



Environmental Analysis Program

Pomona College
Biogeochemistry Laboratory

SOP-F207

Secchi Disk and Secchi Disk Tube

Standard Operating Procedure

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1. Purpose

This SOP describes the use of the standard Secchi disk and the Secchi disk tube (transparency tube) for measuring water transparency in lakes, reservoirs, and streams. Secchi depth is one of the oldest and simplest limnological measurements, providing a rapid estimate of the photic zone depth and an index of suspended particle concentration (Carlson, 1977; Wetzel, 2001).

2. Scope

- **Applies to:** Visual transparency measurements in lakes, ponds, and reservoirs (standard Secchi disk) and in streams, shallow wetlands, and stormwater basins (Secchi tube)
- **Does not apply to:** Quantitative turbidity measurements (see [SOP-F205](#)); laboratory transmissometry; PAR light profiles (requires an underwater quantum sensor)
- **Location:** All EA Program surface water field sites

3. Responsibilities

Role	Responsibility
PI / Field Lead	Specify measurement protocol for the project
Trained Personnel	Perform measurements per this SOP
New Students	Complete training before independent use

4. Definitions

- **Euphotic zone depth (z_{eu}):** The depth receiving at least 1% of surface irradiance; approximately 2–3 times the Secchi depth in most lakes; defines the lower boundary of net photosynthesis (Wetzel, 2001).
- **Photic zone:** The surface layer of a water body receiving sufficient light to support photosynthesis; its depth is inversely related to turbidity and Secchi depth.
- **Secchi depth (z_{SD}):** The depth at which a standard Secchi disk becomes just invisible when lowered, averaged with the depth at which it becomes visible again when raised; $z_{SD} = (D_1 + D_2)/2$; an index of water transparency inversely related to suspended particle concentration and dissolved color (Carlson, 1977).
- **Secchi tube (transparency tube):** A clear acrylic tube, typically 60 or 120 cm long, with a Secchi disk pattern printed at the bottom and a drain valve at the base; filled with sample water and drained until the pattern disappears; used in shallow or turbid waters where a standard disk cannot be deployed vertically.
- **Trophic state index (TSI):** A numerical scale relating Secchi depth, chlorophyll a, and total phosphorus to lake trophic status; Carlson's TSI for Secchi depth: $TSI(SD) = 60 - 14.41 \ln(z_{SD})$ (Carlson, 1977).
- **Viewscope:** A tube, box, or bucket with a transparent bottom used to eliminate surface glare when reading Secchi depth; improves consistency between observers but must be noted and applied consistently within a dataset.

5. Safety and Hazards

Hazards

- **Physical:** Secchi disk measurements from boats, docks, or bridges require caution to prevent falls. Wear a personal flotation device (PFD) when sampling from boats.
- **Biological:** Surface water may contain pathogens. Avoid ingestion; wear gloves if hands contact water.
- **Sun glare:** Measuring Secchi depth requires looking directly into the water; use polarized sunglasses or a viewscope to reduce glare (note use in the field notebook for consistency).

5.1. Required PPE

- ☐ Closed-toed shoes or wading boots
- ☐ Personal flotation device (boat sampling)
- ☐ Nitrile gloves (recommended for impaired waters)
- ☐ Sun protection (hat, sunglasses)

5.2. Emergency Procedures

Refer to [SOP-F001 Field Safety](#). If sampling from a boat, ensure all occupants know the location of PFDs and throwable flotation devices.

6. Equipment and Materials

6.1. Standard Secchi Disk

Item	Notes
Standard Secchi disk (20 cm diameter)	Alternating black and white quadrants; weighted to sink horizontally
Graduated line (marked every 0.1 m)	Non-stretch braided cord or chain
Viewscope (optional)	Eliminates surface glare; a capped PVC section with a clear bottom works well

6.2. Secchi Tube (Transparency Tube)

Item	Notes
Secchi tube (60 or 120 cm)	Clear acrylic tube; Secchi disk pattern at bottom; cm scale on side; drain valve at base
Sample bucket or wide-mouth bottle	For collecting water to fill the tube

6.3. General

Item	Notes
Field notebook	Per SOP-F003
Watch	For recording time of measurement
Camera	For documenting site conditions

7. Procedure

7.1. Standard Secchi Disk (Lakes, Reservoirs, Deep Pools)

Take measurements on the shaded side of the boat or dock, between 10:00 and 14:00 local time for consistency. Avoid measurements during heavy cloud cover, rain, or high wind (Wetzel, 2001).

1. Lower the Secchi disk on the shaded side until it just disappears from view. Record this depth as **D1** (disappearance depth).
2. Slowly raise the disk until it just reappears. Record this depth as **D2** (reappearance depth).
3. Calculate Secchi depth:

$$\text{Secchi depth} = \frac{D_1 + D_2}{2}$$

4. Record in the field notebook:
 - Secchi depth (m) and D1, D2 individually
 - Date and time
 - Sky conditions (clear, partly cloudy, overcast)
 - Wind and water surface conditions
 - Whether a viewscope was used
 - Observer name (readings vary between observers)
5. If the disk is visible on the bottom, record “Secchi depth > [bottom depth]” and note the bottom depth.
6. Repeat the measurement a second time; the two readings should agree within 0.5 m. Record both and report the mean.

7.2. Secchi Tube (Streams, Shallow Waters)

1. Collect a water sample from mid-depth using a bucket or wide-mouth bottle; avoid disturbing sediment.
2. Pour the sample into the Secchi tube until full.
3. Hold the tube vertically and look down through the water column at the Secchi pattern on the bottom.
4. Open the drain valve slowly. Watch the Secchi pattern.
5. When the pattern just disappears, close the valve and read the water level on the graduated scale. Record as **Secchi tube depth** (cm).
6. Refill the tube and repeat; the two readings should agree within 2 cm. Record both and report the mean.
7. Rinse the tube with DI water between sites to prevent cross-contamination.

8. Data Interpretation

Secchi depth is inversely related to turbidity and suspended particle concentration (Carlson, 1977; Wetzel, 2001). Approximate trophic-state guidelines for lakes:

Secchi Depth (m)	Trophic Class
> 5	Oligotrophic
2–5	Mesotrophic
1–2	Eutrophic
< 1	Hypereutrophic

Note

These categories are approximate and vary with dissolved color, algal species, and suspended sediment type. Do not use Secchi depth alone to classify trophic state; combine with nutrient and chlorophyll data (Carlson, 1977).

9. Quality Control

- Use the same observer for repeated measurements at a monitoring site whenever possible; inter-observer variability is the largest source of error (Wetzel, 2001).
- Always take duplicate measurements and report the mean.
- Record consistently whether sunglasses or a viewscope were used.
- Verify Secchi tube graduation markings against a ruler at least once per year.
- When both a Secchi disk and a turbidity meter are available, pair the measurements to develop a site-specific Secchi-turbidity regression.

10. References

- Wetzel (2001)
- Carlson (1977)
- APHA et al. (2012)

APHA, AWWA, & WEF. (2012). *Standard methods for the examination of water and wastewater* (22nd ed., p. 1360). American Public Health Association.

Carlson, R. E. (1977). A trophic state index for lakes. *Limnology and Oceanography*, 22(2), 361–369. <https://doi.org/10.4319/lo.1977.22.2.0361>

Wetzel, R. G. (2001). *Limnology: Lake and river ecosystems* (3rd ed.). Academic Press.

11. Related SOPs

SOP	Title	Relationship
F001	Field Safety	Required prerequisite
F205	Handheld Turbidity Meter	Quantitative turbidity companion
F300	Surface Water Sampling	Sample collection context
L310	Chlorophyll Extraction	Trophic state companion

12. Training Record

Before performing Secchi measurements independently, personnel must:

1. Read this SOP in full
2. Perform supervised duplicate Secchi disk or Secchi tube measurements at one site
3. Demonstrate agreement within the QC criteria (0.5 m for disk, 2 cm for tube)
4. Be signed off by the PI or field lead