By the approval of the

RACE MANAGEMENT COMMITTEE

Race Courses and Records

Relationship between the work of the Race Committee and their appointed Professional Land Surveyor, and speed record claims – with helpful guidelines for acceptable lay out of race courses for records.

By Co-Chief Surveyors

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Also under the guidance and approval of The American Power Boat Association Board of Directors

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Introduction:
So, your club, association or region wants to develop a race course on which APBA and International (UIM) speed records can be claimed? This guideline is prepared for use by regatta organizers or race chairmen and their appointed professional Land surveyor, as they plan for a chart marked “Approved for Records" (see below).

Not all race courses need to be surveyed and recorded. Your event may attract better competition if the race course is certified, but that is not always plausible. If official speed records are **not** to be claimed, then any configuration or approximate course length, if authorized by the appropriate Racing Commission, is acceptable. In this case, the APBA sanction and race circular will state "Not Approved for Records".

General guidelines for establishing a race course for records are recorded in the General Racing Rules and within various class rules as well.

The **purpose** of surveys, and of APBA approved survey charts, is to pre-establish and document the distance component in the speed equation, whenever speed calculations and records are to be claimed. APBA has over the years, earned an invaluable reputation for the integrity and accuracy of its surveys and recorded charts. It is incumbent upon all of us to continue that fine tradition. It is the role of the Racing Commission Chairman to review a proposed race course, for compliance with safety and class requirement; and, the role of the Chief Surveyor is to provide helpful technical assistance and approval of the official chart to be used for record claims. If approved, the chart will bear a stamp and seal of the Chief Surveyor, stating "Approved for Records".

The **basic rules** for surveying and chart preparation allow no deviation from certain requirements. They are as follows: (Also see the checklist under the Course Survey Chart section)

1. Charts (used here to refer to maps involving bodies of water) shall be prepared by a Licensed Professional Land Surveyor. All States have licensing requirement for Surveyors. APBA has recognized the services of a Surveyor’s work in another state where he/she is not licensed, as the placement of race course monuments and buoys do not indicate the division of land or the placement of land corners. These surveys are unique only on to themselves. A State license is required to show that a competency and ethical level of the profession has been met.
2. All measurements and calculations must be performed in straight lines between buoys, NOT along the arcs.
3. The course must be of the length required for the class being raced; and its shape and general layout shall be reviewed for consistency with racing safety and class rules including the number of buoys required by the chairman of the appropriate Racing Commission (also see design concepts below). More than one size course may be shown on the same chart, e.g. 1 ¼ mile oval and 1 mile oval which might or might not be concentric to each other.
4. The start and finish line must be identical on circular or closed courses and shall be marked on both ends. (Start buoy plus an on-shore or near-shore marker).

5. Both traditional and modern surveying methods are acceptable. However, a basic requirement is that all calculations and measurements be reference to at least two inter-visible land markers (monuments) of at least 3rd order surveying accuracy.
6. The surveyor shall certify and stamp the accuracy of the chart and describe the method of how the buoys shall set, e.g. transit, EDM, and radio communication.
7. The actual placement of the buoys (see SURVEY METHODOLOGY #5**)** is to be done by the surveyor or under his/her direct control. Buoys are to have sufficient weight to hold the buoys in place so as not to be moved by wind or currents in the water. It is required that buoys be secured with a minimum amount of slack to keep the buoy from moving, degrading the course shape, or move into the traveled line of a race boat. It is recognized that the buoys will not be in the actual location that the surveyor set it as there is to be some slight movement from the current or wind. The race course then should be “asbuilt” and the distances between each buoy recalculated to prove that the total distance is equal to or greater than (not less than) the approved chart.
8. Every ten (10) years, previously approve course charts must be re-surveyed or verified, and a new course chart must be prepared and submitted for approval by one of the Co-Chief Surveyors. This chart, after approval, will become the new "Chart of Record" for a given course and site. Similarly, whenever changes to a course or any of its permanent markers or monuments have occurred, the course must be re-surveyed and a new course chart submitted and approved.
9. Speed record claims must include a certification by the course Licensed Land Surveyor, that the actual course was established as shown on the dated chart previously filed with APBA, and that the course was verified by surveying methods immediately after the claimed record is verified by the timer and scorer.

Design Concepts: It is not possible to specify a single type of race course that would be suitable for all occasions and locations. Exceptions to this are the specific designed courses for categories that require certain distance courses. Known courses at this time are the ¾ mile course used by the Outboards and the ¾ mile course used by the Outboard Performance Crafts (check with APBA for design requirements for additional information). The varying needs for pit or launching facilities, spectator areas, safe and yet interesting racing, and local topographic and hydrographic features often conflict. Each course becomes a special challenge, requiring judicial compromises. In recognition of this, wide latitude is allowed the local race committee in adapting a proposed course to available waters.

Generally, symmetry is the best approach to race course design. This means parallel straightaways of equal length, and symmetrical turns as in *Figure* 1. Variations from symmetrical designs, such as irregularities in the length of the chords, or in the deflection angle at the buoys, can be confusing and may lessen the speed. However, an occasional compromise is to provide easements to curves (spiral curves) at the first and last buoys. Though un-proven, this theory is preferred by some, and is acceptable.

Additional buoys are required along the straightaways, such as the start buoy, and extra buoys to assure a required total or visual aid to the racer. Refer to rules for a given class.

The following figures show typical layouts for 5 buoy turns, followed by formulas to readily determine the appropriate dimensions for a truly symmetrical shape. From these examples it can be seen that the formula applies to turns having any desired number of buoys. Turns having an even number of buoys tend to be "flatter" than odd numbered turns. More buoys make for less deflection at each one and thus aid in the turning of a boat. Wider turns also help boats maintain a given arc and thus would be considered to be an aid to safety.

The figure below shows a monument at the start/finish line. It is not necessary that the control point be there and it might be a problem of being in the way of the timers. It is beneficial to the surveyor and the race committee to be close so that if a record is set, the surveyor can be quickly notified and began checking the course for accurate distance. A measurement to the start line should be then noted on the chart.

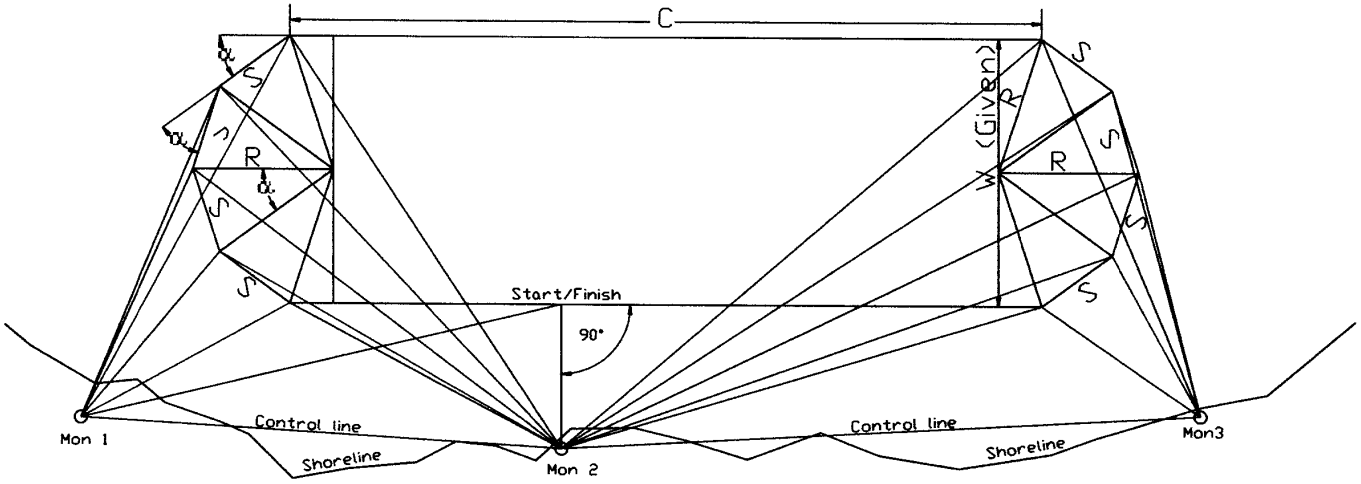


Figure 1.
Five buoy turns --- N=5 --- α=36°
(With possible ties to Monuments also indicated)

Formulas:

D = (Given)
W = (Given
$\alpha = 180°/N$
$S = W \tan(\alpha/2)$
$C = \frac{D - [2 \times (N-1) \times S]}{2}$

Where:

D = the distance around the course, in feet
W = distance between straightaways.
α = deflection angle at each buoy.
N = number of buoys per turn.
S = distance between buoys.
C = length of each straightaway, in feet
R = radius (used only to show relationship)

Other Relationships:

$W = S \cot(\alpha/2)$
$R = W / [2 \cos(\alpha/2)$
$R = S / [2 \sin(\alpha/2)$

These formulas will produce a closed polygon. As a precaution, solve for each unknown element and perform a traverse calculation around the course to verify the total length, and the closure.

As stated, wide latitude is allowed in adapting to local conditions. Certain bodies of water necessitate non-parallel straightaways, creating a narrower course width on one end. Also, slightly non-symmetrical turns may be desired to fit local situations. Where justified, these types of variations to ideal design are allowed, and will be approved. The formulas for non-parallel straightaways (Fig 2), would then be:

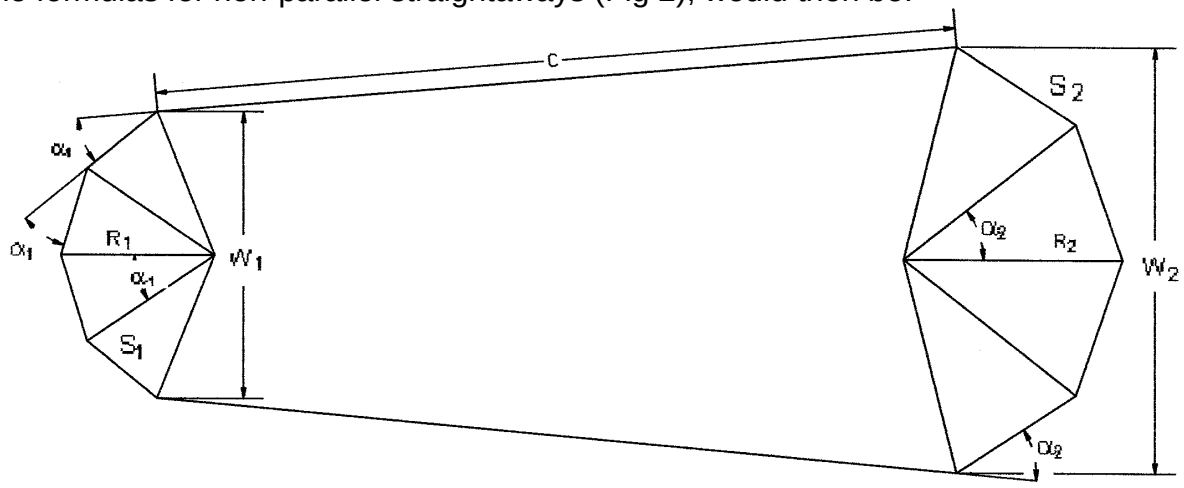


Figure 2.
(Non-parallel straightaways

Formulas:

W_1 = distance between straightaways at narrow end.

W_2 = distance between straightaways at wide end.

α_1 = deflection angle at the narrow end.

α_2 = deflection angle at the wide end.

S_1 = distance between buoys at the narrow end.

S_2 = distance between buoys at the wide end.

C = length of each straightaway, in feet

N = number of buoys in the turns

β = Skew angle between opposite straightaways

$\alpha_1 = (180° - \beta)/N$

$\alpha_2 = (180° + \beta)/N$

$$C = \frac{D-[(N-1) \times S_1] - [(N-1) \times S_2]}{2}$$

Note: W_2 or β may not be readily known. Approximation formulas are:

$W_2 = W_1 + [2 \sin(\alpha/2)]$ and $\sin^{-1}\beta = (W_2 - W_1)/C$

Also in: $R = W / [2 \cos (\alpha/2)$ Substitute: R_1, α_1 or R_2, α_2

In this case, use the approximation and run a hypothetical traverse around the course. Then adjust, to assure total length and the closure. The designer is not limited to the same number of buoys in each turn. This of course complicates things a little but the use of an electronic spreadsheet with all the formulas and the ability to do instant calculations and quick iterations of various distances helps make the process easier.

Time Trial Courses – (Design rules and suggested procedures for setting up a race course. that can be approved for records.)

The rules for conducting Time Trials, once the course chart is approved and filed, are well defined in General Racing Rule 26. Care must be taken to avoid any conflict in the application of either the General, or Specific Design Rules, or by their corresponding jurisdictions.

Specific required elements of the Time Trial race course design are as follows. Both the critical element and the design rule are highlighted in bold print:

1. A monumented, third order control survey to provide position and azimuth to all of the essential elements. Witness or reference notes are required for all monuments.
2. A single straightaway, one kilometer or one statute mile in length, called the track line to which has been added ample approach and run-out distances on both ends. (Refer to *Example #4)*
3. Two Range Lines, placed at right angles to the ends of the Kilometer, one mile, or ¼ mile straightaway. The suggested procedure is to produce a to-scale an overlay drawing of the Straightaway and Range Lines. Rotate this overlay on a same-scale map of the Lake, to form a trial best-fit of the race track in open water. After identifying possible sites for the Timer Locations and Range Markers on the Lake map, then further rotate and refine a final best-fit with the map detail, including the Timer Locations. Proceed with planning and executing the required survey. (See *Example #4)* It important to note that there needs to be a significant distance, around 1 kilometer or more both before and after the timed distance for the for the acceleration and deceleration distance which has to be unobstructed, navigable water in the lake or river
4. Two Alignment Markers, (Neither of which may be floating) will be placed on the Range Line, clearly visible from the Timer Location. Targets will be placed at the alignment marker just prior to race day. Limitations of present-day timing equipment precludes the use of back-sights for scanning the boat's track. Therefore the targeted alignment marker must be in front of the timer station, and this usually requires placement of the Alignment Marker on the opposite shoreline of the body of water. In situations where land access is blocked or the distance is too great, a work-around is available involving a combined anchor/monument/target holder which is submerged in shallow water, along the Range Line. The target is attached to the submerged Range Marker just prior to race day, using the RTK Global Positioning System or other appropriate measures to recover the submerged monument. A similar work-around would be acceptable, should the situation occur at the timer side. A temporary but stable platform, secured to the submerged

monument Marker in shallow water is suggested. Approval, in this case, would be limited to the current event only.

5. Two Timer Locations, placed on stable bases of the two parallel Range Lines - usually on the near side of the lake or river. The Timer / Scanner equipment must meet the specifications outlined in General Racing Rule #26. The Timer Locations will intercommunicate.
6. The course track line must be marked by at least two guide-buoys positioned by normal surveying methods by the course surveyor as shown on the charted line to assure a right-angle relationship between the course and the range lines and also to identify the surveyed track for the racer's benefit and guidance. It is recommended that additional buoys be placed between the guide-buoys and also beyond the limits of the measured track. A lane must be established by buoys (Please refer to *Example* #4 and below – in this example, the distance exceeds the rule shown in #8 below), so that boats will be confined in a safety zone. The lane width established by the chart would mark where the traveled distance was free from unsafe obstacles such as docks, shallow water, etc. This rule is supported by a statement on the approved chart that directs the racer to a traveled path on the away side of the surveyed track line or in the marked lane provided. Contestants who do not follow this rule will be disqualified. Verbal instructions to the racers must not conflict with the approved chart. In practice, buoys are used to guide the racer to the most beneficial route.
7. The review and approval, recording and speed record claims process is the same as for any other "Chart of Record" for APBA. (See last page of text).
8. The following is a rule setting minimum distances from scanner equipment and operators. Minimum distances will be established by the setting of lane buoys by the course surveyor.

   Straightaway Time Trial courses will be designed to provide safe and accurate scanning distances for the wide variety of boats that participate in such events.

   Minimum of approximately 150' distance from scanner monument to course line for participant boats where the established speed records are between 1-99.999 mph.

   Minimum of approximately 300' distance from scanner monument to course line for participant boats where the established speed records are between 100 and 175 mph.

   Minimum of approximately 450' distance from scanner monument to course line for participant boats where the established speed records are in excess of 175 mph.

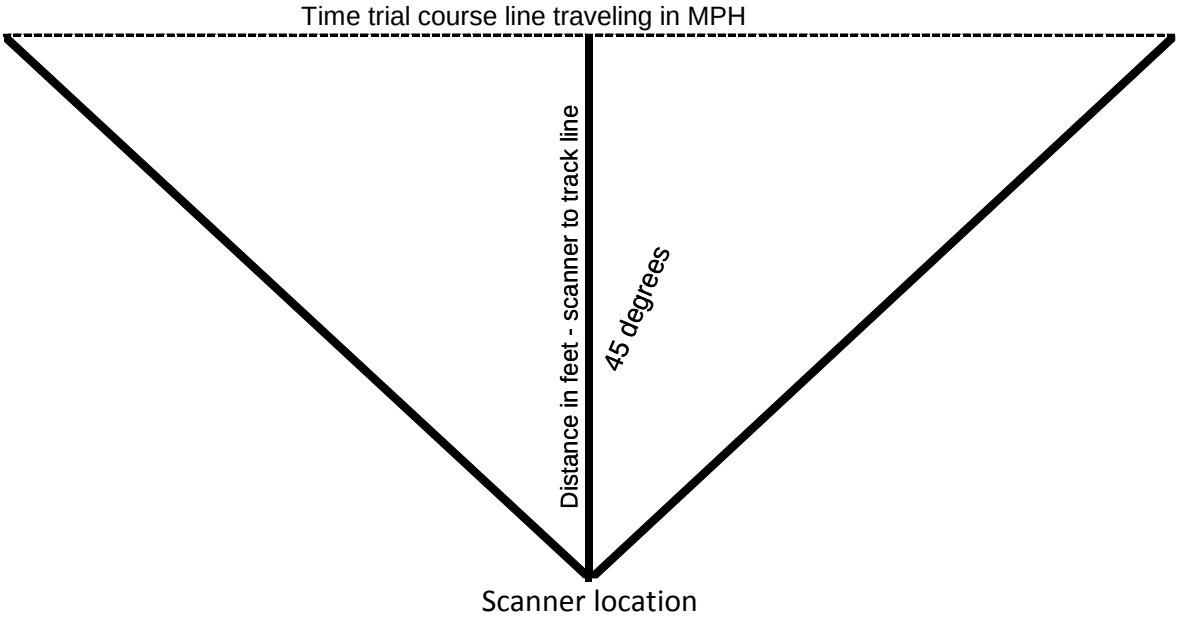
   If there is not an established record speed for a class, a speed for that class determined by the Race Committee and announced at Driver's Meeting will determine the minimum distance for that class.

   Course maps will show the appropriate course line and outer markers to comply with these minimum distances. The minimum distances are not intended to create lanes. The 150' minimum distance is essentially outer course markers on the scanner side of the course, as opposed to being a second course line.

9. The above rule is only the minimum distances that boats may pass for the above listed speeds. The geometry and geography of the shoreline also influences the position of the course, and sometimes the minimum distance never comes into play because the charted lane falls further than the above rule. No body of water may be less than the minimum distance across for the boat speed being timed plus a width of a lane that will safely accommodate a timed boat in which to run. The topography of the land where the scanners are positioned often dictates a greater distance be made to the boat lanes. It is acknowledged that there is a practical limit to any scanner operator's ability to obtain a reliable scan reading on a moving boat in short scanning distances. If a body of water allows for more room to move the boats away from the scanners, it should be done and shown on the chart. So, a longer distance is better. The following is an excerpt from a spreadsheet showing how little time is afforded to the scanner operator for speeds and distance shown above and how further distances enhances the scanning process. The review and approval, recording and speed record claims process is the same as for any other "Chart of Record" for APBA.
10. The survey chart shall show the lanes for the boats running at speeds listed in the rule above. State that 3 sets of alignment buoys shall be set by the course surveyor. It is advised that different colored buoys be used to help the boat drivers pick the appropriate lane.
    Statements written in the lanes or notes shown on the chart are suggested as follows:
    No boat will be timed passing closer than 150' to the scanners.
    Lane 1 - minimum distance of 150' and up to 300' from the scanners, Boats passing at less than 100 mph shall be timed for the time trials in this lane or any other lane.
    Lane 2 - minimum distance of 300' and up to 450' from the scanners, Boats passing at greater than 100 mph but less than 150 mph shall only be timed for the time trials in this lane or lane 3.
    Lane 3 - minimum distance of 450' from the scanners, Boats exceeding 150.00 mph must only run in this lane to be timed for the time trials

Time in seconds to lock onto and scan to the Start/Finish line using 45 degrees of sweep of scanner

Speed in MPH		50	100	175	200	
Minimum distances in feet. Scanner to course line	Feet					Time in seconds to lock onto the bow of a boat and scan to the Start/Finish line using 45 degrees of sweep of the scanner
	150	2.05	1.02	0.58	0.51	
	300	4.09	2.05	1.17	1.02	
	450	6.14	3.07	1.75	1.53	
	600	8.18	4.09	2.34	2.05	
	750	10.23	5.11	2.92	2.56	



Notes:

1.	Approved scanners now being used can **only** move horizontally. That means that they cannot look downward from a horizontal plane.
2.	Approved scanners now being used are telescopes that significantly narrow the field of view but bring the image closer to the operator for better viewing. Boats too close to the scanner might not be seen in the field of view of the scope.
3.	The higher the elevation of the scanner above the body of water where the boats travels, the further away from the scanner the course line must be so that a boat can be seen in the field of view.
4.	The scanners have a vertical hairline that is to be positioned at the bow of the timed boat by the scanner operator and then followed along the course line.
5	It is assumed that there will be at least 45 degrees of viewing to scan boats. There could be more. There could be less due to obstructions such as trees, buildings, moored boats, etc. which would compound the timing problem thus requiring the track line to be further away.

SURVEY METHODOLOGY

A wide variety of surveying methods are being used, and accepted. The individual preference, practice, and equipment owned by each land surveyor and local conditions will determine the method used in making the survey. Currently they include:

1. Direct measurements such as transit and chain (tape), or traverse. Though seldom used in recent years, APBA has for example, approved permanent buoy anchors set by traverse on top of frozen lakes and reservoirs, or in dry reservoirs prior to flooding. In both of these surveys, adequate ties to two or more land markers, with accompanying angles, were also required for rechecking of buoy locations before the event and after a record is set.
2. Triangulation is still one method, using the positions of known monuments and backsights, or measured base-lines laid out on the shore. Angles or azimuth bearings are then calculated from at least two of the shore stations to locate each buoy. Note that intersections of those bearings or vectors, nearest to 90° (at the buoy), are the strongest. This method requires radios at both land stations the directions given from them can be confusing to the boat operator.
3. Electronic survey transit, often misnamed theodolites which are only used for the measurement of angles, and added external or internal EDM (electronic distance measurement) devices provide great improvement over conventional triangulation. Total Stations, a combined Transit, EDM, and computer are well suited to this application especially if the unit is capable of distance tracking (constant distance updating while moving in a straight line towards the instrument. Buoy locations are calculated and set by one angle and distance, from the control point(s). On the chart, redundancy is desired, in case one of the monuments is lost, destroyed, or otherwise rendered not useable. Backsights may be in-the-ground monuments or permanent objects, e.g. flag poles, house roof peaks, etc. and called out on the chart with lines and descriptions.
4. G.P.S. (Global Positioning System) is being used increasingly. This method is acceptable for buoy placement, <u>provided that RTK (real time kinematics) or a state or regional wide virtual reference system method is used.</u> No single handheld GPS unit without the aid of constant position correction is accurate enough for setting a record course. Coordinates are shown for all positions, including at least two inter-visible on-shore monuments, and that redundant angle or azimuth bearing values are also shown on the chart. This is for the purpose of later verification by the surveyor, assuming that more conventional methods would be employed, as in method No. 2 or 3.
5. Any future system that achieves universal acceptance by the surveying profession will be accepted. Redundancy will be required, an in any other method, for the purpose of verification by conventional surveying methodology.
6. After many years of setting buoys, it has been proven that a small boat of around 10’ in length and an outboard motor of 10 HP or less provides that best vehicle to set buoys. Bigger boats are difficult to maneuver and tend to travel too fast to get the desired accuracy. They are difficult to hold a position and tend to drift, pulling the buoy from the set position and are often higher out of the water making tying up buoys tightly more difficult. Anchors dropped from the water line to the bottom often do not fall straight down. By letting the weight hang from the boat a few feet off of

the bottom of the lake will help control the boat speed and assure that the weight is in or very near its proper location. (See “asbuilts”) Setting a small sub-buoy such as a gallon plastic jug makes the process easier too. The bigger race buoys would then have a short tag line with a clip to attach to the line just below the sub-buoy. Buoys are to be held in place with sufficient weight to hold them in place so as not to be moved by wind or currents in the water. It is required that buoys be secured with a minimum amount of slack to keep the buoy from moving, degrading the course shape, or move into the traveled line of a race boat.

The Course Survey Chart

Regardless of the method of surveying utilized, the race course chart must be complete in all of the necessary details. Consider both the method to be used in establishing the buoy positions, and the probable methods to be used for post-race (record set) verification of the layout to substantiate speed record claims as required by the surveyor.

Following is a **checklist** of necessary elements of an acceptable chart for record claims:

1. The desired chart size is 24” X 36” in reproducible form. No less than 18” X 24” paper size is acceptable to show all the course(s), survey control, and course details. List angles, distances, and coordinates for all buoys to be set, control points and backsights used. The chart for any race course shall be only one sheet. The surveyor shall attempt to make the drawing to a scale of 1” = 200’. A lesser scale may be used if the amount of information on the chart is so great as to leave no room for the course drawing and shore line (Try 24” x 36” size). Distances to the course line and shoreline shall be shown.
2. Angles (or bearings or azimuth bearings), or angle (bearing) and distance, depending on the method of surveying, are required and are best shown in table form at the edge of the drawing. Be sure to indicate a backsight and/or a beginning bearing for each instrument set-up.
3. Recovery notes and references are required for all land markers used in the survey, including backsights.
4. Sea-level elevation of the site must be shown on the chart.
5. Typical water depths are required, particularly in shallow areas.
6. Provide a typical sketch showing the proposed method of anchoring.
7. If tidal or reservoir elevation changes are anticipated, include in the sketch the proposed method of compensating for height differences.
8. NO significant notes shall be hidden in the surveyor's notebook. The chart must be a complete, plat-like record.
9. Show certain other key distances and significant features. These include, but are not limited to:

   Starting buoy to the first turn buoy, safety buoy to the turn, racing lane widths, distances to shoreline, shoals and other hazards such as docks and permanent boat anchoring buoys. Show also the official stand on the start/finish line and location of the pit, launching and spectator areas.

10. Near the title block, the surveyors signature and seal must be accompanied by a statement of certification that includes but not necessarily limited to:
    - Accuracy of the survey (at least third-order)
    - "established by me, or under my direct supervision"
    - existence of monumentation
    - method to be used in buoy placement
    - other statements, as necessary
11. Show, in a Title Block or area, the name and date of proposed sanctioned regatta; city, County, State, etc. Show also the category{s} of boats racing, the name of the APBA Sponsor organization, and any other identifying information.

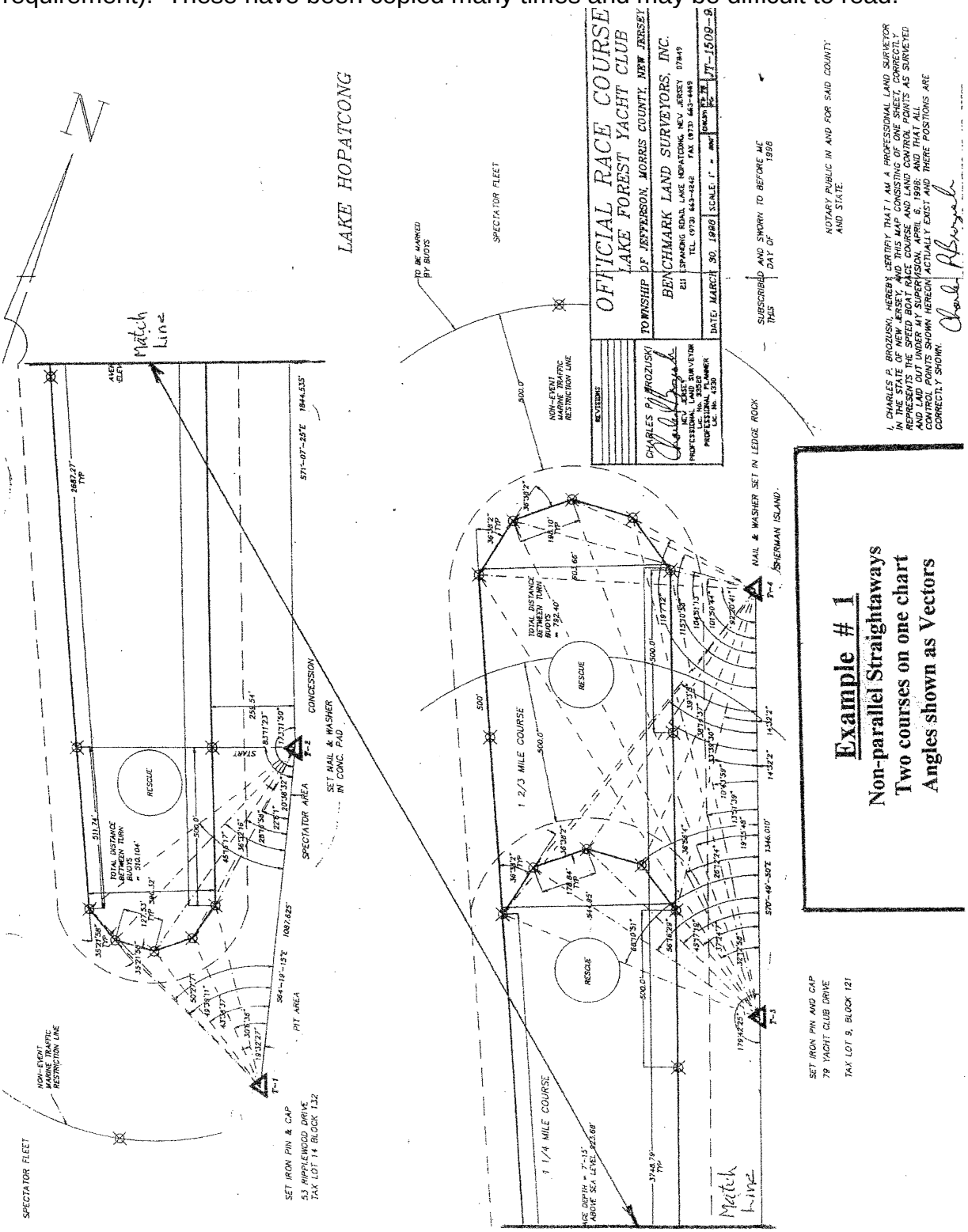
Review and Approval and Recording Process:
The Chief Surveyor provides a preliminary review of race course charts for those needing some helpful assistance and assurance. Two (2) copies are required, and should be sent as early in the planning process as is practical. One copy will be returned with comments or suggestions for completion. After revision and/or approval, an approval sticker will be sent to the surveyor to be placed on the chart. Then one final print shall be sent to the Chief Surveyor and one sent to APBA Headquarters. It is also good to send copies to the Race Committee. The process should be completed by 45 days prior to the regatta. If warranted by circumstances, this time requirement can be waived if there is good communication between the local surveyor and the Chief Surveyor. Remember – The race sanction cannot be released by APBA stating that the course is approved for records without the Chief Surveyor's approval.

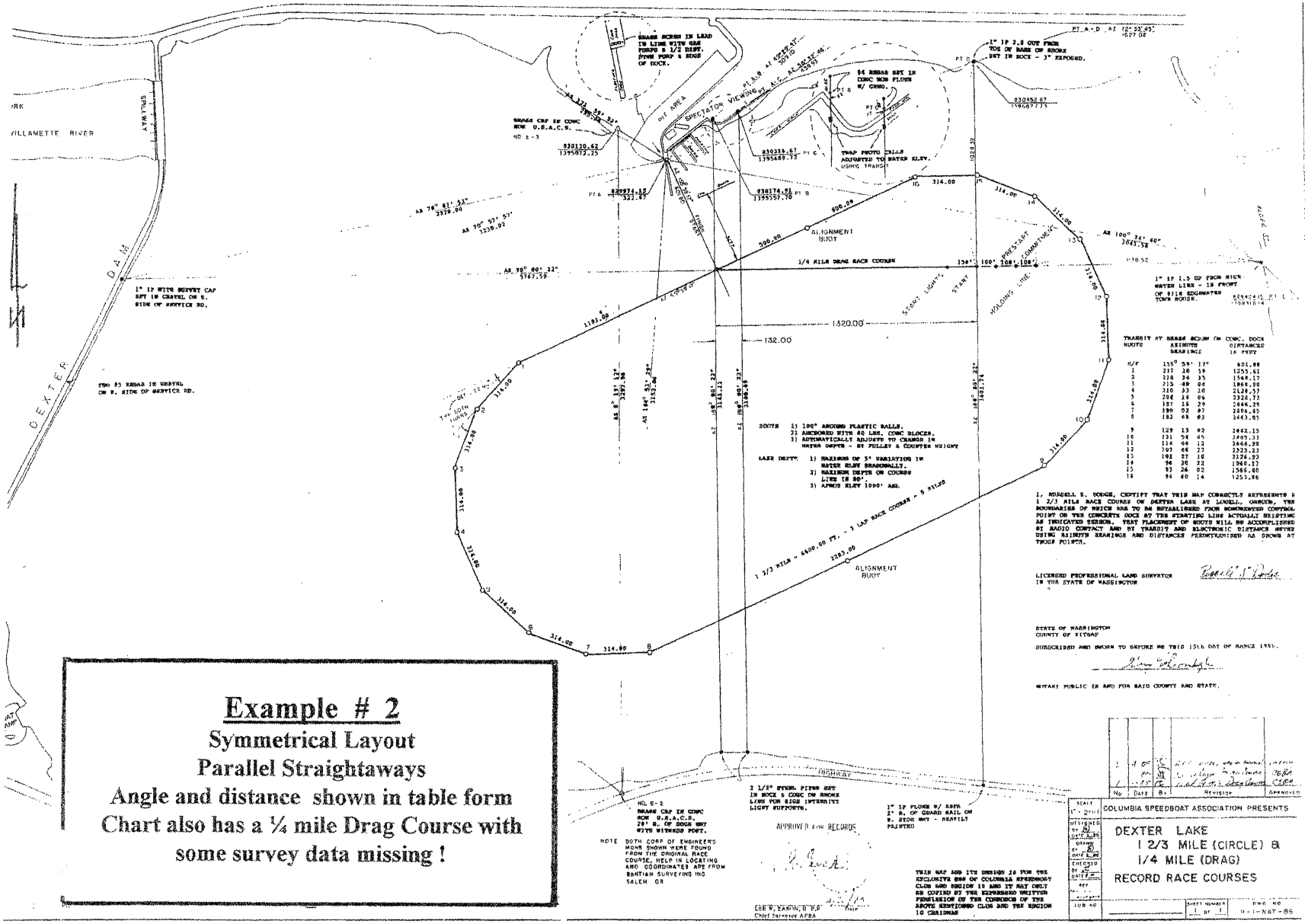
Keeping Charts Current:
A potential exists for our recorded charts to become obsolete. Monuments get lost or are made unusable, and of course any changes need to be incorporated in the "Chart of Record". A new chart with re-certification by a surveyor is a local responsibility, and is required. Also, APBA review and approval must be obtained, prior to recording in the national archive.

Record Claims:
The General racing rules, and Class Rules outline the required process for claiming records for specific events. One of the required documents is a signed statement by a licensed land surveyor (preferably the same one that placed the course) indicting that the actual course was "verified by me" using surveying methods immediately after the claimed record was set, and that the course was established as shown on the (dated) chart previously filed with APBA. This "Certification" is but one of several documents required of the event chairman, when claims of speed records are filed.

Examples:

Appended are examples of approved race course charts currently in use. Note that they have been reduced in size for convenience. (See checklist on page 7, for scale requirement). These have been copied many times and may be difficult to read.



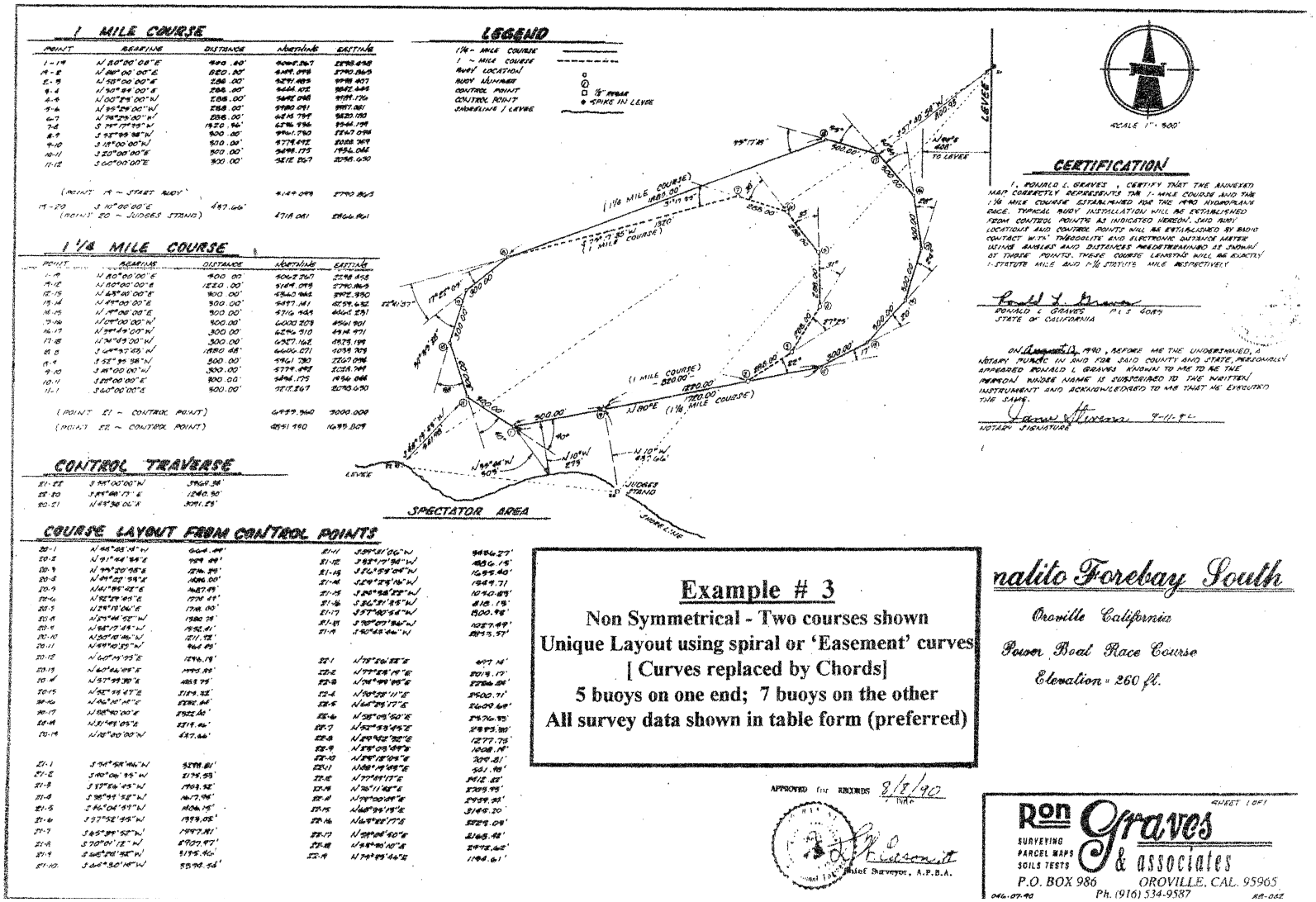


Example # 2

Symmetrical Layout
Parallel Straightaways
Angle and distance shown in table form
Chart also has a ¼ mile Drag Course with some survey data missing !

Revised January 2014

RKD



Example # 3

Non Symmetrical - Two courses shown
Unique Layout using spiral or 'Easement' curves
[Curves replaced by Chords]
5 buoys on one end; 7 buoys on the other
All survey data shown in table form (preferred)

nalito Forebay South

Oroville California

Power Boat Race Course

Elevation = 260 ft.

APPROVED for RECORDS 9/8/90

Chief Surveyor, A.P.B.A.

SHEET 1 OF 1

Ron Graves & associates
SURVEYING
PARCEL MAPS
SOILS TESTS
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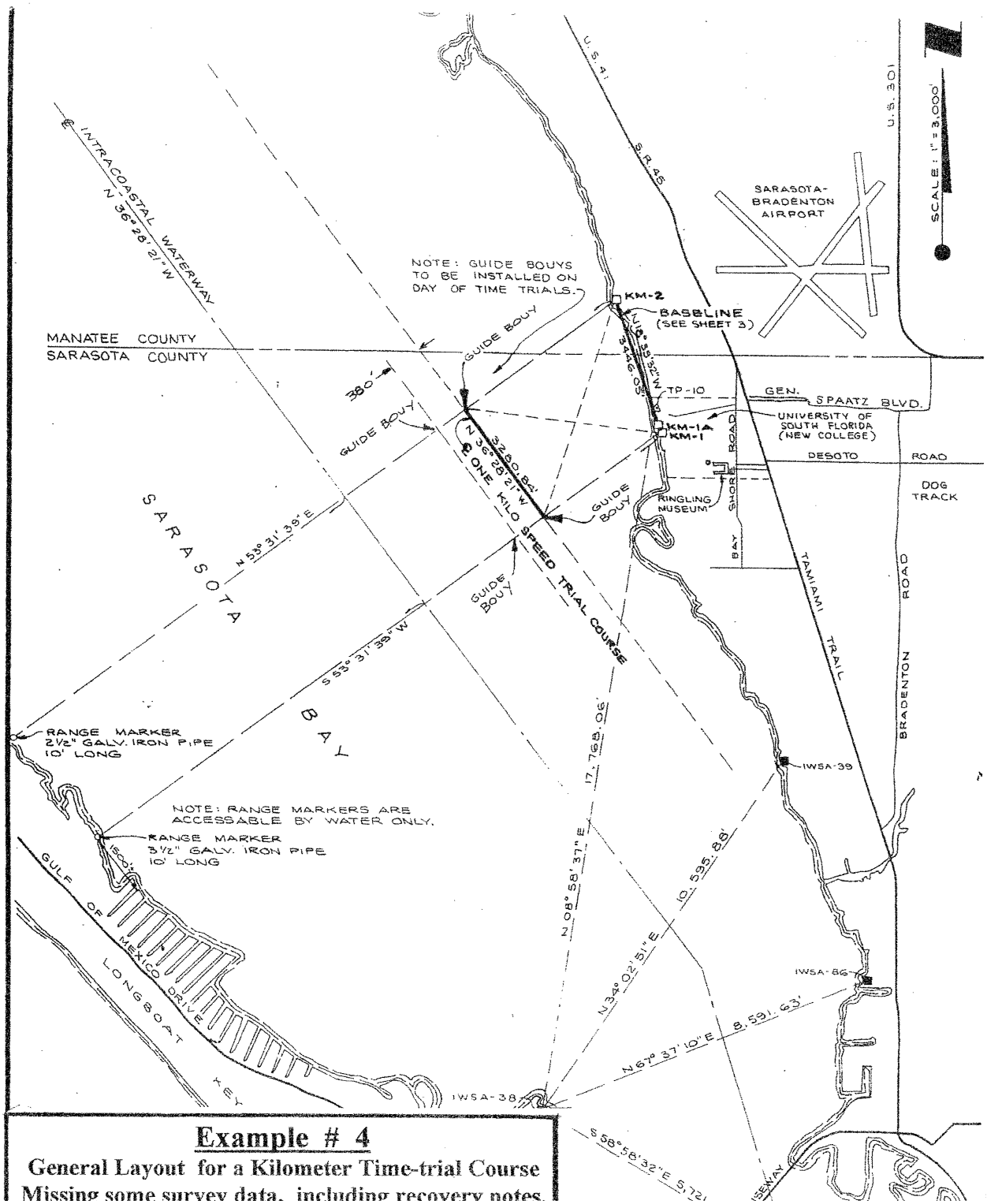
SCALE: 1" = 3,000'
U.S. 41
S.R. 45
U.S. 301
SARASOTA-BRADENTON AIRPORT
INTRACOASTAL WATERWAY
N 36° 28' 21" W
NOTE: GUIDE BOUYS TO BE INSTALLED ON DAY OF TIME TRIALS.
KM-2
BASELINE (SEE SHEET 3)
S 46° 33' 32" W
3460.03'
MANATEE COUNTY
SARASOTA COUNTY
GUIDE BOUY
380'
TP-10
GEN. SPAATZ BLVD.
UNIVERSITY OF SOUTH FLORIDA (NEW COLLEGE)
KM-1A
KM-1
DESOTO ROAD
N 36° 28' 21" W
3280.84'
ONE KILO
SPEED TRIAL COURSE
RINGLING MUSEUM
SHORE ROAD
BAY
DOG TRACK
SARASOTA BAY
N 53° 31' 39" E
S 53° 31' 39" W
TAMIAMI TRAIL
BRADENTON ROAD
RANGE MARKER
2½" GALV. IRON PIPE
10' LONG
17,768.06'
IWSA-39
NOTE: RANGE MARKERS ARE ACCESSABLE BY WATER ONLY.
RANGE MARKER
3½" GALV. IRON PIPE
10' LONG
GULF OF MEXICO DRIVE
LONGBOAT KEY
N 08° 58' 37" E
10,595.86'
N 34° 02' 51" E
IWSA-86
N 67° 37' 10" E 8,591.63'
IWSA-38
S 58° 58' 32" E 5,721
Example # 4
General Layout for a Kilometer Time-trial Course
Missing some survey data, including recovery notes.