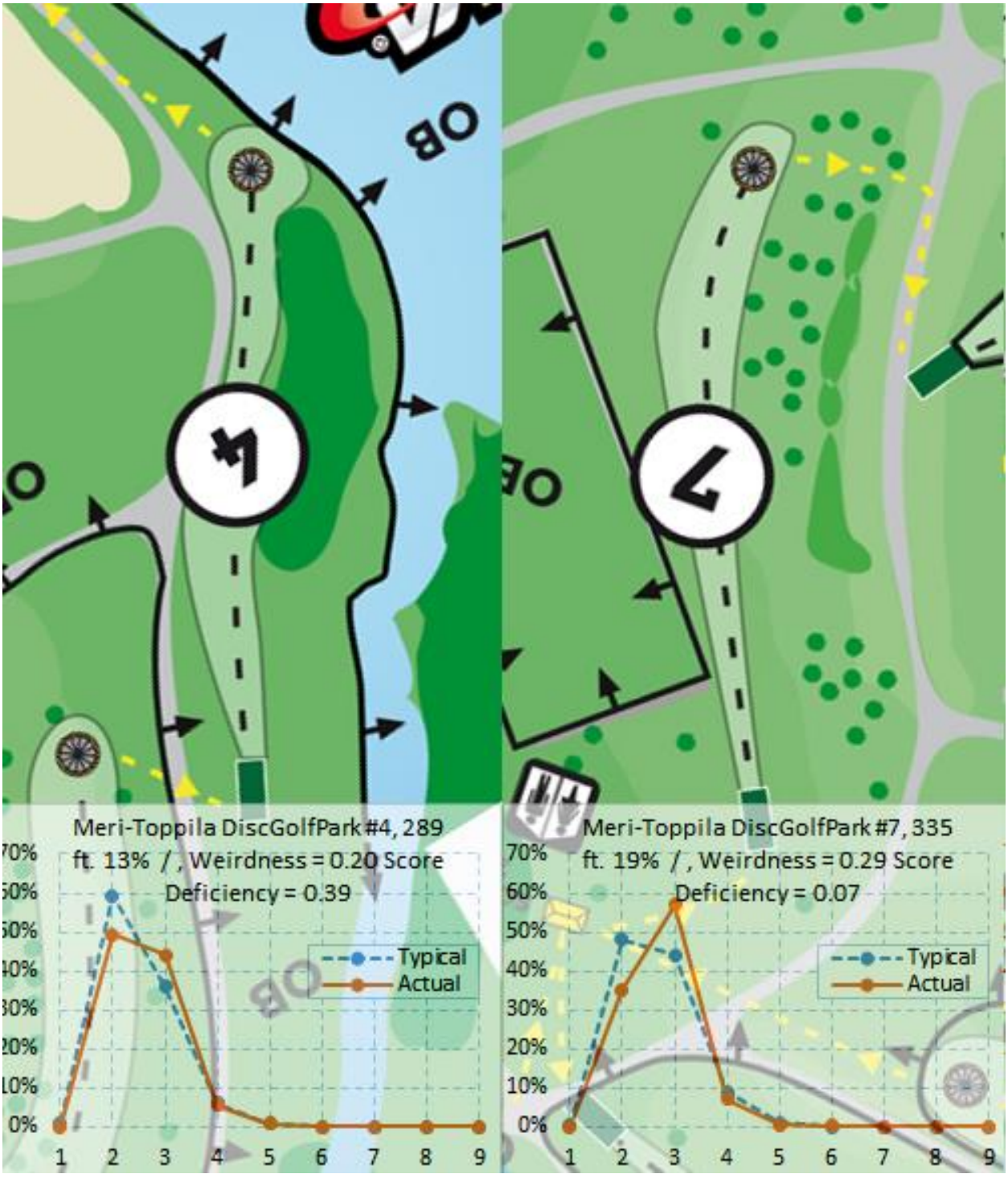
There are no known examples of holes that use Throw and Distance and produce typical scoring distributions, no matter the size of the island. All holes that use Throw and Distance should be tested before being used in competition.

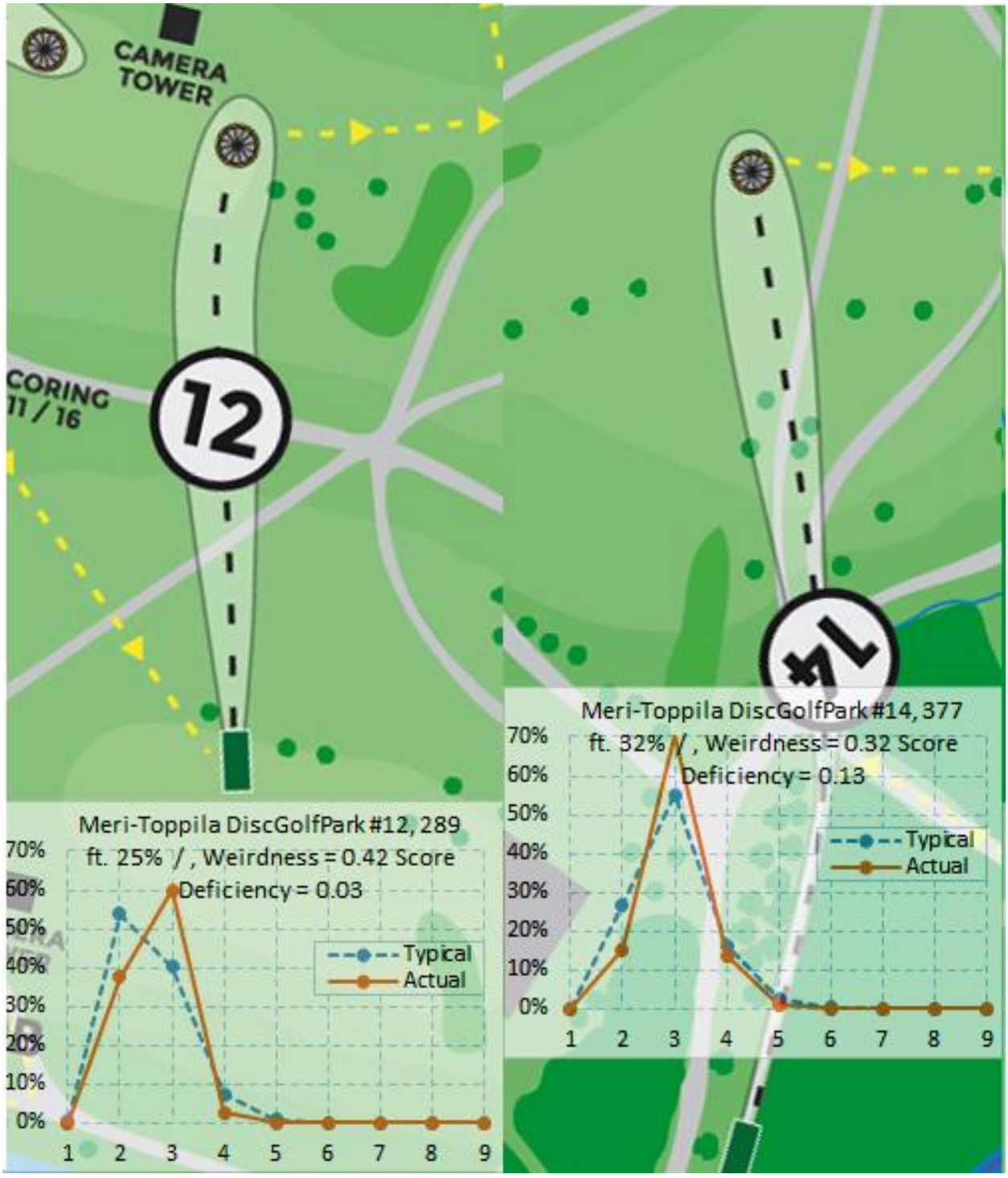

14
15
12
Jones East PW #15, 351 ft. 23%
/OB, Weirdness = 0.14 Score
Deficiency = 0.08
70%
60%
50%
40%
30%
20%
10%
0%
1 2 3 4 5 6 7 8 9
Typical
Actual
Jones East PW #12, 320 ft. 23%
/DZ+1, Weirdness = 0.32 Score
Deficiency = 0.46
70%
60%
50%
40%
30%
20%
10%
0%
1 2 3 4 5 6 7 8 9
Typical
Actual

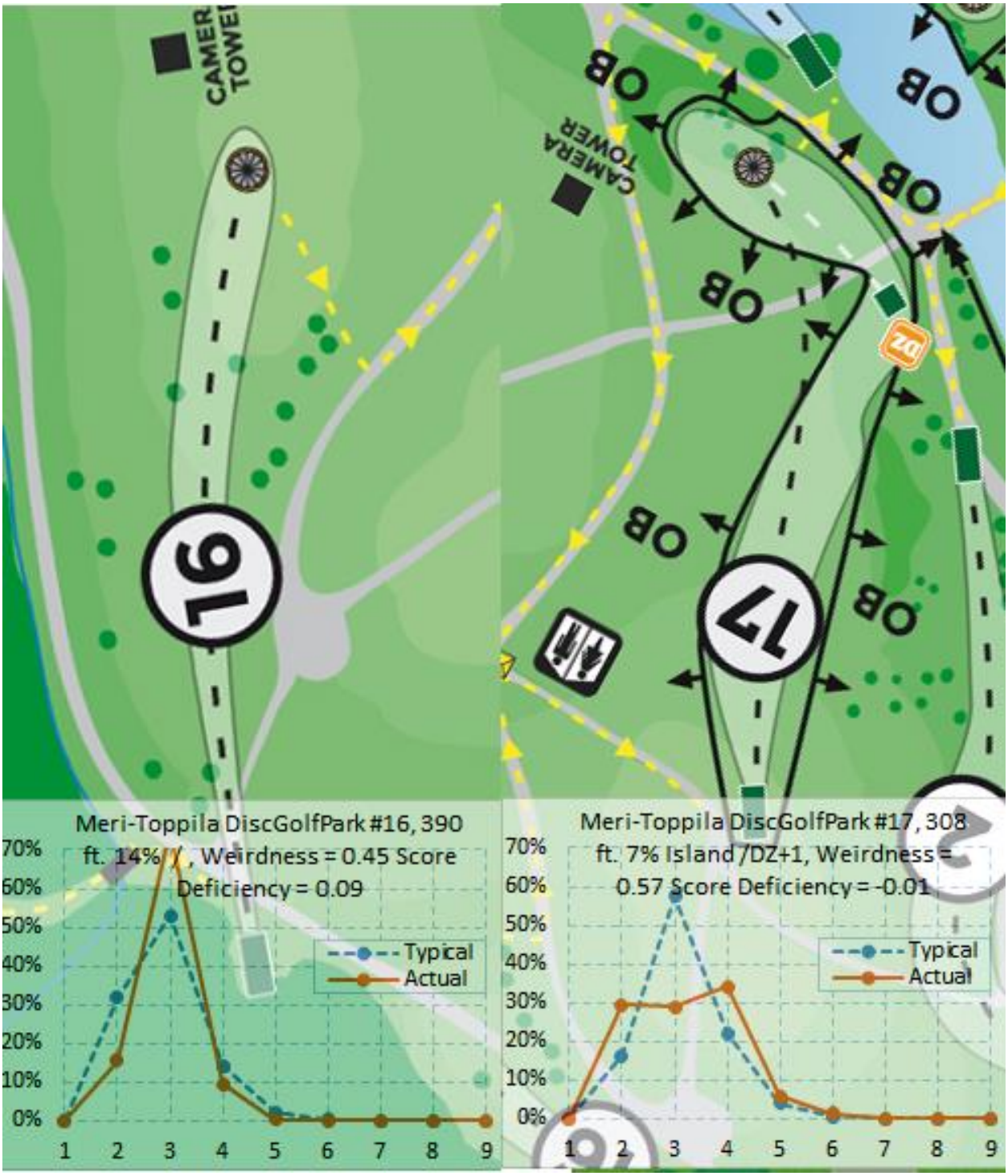

Emporia Country Club Gold #7, 386
ft. 22% /OB, Weirdness = 0.27
Score Deficiency = 0.05
70%
60%
50%
40%
30%
20%
10%
0%
1 2 3 4 5 6 7 8 9
Typical
Actual
Emporia Country Club Gold #4, 324
ft. 41% /OB, Weirdness = 0.25
Score Deficiency = 0.08
70%
60%
50%
40%
30%
20%
10%
0%
1 2 3 4 5 6 7 8 9
Typical
Actual

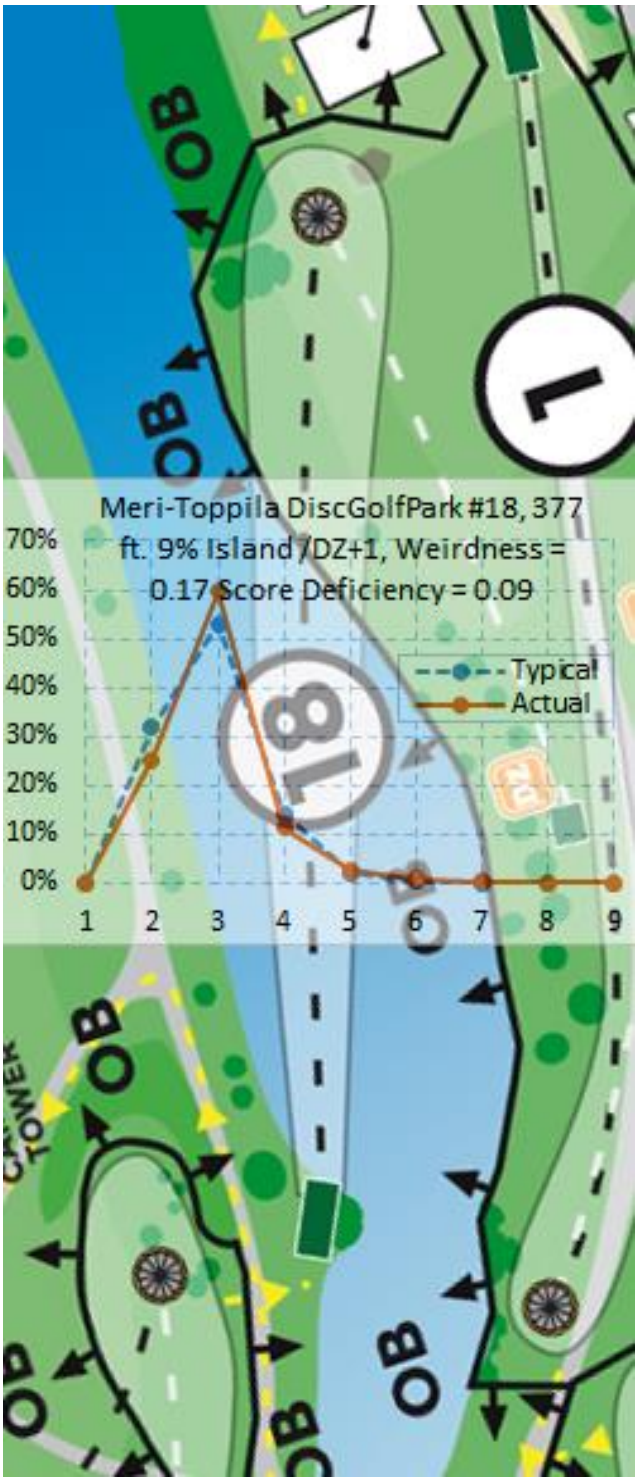

Emporia Country Club Gold #13,
371 ft. 14% /OB, Weirdness = 0.17
Score Deficiency = 0.02
Typical
Actual
0%
0%
0%
0%
0%
0%
10%
0%
1 2 3 4 5 6 7 8 9
13
Emporia Country Club Gold #16,
365 ft. 14% Island /DZ+1,
Weirdness = 0.46 Score Deficiency
= 0.16
Typical
Actual
0%
0%
50%
40%
30%
20%
10%
0%
1 2 3 4 5 6 7 8 9
16
18


DZ
12
DZ
5
Peter Pan PW #11, 300 ft. 18% /DZ+1, Weirdness = 0.19 Score Deficiency = 0.23
70%
60%
50%
40%
30%
20%
10%
0%
1 2 3 4 5 6 7 8 9
Typical
Actual
Järva DiscGolfPark Tourney #5, 276 ft. 15% Island /DZ+1, Weirdness = 0.34 Score Deficiency = 0.32
1 2 3 4 5 6 7 8 9
Typical
Actual

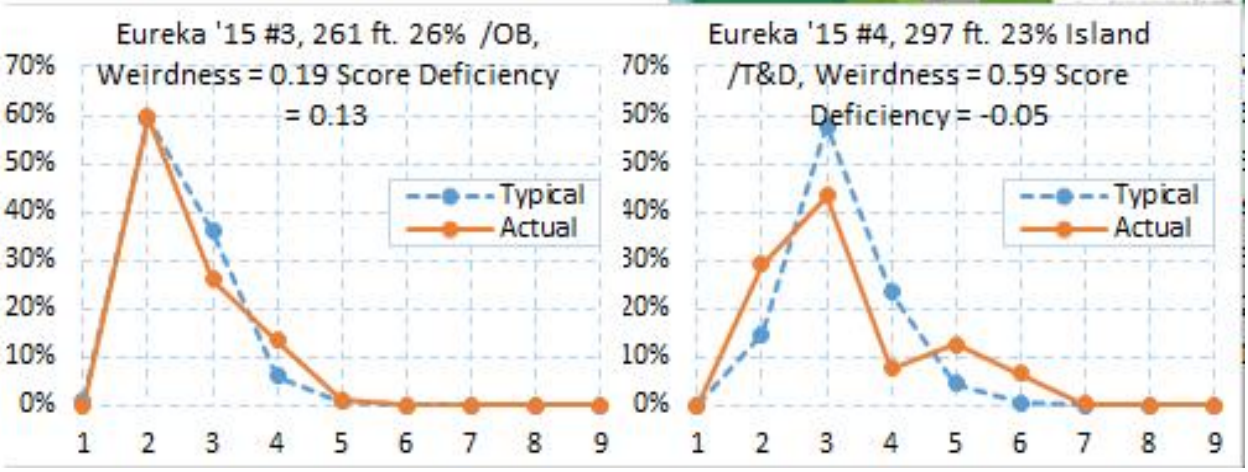

OB
4
OB
7
Meri-Toppila DiscGolfPark #4, 289 ft. 13% / , Weirdness = 0.20 Score
Deficiency = 0.39
Typical
Actual
70%
60%
50%
40%
30%
20%
10%
0%
1 2 3 4 5 6 7 8 9
Meri-Toppila DiscGolfPark #7, 335 ft. 19% / , Weirdness = 0.29 Score
Deficiency = 0.07
Typical
Actual
70%
60%
50%
40%
30%
20%
10%
0%
1 2 3 4 5 6 7 8 9


CAMERA TOWER
CORING 11 / 16
12
14
Meri-Toppila DiscGolfPark #12, 289 ft. 25% / , Weirdness = 0.42 Score
Deficiency = 0.03
Typical
Actual
70%
60%
50%
40%
30%
20%
10%
0%
1 2 3 4 5 6 7 8 9
Meri-Toppila DiscGolfPark #14, 377 ft. 32% / , Weirdness = 0.32 Score
Deficiency = 0.13
Typical
Actual
70%
60%
50%
40%
30%
20%
10%
0%
1 2 3 4 5 6 7 8 9

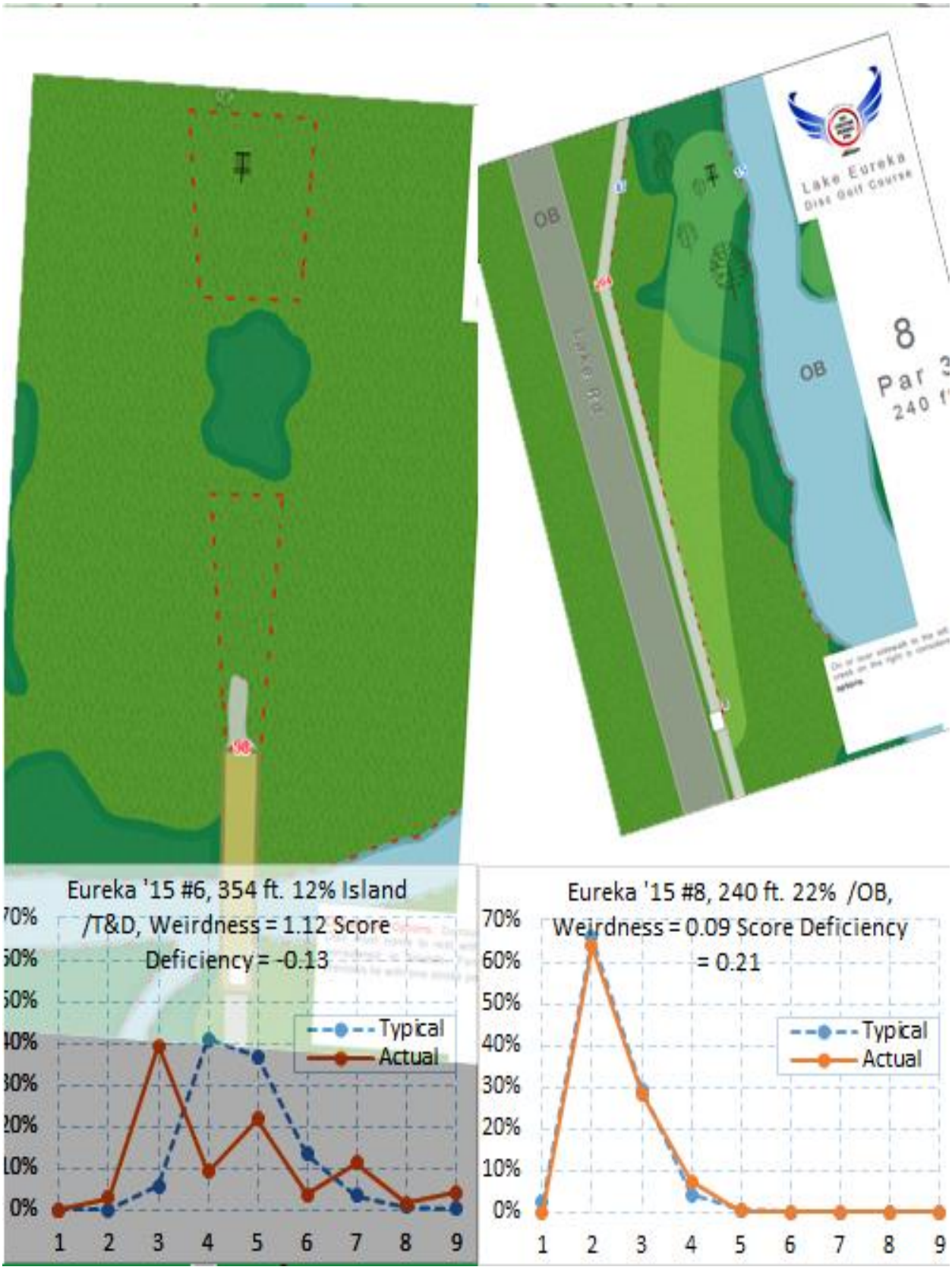

CAMERA TOWER
16
OB
CAMERA TOWER
OB
OB
OB
DZ
17
OB
Meri-Toppila DiscGolfPark #16, 390 ft. 14% /, Weirdness = 0.45 Score Deficiency = 0.09
70%
60%
50%
40%
30%
20%
10%
0%
1 2 3 4 5 6 7 8 9
Typical
Actual
Meri-Toppila DiscGolfPark #17, 308 ft. 7% Island /DZ+1, Weirdness = 0.57 Score Deficiency = -0.01
70%
60%
50%
40%
30%
20%
10%
0%
1 2 3 4 5 6 7 8 9
Typical
Actual

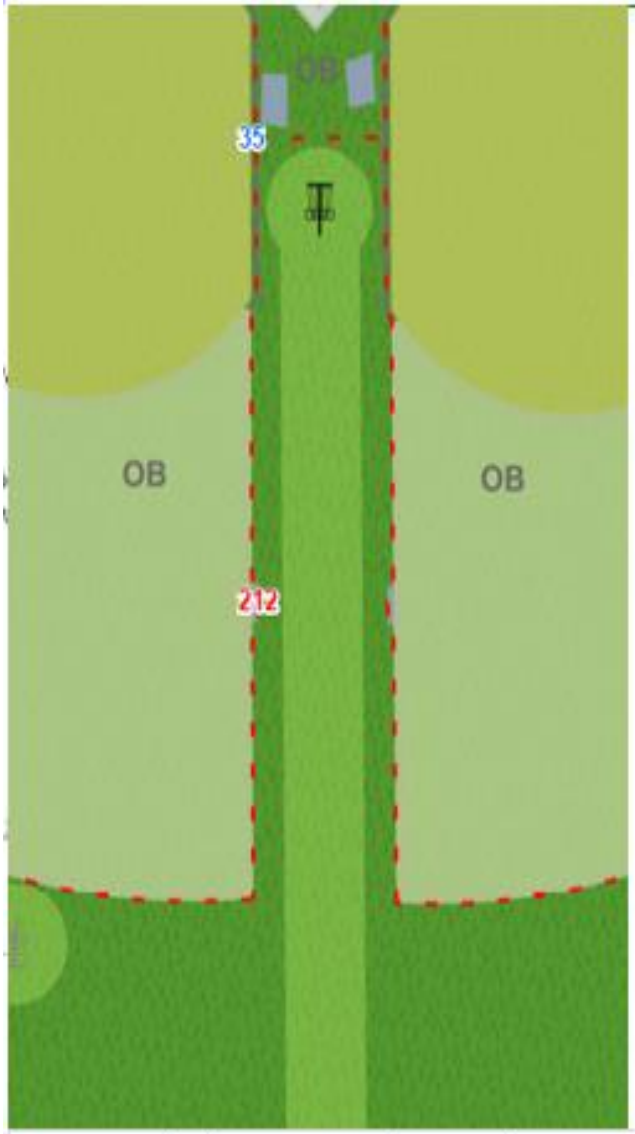

Meri-Toppila DiscGolfPark #18, 377 ft. 9% Island /DZ+1, Weirdness = 0.17 Score Deficiency = 0.09
70%
60%
50%
40%
30%
20%
10%
0%
1
2
3
4
5
6
7
8
9
Typical
Actual
OB
OB
OB
OB
OB
OB
1
18

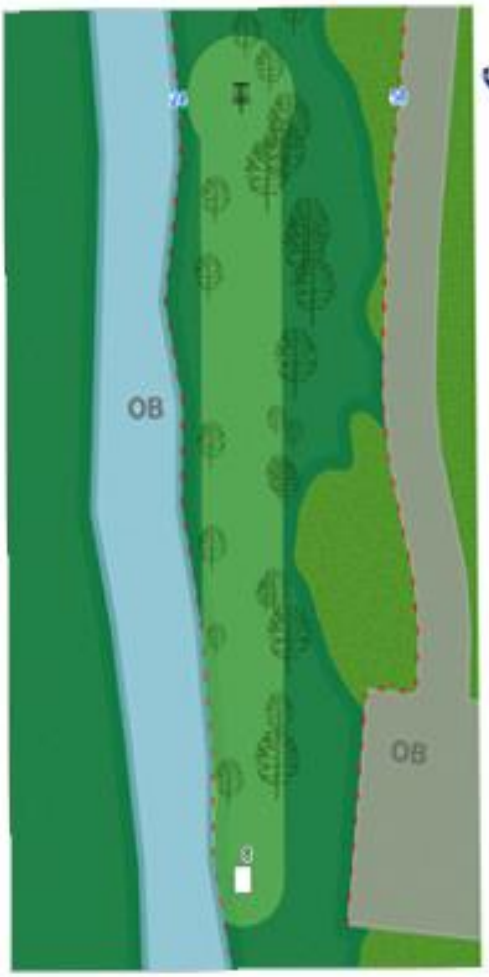

OB
OB
OB

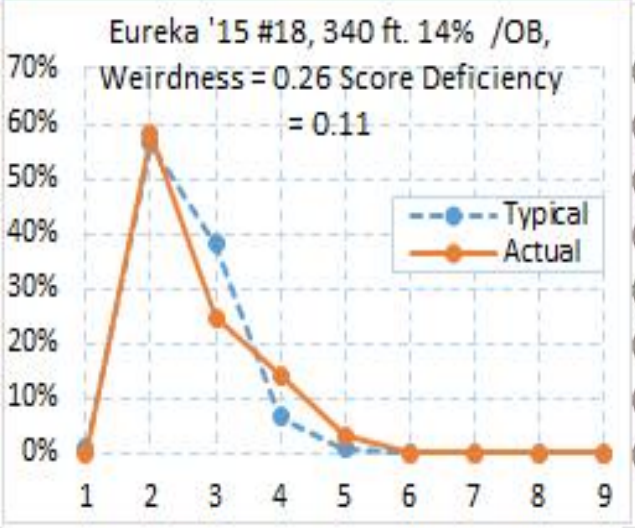

Eureka '15 #3, 261 ft. 26% /OB, Weirdness = 0.19 Score Deficiency = 0.13
70%
60%
50%
40%
30%
20%
10%
0%
1 2 3 4 5 6 7 8 9
Typical
Actual

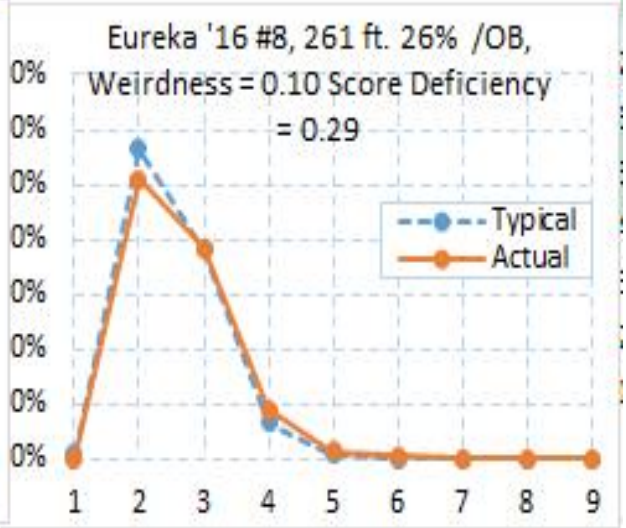
Eureka '15 #4, 297 ft. 23% Island /T&D, Weirdness = 0.59 Score Deficiency = -0.05
70%
50%
40%
30%
20%
10%
0%
1 2 3 4 5 6 7 8 9
Typical
Actual

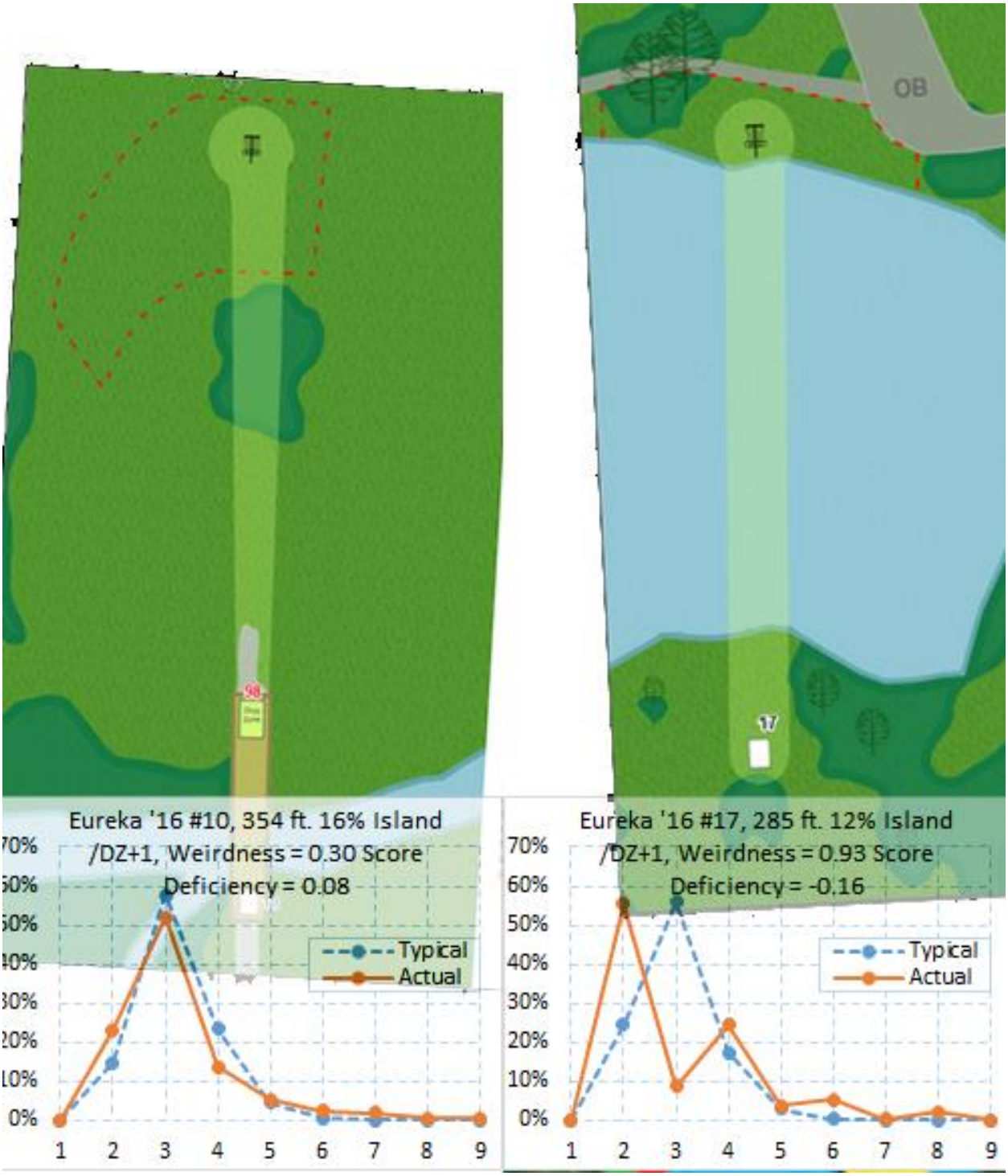

OB
OB
8
Par
Lake Eureka
Disc Golf Course
Eureka '15 #6, 354 ft. 12% Island /T&D, Weirdness = 1.12 Score Deficiency = -0.13
Typical
Actual
1 2 3 4 5 6 7 8 9
Eureka '15 #8, 240 ft. 22% /OB, Weirdness = 0.09 Score Deficiency = 0.21
70%
60%
50%
40%
30%
20%
10%
0%
Typical
Actual
1 2 3 4 5 6 7 8 9

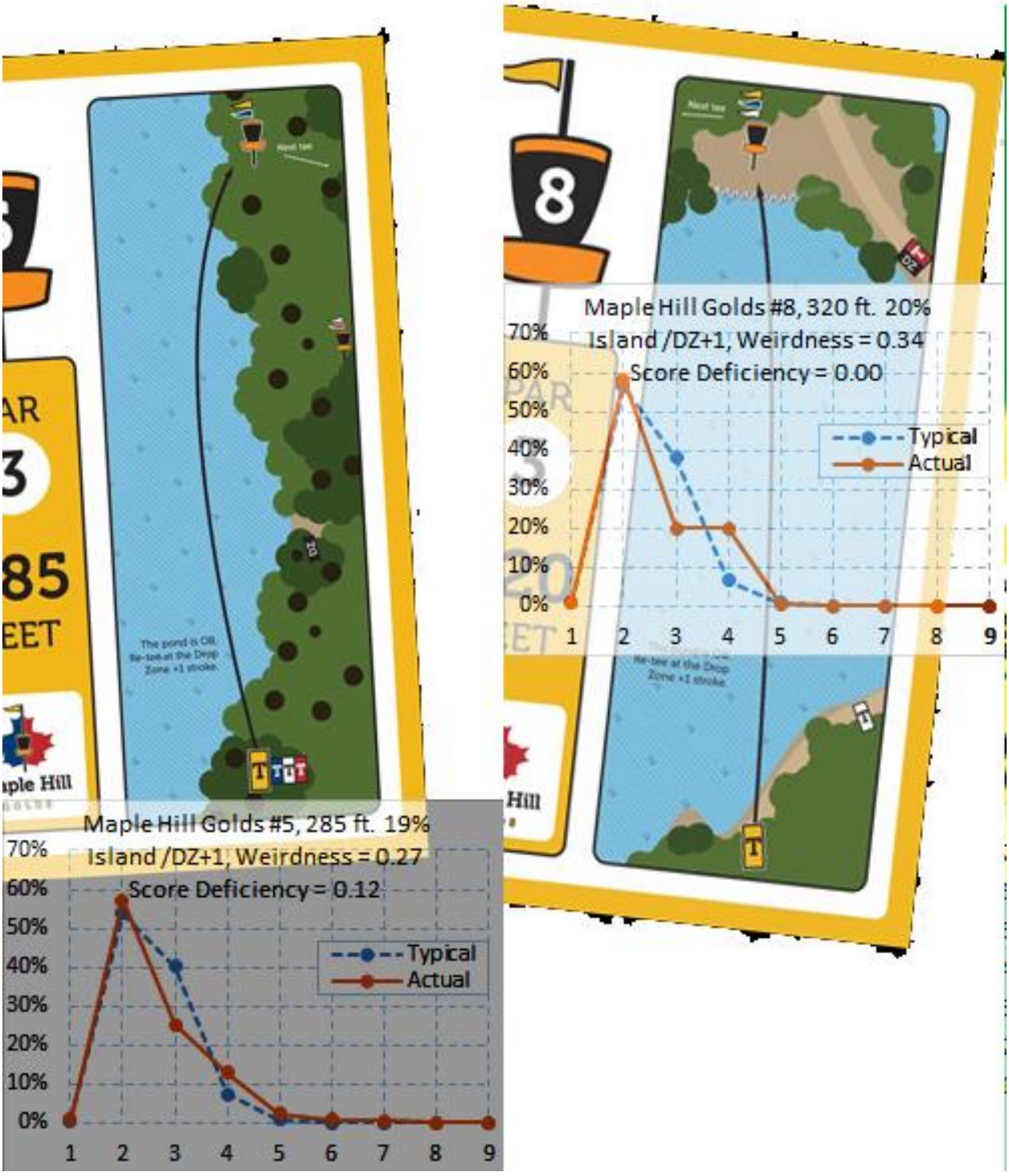

OB
35
OB
OB
212

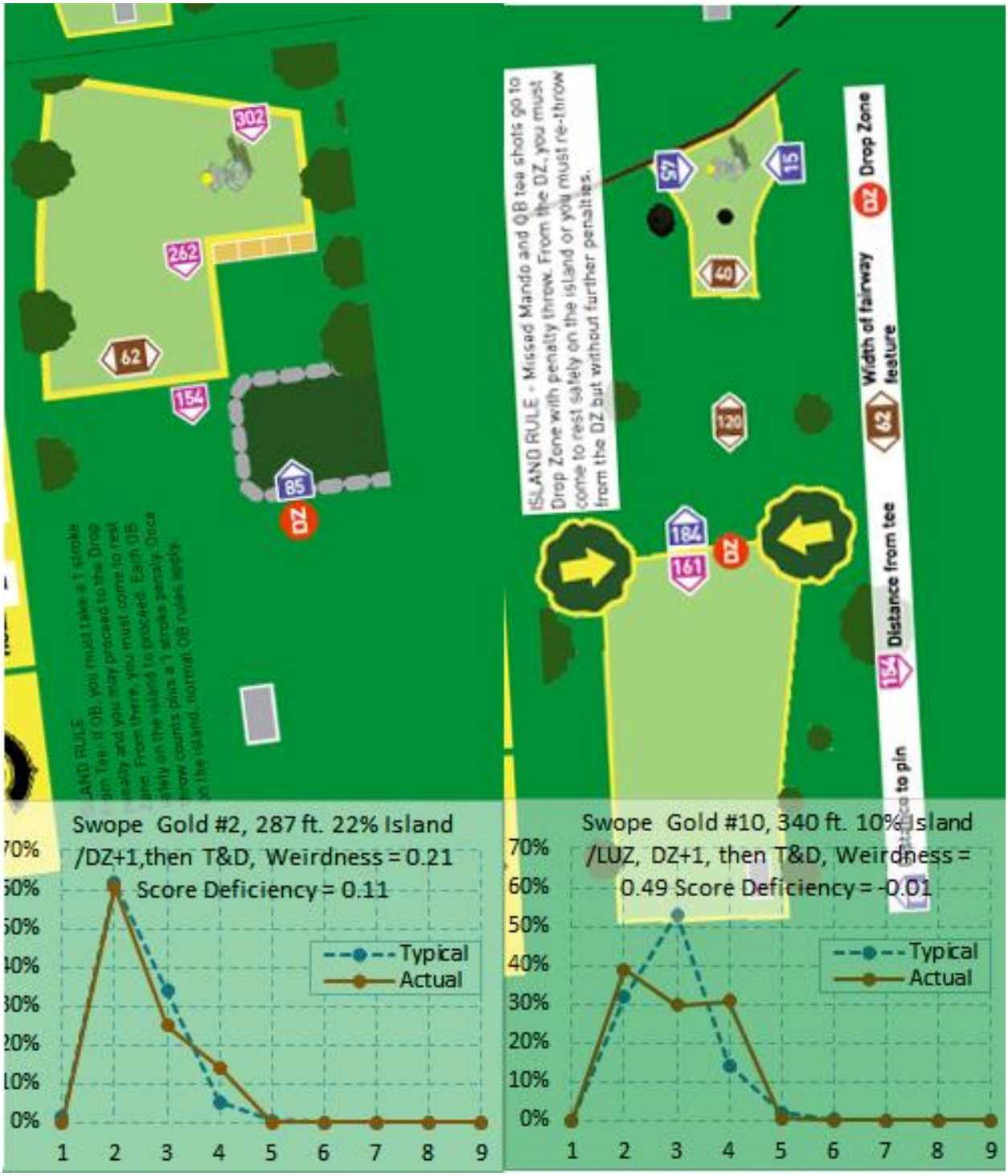

OB
OB

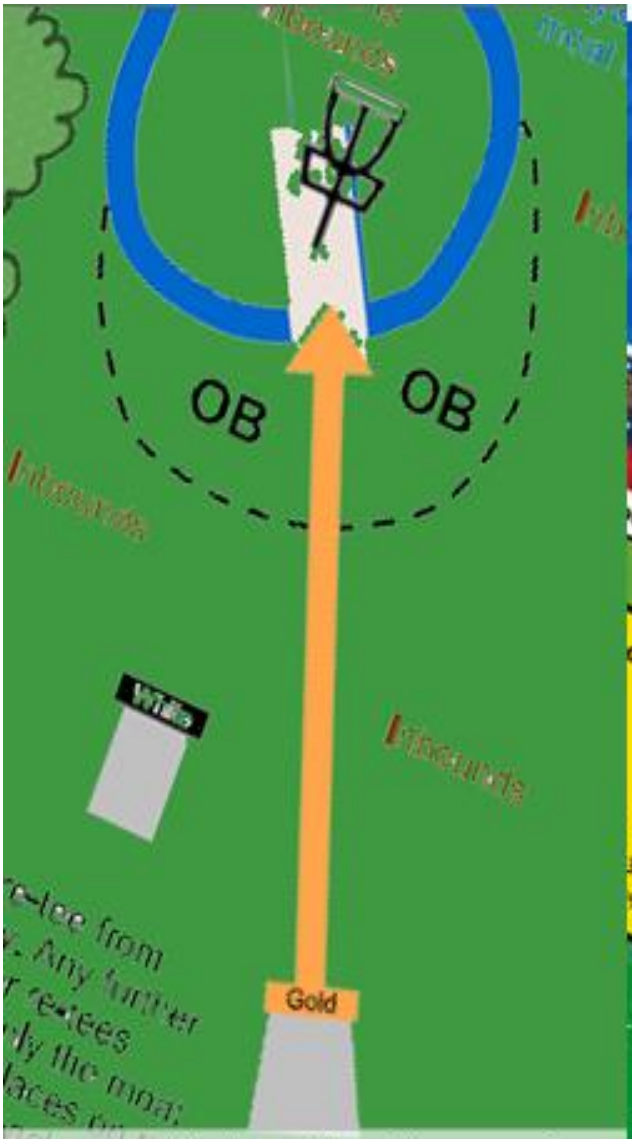

Eureka '15 #18, 340 ft. 14% /OB,
Weirdness = 0.26 Score Deficiency = 0.11
70%
60%
50%
40%
30%
20%
10%
0%
1 2 3 4 5 6 7 8 9
Typical
Actual


Eureka '16 #8, 261 ft. 26% /OB,
Weirdness = 0.10 Score Deficiency = 0.29
0%
0%
0%
0%
0%
0%
0%
0%
1 2 3 4 5 6 7 8 9
Typical
Actual

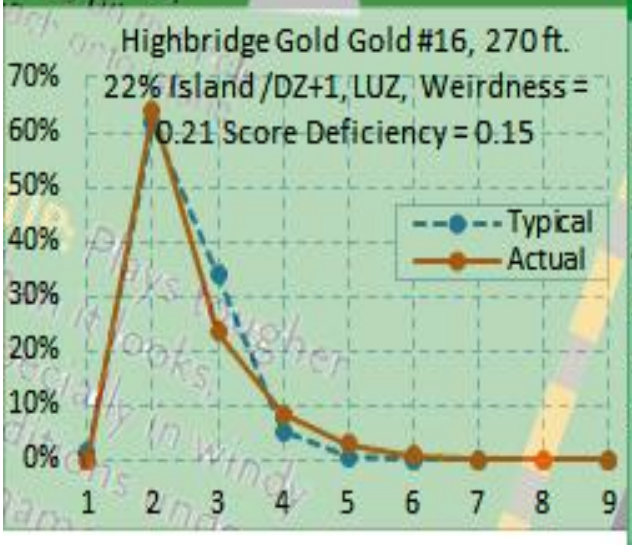

OB
98
17
Eureka '16 #10, 354 ft. 16% Island
/DZ+1, Weirdness = 0.30 Score
Deficiency = 0.08
Typical
Actual
70%
60%
50%
40%
30%
20%
10%
0%
1
2
3
4
5
6
7
8
9
Eureka '16 #17, 285 ft. 12% Island
/DZ+1, Weirdness = 0.93 Score
Deficiency = -0.16
Typical
Actual
70%
60%
50%
40%
30%
20%
10%
0%
1
2
3
4
5
6
7
8
9

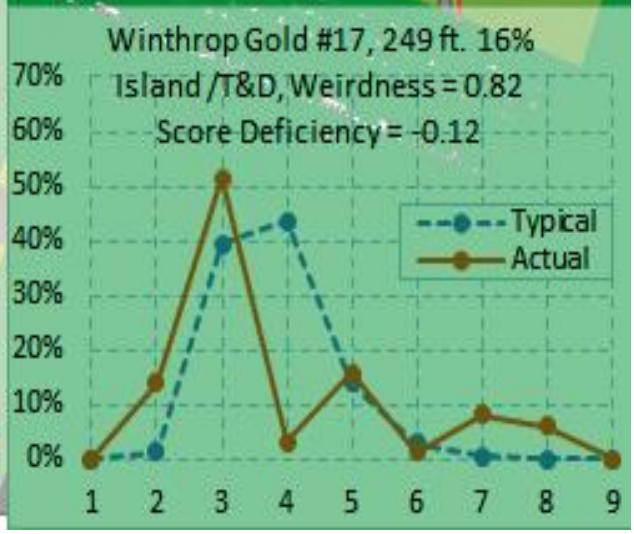

8
Maple Hill Golds #8, 320 ft. 20%
Island /DZ+1, Weirdness = 0.34
Score Deficiency = 0.00
70%
60%
50%
40%
30%
20%
10%
0%
1 2 3 4 5 6 7 8 9
Typical
Actual
Maple Hill Golds #5, 285 ft. 19%
Island /DZ+1, Weirdness = 0.27
Score Deficiency = 0.12
70%
60%
50%
40%
30%
20%
10%
0%
1 2 3 4 5 6 7 8 9
Typical
Actual


302
262
62
154
85
DZ
ISLAND RULE - Missed Mando and OB tee shots go to Drop Zone with penalty throw. From the DZ, you must come to rest safely on the island or you must re-throw from the DZ but without further penalties.
57
15
40
120
184
161
DZ
Drop Zone
Width of fairway feature
Distance from tee
to pin
Swope Gold #2, 287 ft. 22% Island /DZ+1,then T&D, Weirdness = 0.21 Score Deficiency = 0.11
70%
60%
50%
40%
30%
20%
10%
0%
1 2 3 4 5 6 7 8 9
Typical
Actual
Swope Gold #10, 340 ft. 10% Island /LUZ, DZ+1, then T&D, Weirdness = 0.49 Score Deficiency = -0.01
70%
60%
50%
40%
30%
20%
10%
0%
1 2 3 4 5 6 7 8 9
Typical
Actual

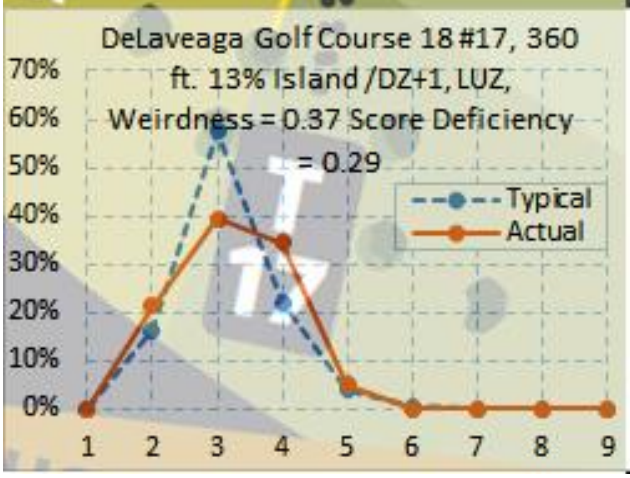

OB
OB
Gold

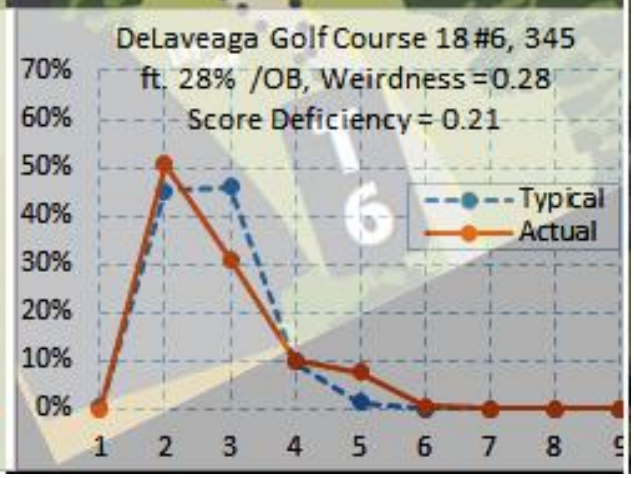

AMPIONSHIP
A
B
OB
015 STATS
<1%
24%
40%
12%
13%

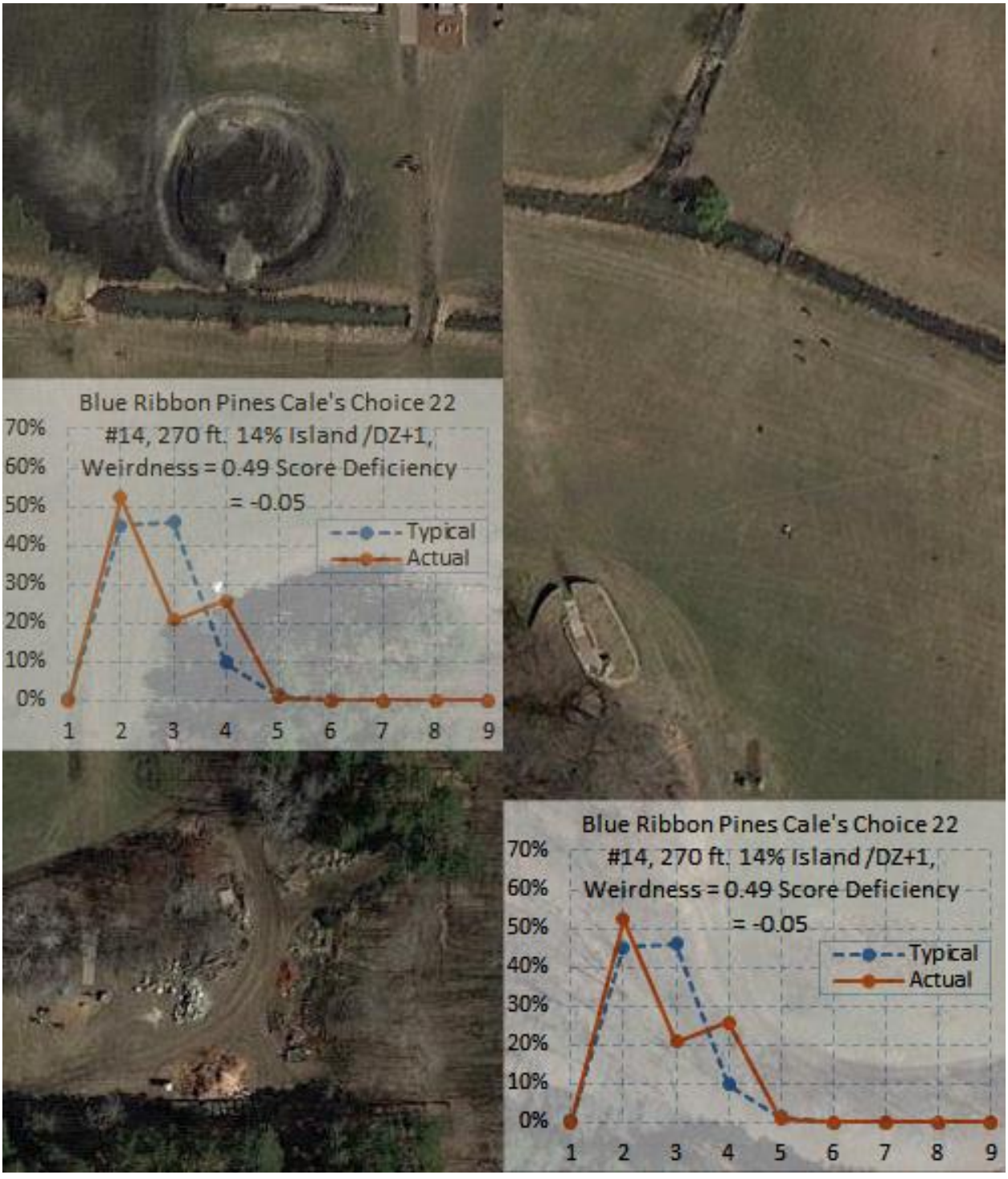

Highbridge Gold Gold #16, 270 ft.
22% Island /DZ+1, LUZ, Weirdness =
0.21 Score Deficiency = 0.15
70%
60%
50%
40%
30%
20%
10%
0%
1 2 3 4 5 6 7 8 9
Typical
Actual


Winthrop Gold #17, 249 ft. 16%
Island /T&D, Weirdness = 0.82
Score Deficiency = -0.12
70%
60%
50%
40%
30%
20%
10%
0%
1 2 3 4 5 6 7 8 9
Typical
Actual


SAFE AREA
OB AREA
SAFE AREA
layup area
drop
SAFE AREA
SAFE AREA
OB LINE
mando left
OB AREA


DeLaveaga Golf Course 18 #17, 360 ft. 13% Island /DZ+1, LUZ, Weirdness = 0.37 Score Deficiency = 0.29
70%
60%
50%
40%
30%
20%
10%
0%
1 2 3 4 5 6 7 8 9
Typical
Actual


DeLaveaga Golf Course 18 #6, 345 ft. 28% /OB, Weirdness = 0.28 Score Deficiency = 0.21
70%
60%
50%
40%
30%
20%
10%
0%
1 2 3 4 5 6 7 8
Typical
Actual


Blue Ribbon Pines Cale's Choice 22
#14, 270 ft. 14% Island /DZ+1,
Weirdness = 0.49 Score Deficiency
= -0.05
Typical
Actual
70%
60%
50%
40%
30%
20%
10%
0%
1 2 3 4 5 6 7 8 9
Blue Ribbon Pines Cale's Choice 22
#14, 270 ft. 14% Island /DZ+1,
Weirdness = 0.49 Score Deficiency
= -0.05
Typical
Actual
70%
60%
50%
40%
30%
20%
10%
0%
1 2 3 4 5 6 7 8 9