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Helicopter Fish Strainer

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SUMMARY
Helicopter snorkel and bucket operations can be restricted in certain water bodies when threatened or endangered (T&E) aquatic species are present.

The Forest Service, U.S. Department of Agriculture, San Dimas Technology and Development Center (SDTDC) developed a helicopter fish strainer that incorporates design and performance standards that prevent aquatic organisms from reaching the snorkel or bucket during drafting and dipping operations in still bodies of water, such as lakes or ponds. The fish strainer is approximately 15 feet in diameter and 10 feet deep. A flotation system suspends the top of the strainer at the water surface. Helicopters draft or dip from inside the fish strainer and the strainer mesh prevents aquatic organisms from reaching the bucket or snorkel. The system can be deployed and retrieved by light helicopter and can be flown at speeds up to 60 knots (70 miles per hour). See figure 1.

HISTORY

SDTDC received a request to develop a system that would allow helicopter dipping operations in bodies of water containing T&E species in lieu of committing significant resources in an attempt to prove conclusively that snorkeling and bucket dipping does no harm.

Figure 1. Light helicopter dipping from fish strainer with a 180-gallon Bambi Bucket.

SDTDC previously developed a hose-end fish strainer, which facilitates drafting in water bodies containing T&E species. The fish strainer attaches to the end of a suction hose and includes an integral foot valve. See figure 2.

Figure 2. Hose-end fish strainer for drafting operations.

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Requirements developed for the hose-end fish strainer—related to the protection of aquatic organisms—were applied to the helicopter fish strainer project. Specifically, strainer opening or "mesh" requirements (3/32 or 0.094-inch maximum)—previously identified by the U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service—were incorporated as design requirements for the helicopter fish strainer.

PROJECT OBJECTIVES

The objectives identified during the project's feasibility phase included:

- Conform to guidance for complying with Endangered Species Act requirements.
- Assemble at helibase with minimal tools.
- Keep product cost reasonable.
- Make it lightweight (for shipping and for type-3 helicopter compatibility).
- Ensure it is easy and safe to deploy:
  - Deploy and retrieve from helicopter (no need for personnel in a boat).
  - Stable in flight.
- Make it easy to refurbish at fire cache or by contractor.
- Make it suitable for short term (incident-specific) or extended (season-long) deployment.
- Include an integral anchor system.
- Base the opening diameter on the "Heliwell" product—adequate for large buckets.

PROJECT DEVELOPMENT

SDTDC developed the helicopter fish strainer in cooperation with SEI Industries (Delta, British Columbia, Canada). Jointly, SEI and SDTDC developed system concepts and performed trade studies; these efforts evaluated the frame, flotation system, deployment and retrieval system (DRS), and mesh materials.

In order to provide an adequate area for large buckets, a 15-foot-diameter strainer was selected. Similarly, a 10-foot height was chosen to provide ample depth for snorkels when the pilot's vertical reference (depth perception) is poor. A six-sided perimeter design was selected as the best balance between circularity and number of components required for a given shape. The bottom-frame diameter is larger than the top-frame diameter to minimize snorkel and bucket contact with the strainer sidewall mesh material. See figure 3.

Figure 3. View of fish strainer suspended in air.

Mesh Material

The mesh material was a critical design consideration. Water needs to flow readily through the strainer so the system sinks quickly and does not put an excessive load on the helicopter during retrieval. Other considerations included durability and ultraviolet resistance, which are important to ensure the strainer is capable of being submerged for up to 1 year. Material cost needed to be minimized, since fire cache managers determined the mesh may be replaced during refurbishment.

The selected material is woven from ultraviolet-stabilized, high-density polyethylene. A unique lock-stitch construction provides a durable, dimensionally stable fabric that does not fray or tear when cut.

Flotation System and Frame
The strainer includes a lightweight and reusable frame and flotation system. Closed-cell foam provides flotation, and SEI Industries' "Bambi Bucket" material (a thick, waterproof, durable, laminated textile) encloses the foam and provides attachment points for the frame and mesh material. The orange color increases visibility.

Additional requirements included the minimal use of tools and permanent identification of frame pieces, both intended to simplify assembly for helitack personnel. See figure 4.

Figure 4. Corner pieces include labels for ease of assembly.

Deployment and Retrieval System
Several concepts were evaluated during the DRS trade study. Boats are not available at all potential dip sites, especially those that may include T&E species. Deployment of the DRS by boat is impractical and could unnecessarily expose personnel to hazardous conditions. The team selected a DRS that can be deployed and retrieved by a single helicopter without assistance at the dip site.

The DRS consists of two primary components: a cone assembly and a float assembly. The cone nests inside the float assembly and remains there until the entire system is retrieved. See appendix A for a schematic of system components.

The DRS attaches to the fish strainer via three cables, which are optimized for correct deployment of the fish strainer. The deployment process requires the helicopter to slowly lower the strainer into the water, place the DRS into the water outside of the strainer opening, and release the deployment line with a remote hook. Once released, the deployment line travels through the DRS and becomes an anchor line. See appendix B. The system is retrieved by attaching a steel "retrieval ball" to the end of a leadline. The retrieval ball is lowered into the cone and drops through two opposing counterweighted plates that act as a trap door. See figure 5. Once the ball drops through the two plates, it is locked in place and the entire system can be lifted out of the water. See appendix C.

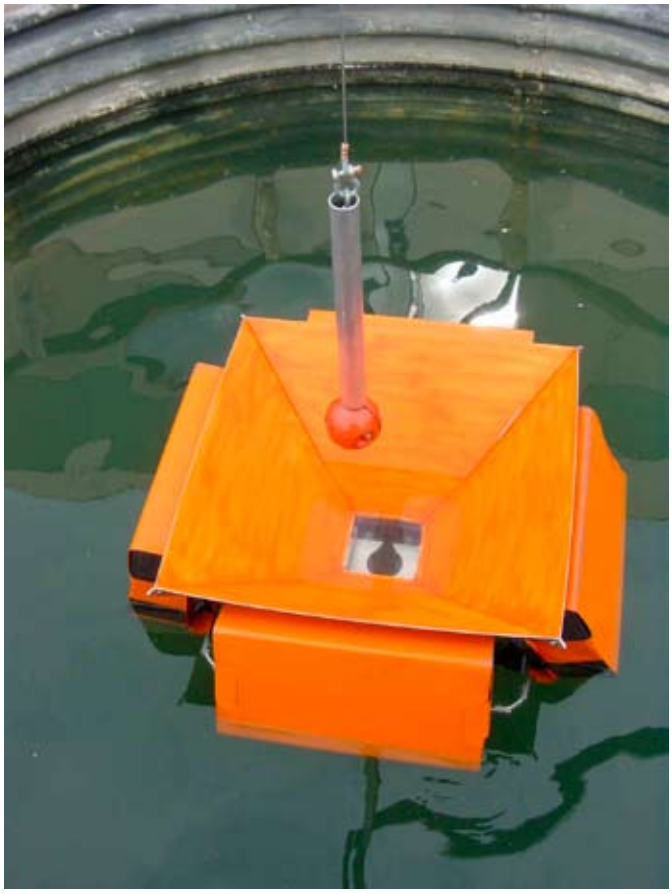


Figure 5. Retrieval ball being lowered into DRS cone.

FULL-SCALE PROTOTYPE TESTING

Full-scale prototype testing occurred at Puddingstone Lake, a 250-acre lake in San Dimas, CA. Since the complete assembly weighed only 420 pounds, a light (type 3) helicopter was used.

Initial test results were promising. Prior to deployment in the lake, the pilot flew the system in level flight at progressively higher speeds. The system was very stable, and was flown at speeds up to 60 knots without problems. See figure 6.

Figure 6. System being flown at 60 knots prior to deployment.

The major problem discovered during testing was that a section of the top frame tended to fold to the inside of the strainer. Subsequently, cable changes (between the DRS and the strainer) corrected this problem. A retest verified correct deployment.

FUTURE DEVELOPMENT CONSIDERATIONS

Several concepts arose during this development that fell outside the scope of this project. In particular, two items could be incorporated as accessories at a later date:

- Optional beacon/strobe kit.
- Auxiliary anchor system.

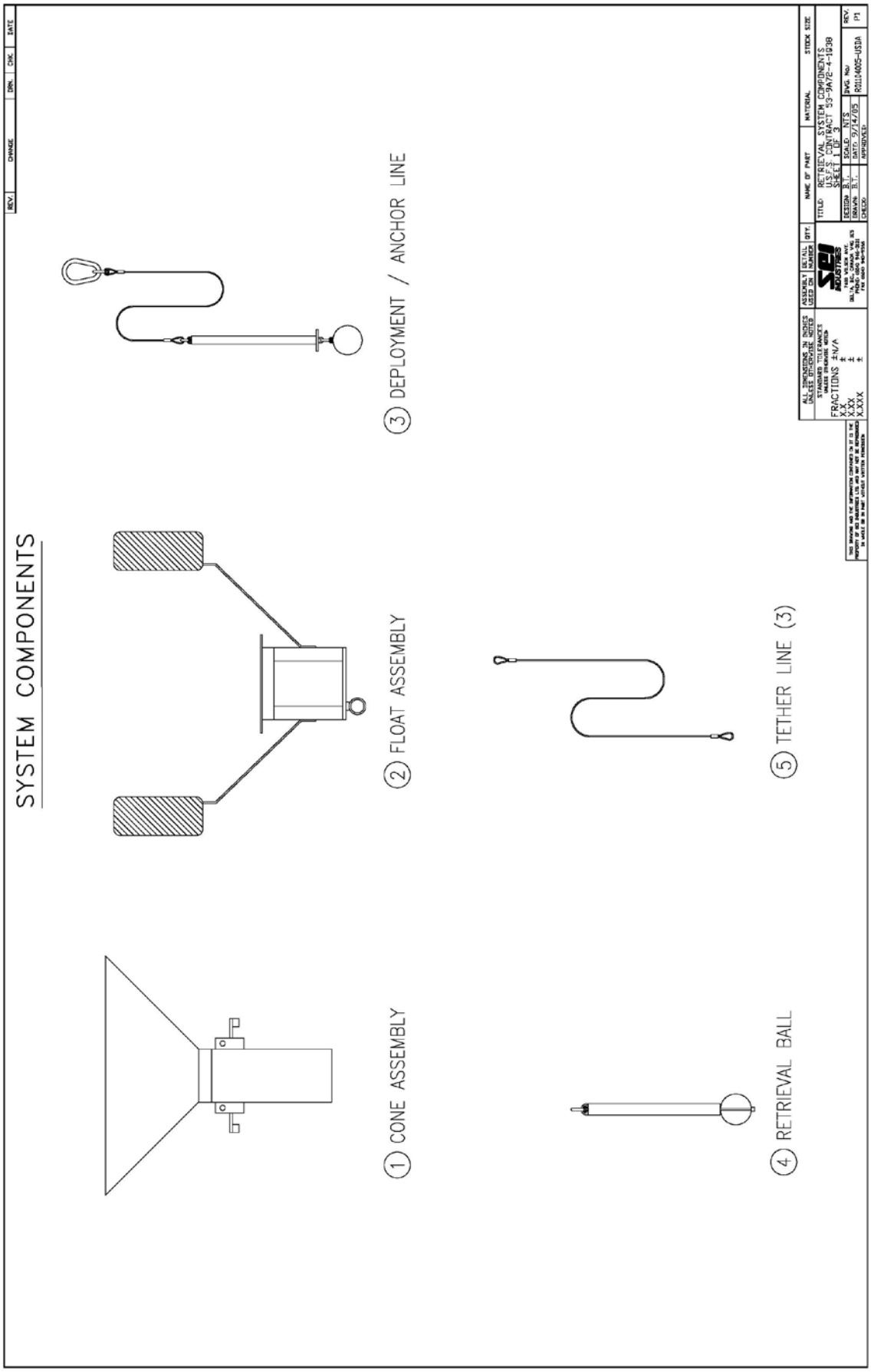
CONCLUSION

A system that facilitates snorkeling and dipping operations in still bodies of water that contain T&E species is now available. It provides reasonable certainty that aquatic organisms and their eggs are protected and conforms to current guidance for design of T&E-safe water drafting operations. The system can be deployed and retrieved by light helicopter.

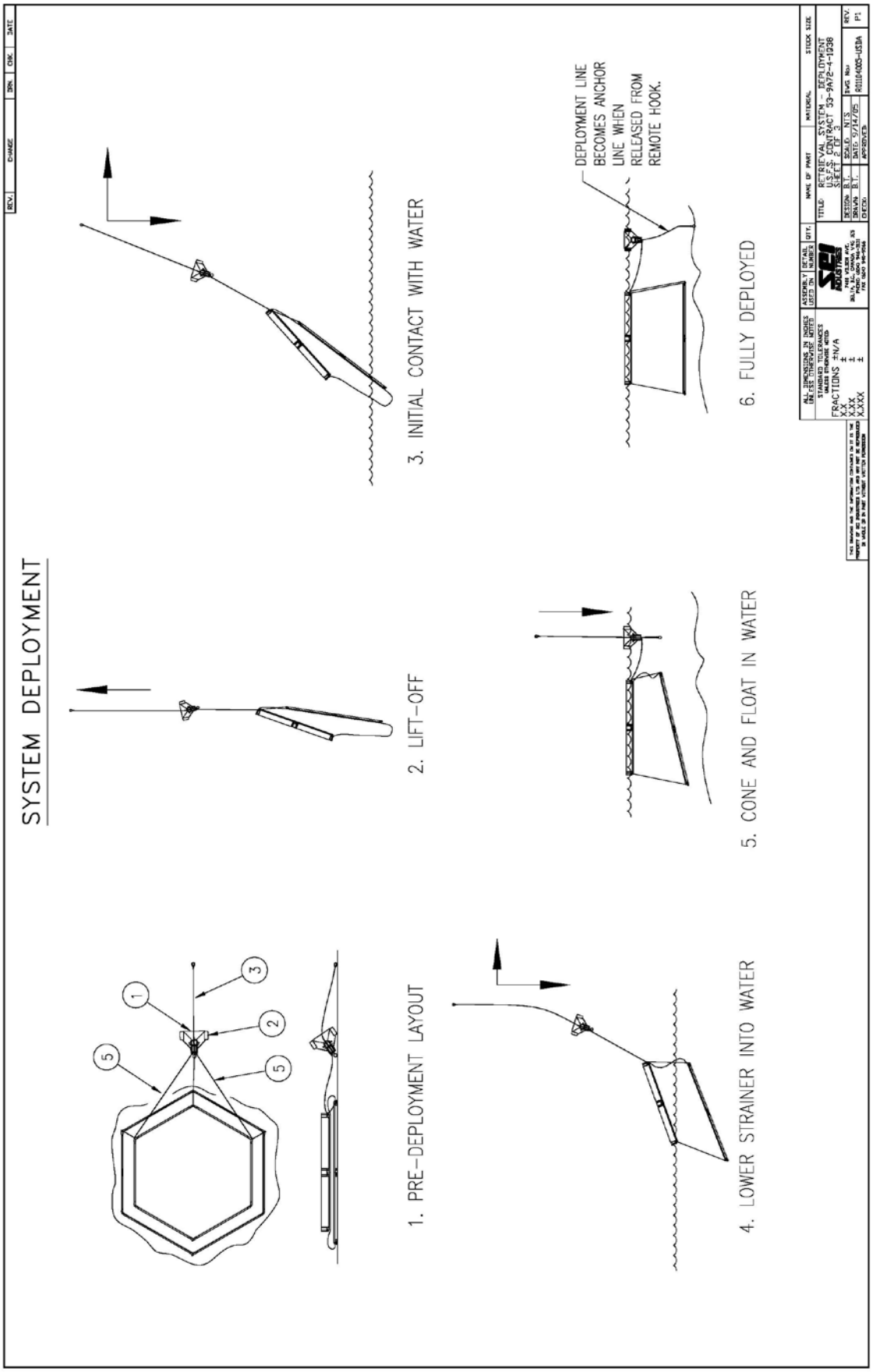
For additional information on the Helicopter Fish Strainer product, contact:

SEI Industries LTD.
7400 Wilson Avenue
Delta, British Columbia, Canada V4G 1E5
604–946–3131

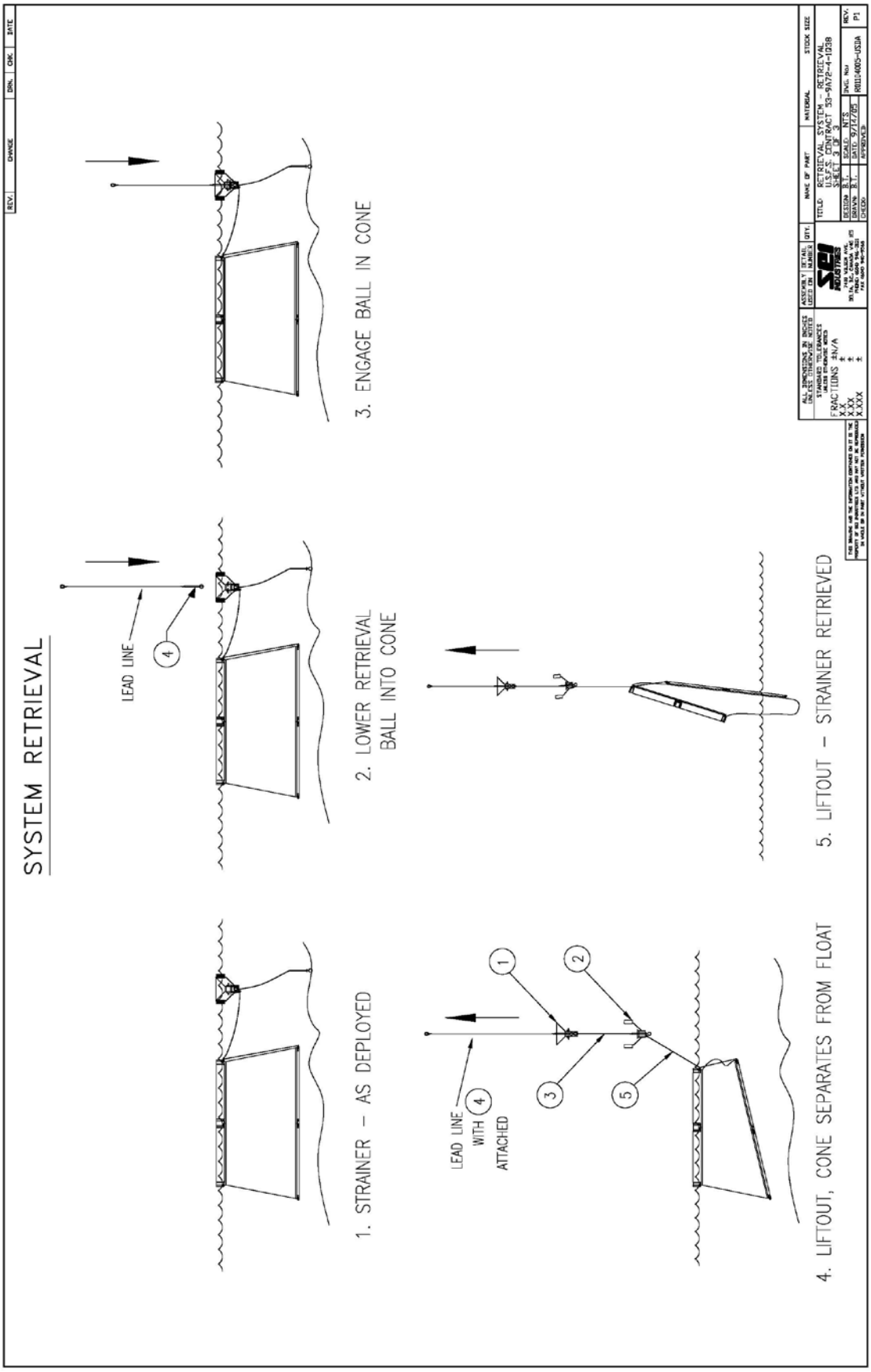
APPENDIX A—SYSTEM COMPONENTS



APPENDIX B—SYSTEM DEPLOYMENT



APPENDIX C—SYSTEM RETRIEVAL



About the Author

Dave Haston has been with the Forest Service since 2003. Before coming to the center, he worked for 18 years in private industry in the areas of design engineering, manufacturing, and project management, the last 12 of which were spent designing respiratory protection equipment for structural firefighting and industrial applications. Dave is a licensed mechanical engineer in the State of California and is the holder of four patents for life support equipment. He represents the Forest Service on several National Fire Protection Association committees.

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San Bernardino National Forest Helitack Crew 535 (Keenwild), *San Jacinto District*

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