

Southeast Coast Network

National Park Service
Inventory & Monitoring Program



Standard Operating Procedure (SOP) #1.3.8

Soil Porewater Equipment Construction and Data Collection

Please cite this as:

Curtis, A. C. 2012. Soil porewater equipment construction and data collection. Southeast Coast Network Standard Operating Procedure NPS/SECN/SOP-1.3.8. National Park Service, Athens, Georgia

Summary

The following Standard Operating Procedure (SOP) outlines the procedures involved in establishing soil porewater monitoring plots and sampling soil porewater in salt marsh community monitoring sites. These procedures are adapted from Louisiana Department of Natural Resources Coastal Resource Division protocol (Folse and West 2004, Folse et al. 2008).

Revision Log

Previous Version #	Revision Date	Author	Changes Made	Reason for Change	New Version #
	25July2014	L. C. Baron	Minor organizational changes and updates for 2014.	Address reviewers comments	8

Overview

Soil porewater constituents are relatively uniform above 20–25 cm (Feijtel et al. 1988) and these depths represent the approximate mean and maximum depth of the root zone (Mitsch and Gosselink 2007). Soil porewater salinities are easily measured in the field with use of a porewater sipper (Figure 1) to aid in extracting interstitial water from each depth and measuring salinity with a handheld salinity meter of extracted water (McKee et al. 1988). Field personnel will measure soil porewater salinity within specific plots at 10 cm and 30 cm depth during site visits.

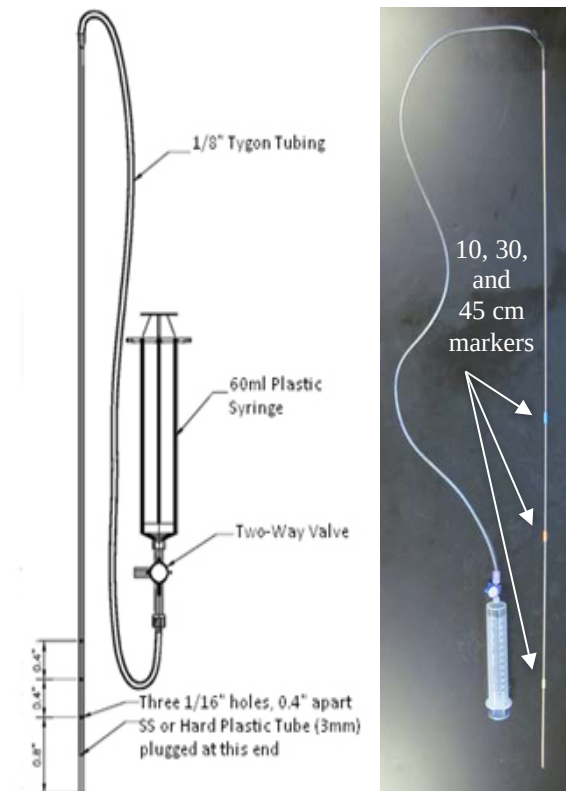


Figure 1. Soil porewater sipper schematic (left) showing the location of the holes drilled into the bottom. Picture of porewater sipper (right) showing the depth markers at 10 cm, 30 cm, and 45 cm.

Procedures

The procedures for soil porewater assembly, installation, and sampling are adapted from Louisiana DNR Coastal Resource Division procedures (Folse and West 2004, Folse et al. 2008).

Soil Porewater Sipper Assembly

Materials

- Rigid plastic or stainless steel tubing with an outer diameter of 3.0 mm (0.12 in.) maximum length of 95 cm (37.4 in.)

- Epoxy or sealant
- Drill bit (1/16 in.)
- Drill press (recommended)
- 60 ml syringe
- Tygon® tubing: 30–90cm (1.0–3.0 ft.) length of Tygon® tubing attached to the open end of the rigid sipper probe
- Two-way valve

Construction

1. Cut the stainless steel or rigid plastic tubing to length (~50 cm).
2. Drill three 1/16 in. holes, at 90° angles to each other around the probe, 2, 3, and 4 cm from one end.
3. Seal the end of the tubing closest to the holes with an epoxy or sealant to prevent the passage of any liquid material. Fill this end with approximately 1 cm of epoxy, but do not allow epoxy to fill drilled holes
4. Mark 10 cm, 30 cm, and 45 cm on the tubing measured from the center of the middle holes. Mark using electrical tape or score the tube so that the correct depth is represented by the top of the electrical tape or score (Figure 1).
5. Securely attach a piece of the Tygon® tubing to the other end of the probe.
6. Attach a two-way valve to the syringe and to the other end of the Tygon® tubing.

Plot Establishment

Soil porewater plots are to be established on the same day that the initial rod-surface elevation table (RSET) readings are recorded (SOP 1.3.6; Asper and Curtis 2013b). One plot will be established along the boardwalk (SOP 1.3.2; Asper and Curtis 2013a) as shown in Figure 2 in a manner that will be easily sampled at a later date from the platform.

All plot establishment procedures must be performed from the platform.

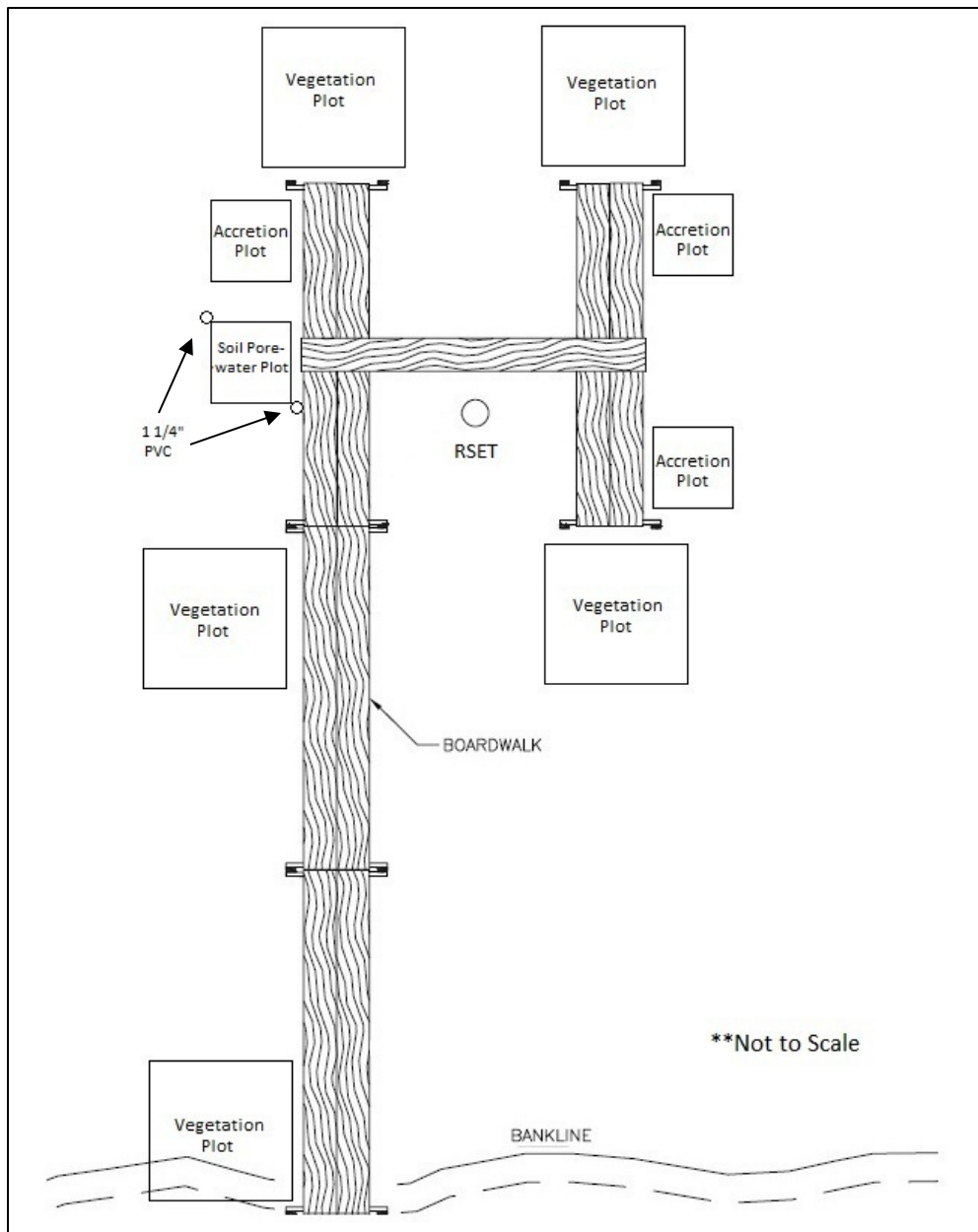


Figure 2. Schematic for boardwalk and locations for accretion plots, soil porewater stations, and other salt marsh monitoring elements. PVC markers are displayed as open circles outside the Soil Poreware Plot. (Modified from Folse and West 2004)

Materials / Equipment

- Two sections of 1.25 in. × 5 ft. PVC
- One 0.5 meter square (Figure 3)
- Tape Measure
- Mallet

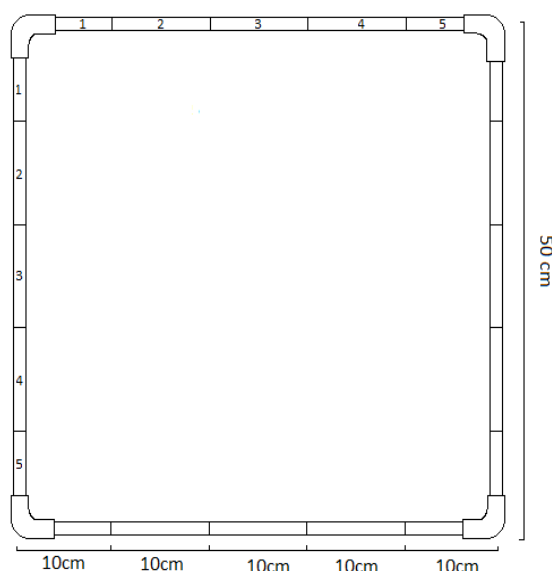


Figure 3. 0.5 m × 0.5 m PVC square frame to be used as a template for installing soil porewater plots.

Field Procedures

1. Place the 0.5 m² PVC quadrat at the location where the plot is to be located (see Figure 3). The soil porewater plot should be placed parallel to the platform with the nearest corner mid-way between the two third section (from water) platform teeth, outside the RSET sampling area, and approximately 125 cm from the fourth tooth assembly, 15 cm from the platform edge.
2. Gently push or hammer a 1.25 in. × 5 ft. section of PVC pipe into the right corner, water side of the plot, just outside the frame until 2.5 ft of PVC pipe is above the surface (see Figure 2 for location of PVC pipes).
3. Gently push or hammer a 1.25 in. × 5 ft. section of PVC pipe into the diagonally opposite corner from the first piece of PVC pipe, outside the PVC square until 2.5 ft of PVC pipe is above the surface.
4. Using a digital camera with the date and time stamp function enabled, take pictures of the plot to show the establishment and orientation of the soil porewater plot. NOTE: Pictures should include one taken directly above each plot with the PVC pipes in place and another picture taken of the entire site.

Equipment Calibration

Before readings are taken in the field with a hand-held salinity meter, the salinity meter must be calibrated for quality assurance.

NOTE: It is important that the calibration process established by the instrument manufacturer be examined in order to determine suggested concentrations of the conductivity standards for the operating environment encountered at the time of field sampling.

Equipment

- Salinity meter
- DI or Distilled water
- Calibration standard (purchased from approved manufacturer)
- 50 mL plastic centrifuge tube
- Calibration Form (Appendix A)

Instructions

NOTE: Calibrate the instrument using a conductivity standard most similar to the range of the field samples. The concentration of the standard used for the calibration should be based on the testing needs for the field activity. A single point check standard in the range of the sample concentration to be measured should be used for field screening and should be within $\pm 5\%$ range of accuracy of true value for the calibration to be acceptable.

Suspend the probe in the solution so that the electrode does not rest against the container. Make sure the electrode's vent hole is submerged. If necessary, move the probe vigorously from side to side to free the vent hole of air bubbles.

1. Ensure that the salinity meter is clean and free from any organic or mineral sediment.
2. Rinse the salinity meter probe with DI or Distilled water between changes of calibration solutions.
3. Rinse the 50 mL centrifuge tube with calibration standard. Dispose of rinse solution.
4. Rinse salinity meter probe with calibration standard. Dispose of rinse solution.
5. Pour 30-40 mL of calibration standard into 50 mL centrifuge tube.
6. Insert salinity meter probe into 50 mL centrifuge tube.
7. Proceed with calibration according to the salinity meter manual.
8. Fill out the Hand-held Salinity Meter Calibration Form (Appendix A).

Porewater Data Collection

Soil porewater samples will be extracted from the sediment matrix from the same soil porewater plot each trip. Three replicate samples will be taken at two depths: 10 cm, 30 cm or 45 cm (if no water is located at 30 cm). The second and third replicate for each depth will be moved successively five centimeters (2 in.) to the right of the previous sample. Prior to sampling the 30-cm depth, the field personnel will move another five centimeters (2 in.) to the right of the third 10-cm sample and begin sampling at the second depth in the same manner (i.e., moving 2 inches to the right on each subsequent sample). In the event additional plots are installed, plot numbers shall begin with the sample closest to the access point.

All sampling procedures must be performed from the platform.

Equipment

- Porewater sipper
- YSI 30 Meter or handheld salinity meter
- 50 mL plastic centrifuge tube
- Distilled water
- Calibration standard
- Cheesecloth
- Field form (Appendix B)

Field Procedures

1. If the probe has not been calibrated, follow the Equipment Calibration instructions on page SOP 1.3.8-5.
2. Complete the top section of the Soil Porewater Salinity Field Form (Appendix B)
3. Prior to insertion for each replication, inspect the sipper holes for blockage and unclog by flushing with water as necessary.
4. Insert the porewater sipper tube into the soil to the top of the 10 cm (or 30 cm or 45 cm) mark.
5. Before measuring porewater salinity, the tubing, syringe, and centrifuge tube must be rinsed with porewater from each sampling depth at least once. Fill about one-third to one-half the volume (~20-30 ml) of the syringe with porewater and rinse the interior of the syringe thoroughly. Discard the water.

NOTE: In highly organic wetland soils pore water extraction may be blocked or severely inhibited by organic or small clay particles. If this condition occurs, securely fasten a piece of cheese cloth around the intake holes of the porewater sipper tube to filter obstructing particles and extract another sample.

6. Extract another 30 ml of porewater and use it to rinse the salinity meter probe (it is recommended to use a two-way valve to dispense water from the syringe into the centrifuge tube to prevent losing suction on the sipper or the sipper hose). Discard the rinse water.
7. Pull a third aliquot of porewater—enough to fill the syringe and cover the salinity meter probe when it is in the syringe (~20-30 ml for YSI 30 salinity meter).
8. Insert the salinity meter probe into the syringe, and record the temperature ($^{\circ}\text{C}$), specific conductance ($\mu\text{S}/\text{cm}$), and salinity (ppt) for the appropriate depth on the soil porewater field form (Appendix B) for each pore water sample. Try to keep the salinity meter probe from touching the side of the centrifuge tube. There are two holes at the top of the probe that must be covered with the sample water (Figure 4). Gently move the salinity meter probe up and down to remove any air bubbles from the sensor.

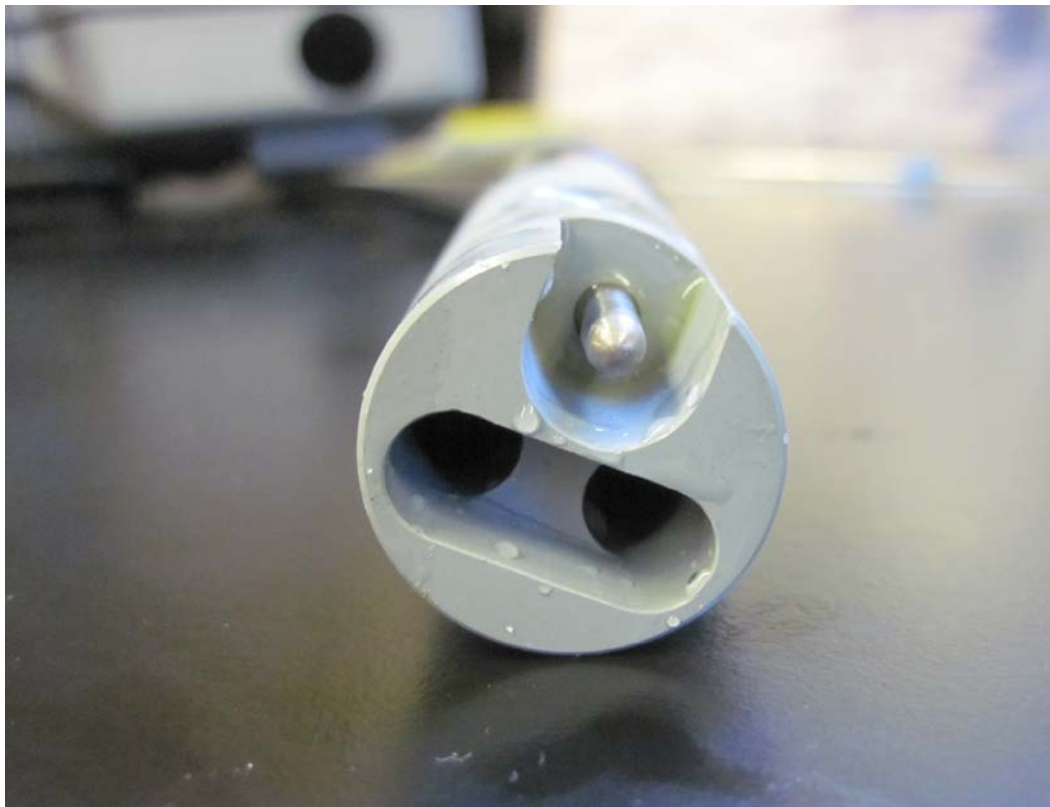


Figure 4. Picture of YSI 30 salinity probe looking at the bottom of the probe. The two holes the water needs to move through to measure salinity can be seen, in addition to the temperature sensor.

9. Carefully remove the sipper tube and move ~5 cm (~2 in) to the right and reinsert the sipper tube into the soil matrix.

NOTE: If there is no water at 10 cm and 30 cm depths, insert the probe to 45 cm and proceed with steps 5-9. Record 45 in the depth column where 30 is located. Record dry if no soil porewater sample was collected.

10. Repeat steps 1-9 for each replicate and each depth. At each plot, up to three replicates will be taken at the 10 and 30-cm depths for a total of six samples (Figure 5). (This might be less if soils are dry; see notes below).

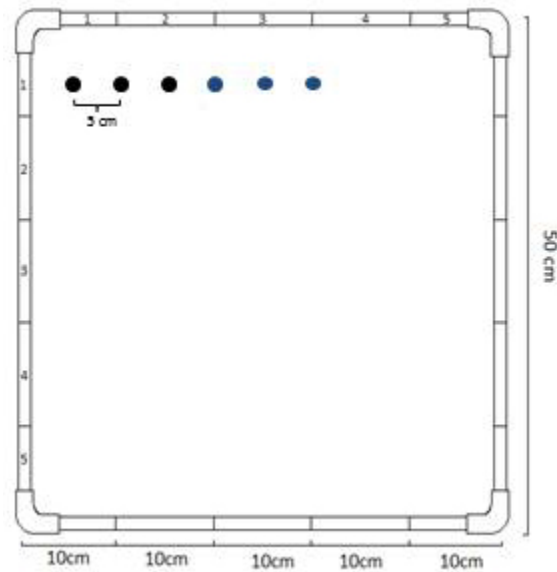


Figure 5. PVC square representing the porewater plot area. Inside the porewater plot the circles represent the sampling location. Sampling location at 10 cm depth is shown as black circles and 30 cm depth is shown as blue circles. After each sample is collected and tested for salinity, the porewater sipper is moved 5 cm to the right

11. If there is surface water on the marsh surface, insert the salinity meter probe into the surface water and record surface water temperature, specific conductance, and salinity.
12. Check the field form for completeness.

NOTE: In some cases, there may not be enough water in the marsh soil for rinsing. Instead, distilled water may be used.

Literature Cited

- Asper, J. R. and A. C. Curtis. 2013a. Procedures for measuring salt marsh elevation using rod-surface elevation tables. Standard Operating Procedure NPS/SECN/SOP-1.3.6. National Park Service, Athens, Georgia.
- Asper, J. and T. Curtis. 2013a. Salt marsh elevation and vegetation community monitoring site platform installation. Standard Operating Procedure NPS/SECN/SOP-1.3.2. National Park Service, Athens, Georgia.
- Asper, J. R. and A. C. Curtis. 2013b. Procedures for measuring salt marsh elevation using rod-surface elevation tables. Standard Operating Procedure NPS/SECN/SOP-1.3.6. National Park Service, Athens, Georgia.
- Feijtel, T. C., R. D. DeLaune, and W. H. Patrick, Jr. 1988. Seasonal pore water dynamics in marshes of Barataria Basin, Louisiana. *Soil Science Society of America Journal* 52:59-67.
- Folse, T. M. and J. L. West. 2004. A standard operating procedures manual for the Louisiana Department of Natural Resource's Coastal Restoration Division: methods for Data Collection, Quality Assurance/ Quality Control, Storage, and Products. Louisiana Department of Natural Resources, Baton Rouge, Louisiana.
- Folse, T. M., J. L. West, M. K. Hymel, J. P. Troutman, L. A. Sharp, D. Wiefenbach, T. McGinnis, and L. B. Rodrigue. 2008. A standard operating procedures manual for the coast-wide reference monitoring system-wetlands: methods for site establishment, data collection, and quality assurance/quality control. . Louisiana Coastal Protection and Restoration Authority, Office of Coastal Protection and Restoration, Baton Rouge, LA.
- McKee, K. L., I. A. Mendelssohn, and M. W. Hester. 1988. Reexamination of Pore Water Sulfide Concentrations and Redox Potentials Near the Aerial Roots of *Rhizophora mangle* and *Avicennia germinans*. *American Journal of Botany*:1352.
- Mitsch, W. J. and J. G. Gosselink. 2007. *Wetlands*. Wiley, Inc., Hoboken, New Jersey.

Appendix A – Calibration Form

Hand-held Salinity Meter Calibration Field Form

[illegible]

* If the instrument is dirty, it should be indicated and then it should be cleaned to prevent any damages.

If cuts are found on the cable, then the instrument needs to be sent in for repairs unless the cuts do not penetrate the exterior coating.

Appendix B – Field Form

Soil Porewater Salinity Field Form

RSET ID: _____ Feature Name: _____

Sample Date: _____ Time: _____ Establishment Date/Time: _____

Measured by: _____ Field Personnel / Organization: _____

Salinity Meter Manufacturer and Model Number: _____ Serial Number _____

Salinity Meter Calibrated: Yes / No Date of Calibration: _____ Calibration Standard: _____

Replicate	Depth (cm)	Temperature (°C)	Specific Conductance (μ S/CM)	Salinity (ppt)
1	10			
2	10			
3	10			
1	30			
2	30			
3	30			

Is water present on the marsh surface? Yes / No

If yes, record the following for the surface water:

Temperature (°C): _____ Salinity (parts per thousand): _____

Specific Conductancy (μ S/cm): _____

Notes:

RSET ID: park four letter code plus 3 digit site code plus one letter code, i.e., CUIS001A

Feature Name: Text from the GNIS data, a description of the water body site is located, such as Great Island Bay.

Sample Date: Date

Establishment Date: Date

Measured by: Name

Field personnel / Organization: Name of other field members and respective organization, up to six letter code, i.e., CUIS or SECN or SCA or GADNR.

GPS Survey: This is performed when established and after differential correction.

Date column: Date

UTM Zone: Two digits

Easting: numeric

Northing: numeric

Z: elevation in meters

Equipment used: Text

Surveyor: Name

Plot: two digit alphanumeric

Time: four digit military time

Salinity Meter Manufacturer and Model Number: Alpha numeric, such as YSI 30.

Serial Number: Serial number of meter, alpha numeric, such as 08L 100233

Salinity Meter Calibrated: Yes or No

Date of Calibration: Date

Calibration Standard: Standard used, such as LDNR/CRD or YSI.

Temperature Column: Temperature in Decimal Degrees Celsius

Specific Conductance Column: a measure of how well water can conduct an electrical current, Numeric five digits with decimal point

Salinity: parts per thousand, three digit plus decimal point

Temperature: decimal degrees Celsius

Salinity: parts per trillion, three digit plus decimal point

Specific Conductance: a measure of how well water can conduct an electrical current, Numeric five digits with decimal point

Notes: Text