# Point Data Types and SCS900 / Siteworks Using Business Center – HCE

## Background Information

In Business Center – HCE these are the main types of Point that can be created in Business Center - HCE

1. Point Cloud Point
2. CAD Point
3. Grid Only Point
4. Grid Point
5. Local Only Point (Has LLH value in the project coordinate system only)
6. Global Only Point (has a LLH value in the WGS84 coordinate system only)
7. As Staked Point (Survey Controller and Access only at this time)

### Point Cloud Point

This is the lightest form of Point in Business Center – HCE. The Points are stored as a Point Cloud or Point Cloud Region that is stored in an external database to the project. These points can have RGB color values as well as Intensity values and N,E,Z values.

### CAD Point

A CAD point is similar to a Grid Only Point. It has a Northing, Easting and Elevation. It can be created through import of a CAD file (DWG, DXF, DGN format file only). A CAD point does not have a feature Code. It is a very light data object in Business Center – HCE. When you create a Surface Texture or Site Improvement location, these use a derivative of the CAD point with specific properties for the purposes of applying Site Improvements or Surface Textures to a surface.

### Grid Only Point

A simple point which has a single Northing, Easting and Elevation coordinate value only. When the Project has a Coordinate System (or a site calibration) the Grid Only Points have a computed Latitude and Longitude (Local) value. When the source Grid Only Point has an Elevation then the points will also have a computed Height Value (Local) and a Computed WGS84 Latitude, Longitude and Height value (Global) (Note a Global Coordinate can only be computed when the source point has a Northing, Easting and Elevation value and the Project has a coordinate system applied).

A Grid Only Point can

1. Only have **one** position.
2. Has **no** quality value.
3. Is represented on screen as a dot.
4. Can be edited through its properties.
5. Is not moved as a result of a Coordinate system change.
6. Can have a Feature Code as well as Description 1 and 2 values. It can be used in Process feature Codes as a result to generate linework etc.

Grid Only Points can be created using the following commands

1. Import .csv file allows you to set a property of the points being imported to Grid Only. If you check the Check box (which is on the third tab of the Import dialog), then you will import points as Grid Only Points. If you do not check the check box then the points are imported as Grid points and you can define the quality of the Grid Points.
2. Create from CAD command allows you to set the same Grid Only property of the points being created. Again if you check the check box it will create Grid Only Points. If you do not check the check box it will create Grid Points.
3. Create at Intervals command allows you to set the same Grid Only property of the points created. Again if you check the check box it will create Grid Only Points. If you do not check the check box it will create Grid Points.
4. Data Prep commands like the Spot command will create Grid Only points.

***Note:***

*At this time a Grid Only Point cannot be created using the Create Point command, I have added this as an enhancement request. All points created using this command are Grid Points by default but can also be Local only or Global only values.*

### Grid Point

A Grid Point can have multiple coordinates stored with the master location. The master or derived location is created by Point Derivation from the multiple coordinates stored on the Grid Point. The Point Derivation report shows how the point has been derived and for each coordinate it will show the deltas to the derived point location. The coordinates stored on a Grid Point can be Northing, Easting, Elevation, a local LLH or a Global LLH.

A Grid Point

1. Can have many coordinates.
2. Has **a** quality value (Control, Survey, Mapping or Unknown hierarchy, Local or Global).
3. Is represented on screen as a circle.
4. Cannot be edited through its properties, however the coordinates for the point can be reviewed and edited individually.
5. Is moved as a result of a Coordinate system change.
6. Can have a Feature Code as well as Description 1 and 2 values. It can be used in Process Feature Codes as a result to generate linework etc.

## As Staked Point

The Trimble Access and Trimble Survey Controller field software products, during stakeout create As Staked records. When imported into Business Center – HCE those As Staked records become As Staked Points. An As Staked Point has the unique properties that reference the As Staked Point to the Design Point, Line, Surface etc. and the delta values between the Design location and the As Staked location. At this time SCS900 / Siteworks As Staked records are not mapped to this object type. I have entered an enhancement request to fulfill this need so that SCS900 data aligns with Trimble Access and Survey Controller data in this regard.

Within the Project Explorer you will find a Points Branch and an As Staked Points Branch. Each As Staked Point will appear in the As Staked Branch. If the As Staked Point was created by staking out a Point then the “Design Point” will be in the Points branch and the As Staked Point will be in the As Staked Branch. If the As Staked Point was created by Staking a Line, A Surface, A Road or Alignment etc. then there will be no Design Point in the Point branch.

An As Staked Point has three levels of information if it was staked once.

1. The As Staked Point, As Staked Corridor Point, As Staked Line Point, As Staked Alignment Point, As Staked Surface Point, As Staked Catch Point
	1. At this level you will find
		1. Point ID
		2. Feature Code
		3. Description 1 and 2
		4. Layer
		5. Original / Design Point ID (As Staked point)
		6. Feature
		7. Design Point Information / Design Corridor etc. information
			1. Point ID
			2. Code
			3. Selected Elevation
			4. Stakeout method (list these e.g. To The Point)
			5. Offset
			6. Azimuth
			7. Elevation Defined By
			8. Design Elevation
			9. Corridors would have Name, Code, Station. Offset, Elevation, Hz, Vt, Station offsets etc. (Create a table here to capture the different types of record and which values are stored with which)
		8. Grid Deltas
			1. Delta N
			2. Delta E
			3. Delta Elev
		9. Polar Deltas
			1. Azimuth
			2. Length
2. A Coordinate
	1. At this level you will find (Depends on whether this is GPS or TS based data)
		1. Point ID
		2. File (Source Job File\_
		3. Latitude
		4. Longitude
		5. Height
		6. Status
		7. ECEF Coordinate
3. The GNSS Position Solution (For GNS based measurement)
	1. Point ID
	2. Start of Measurement
	3. End of Measurement
	4. Duration of measurement
	5. Point ID
	6. Antenna Height
	7. Antenna Height Measurement Method eg Bottom of antenna mount)
	8. Manufacturer eg Trimble
	9. Type (Receiver Type)
	10. Position (APC) (Antenna Phase Center)
		1. Latitude
		2. Longitude
		3. Height
		4. Status
	11. Measurement Statistics
		1. Max PDOP
		2. Max HDOP
		3. Max VDOP
		4. RMS
		5. H Precision (95%)
		6. V Precision (95%)
		7. Solution Type (eg Fixed)
	12. Observation Data
		1. Number of Satellites
		2. Number of Epochs
		3. RTCM age
	13. Device Orientation
		1. Tilt Compensation
		2. Tilt Distance
		3. Tilt
		4. Calibration Date

At the Branch level, you will find statistics about the As Staked Point data in the Project including the number of each type of As Staked Points and the Number of As Staked Points that are outside the target tolerances as specified in the Project Settings – Computations – As-Staked Points (Horizontal and Vertical Tolerance and whether or not you want to Flag vertical out of tolerance records).

## Field Data Management Workflow

When Business Center creates or Adds an External Site to a project, the different elements of SCS900 data are created as Follows

## Site Data

### Office Control Points (when added from a controller)

These are created as Grid Points with the Quality of Control. If you start a Project from scratch and import the Control Points or Enter the Coordinates in by hand using Create Point or Add Coordinate (to an existing point in the point list) then you should set these up as Grid Points with Quality Control or if you absolutely never want the points to be moved, you should import them as Grid Only Points.

### Field Control Points

These are not currently supported by the Field Data Workflows. You can import these points using the CSV file importer and they should likely be imported as Grid Points with Quality “Control” or “Survey” (if you want them to be a lower order of accuracy to the original Control Points provided (to which you calibrated). I have added an enhancement request to support the Control.Field.csv workflow.

## Design Data – Stakeout Points

When you add an External Design to a Project that has Stakeout Points as a CSV file in the design, the Points are created in BC-HCE as Grid Only Points.

## Work Order Data

Importing Measured Data from a Work Order created Grid Only Points

Importing As Staked data from a Work Order creates Grid Only Points

## Workflow Steps

1. Import a Control csv file using the Import Command and set the Importer to Import as Grid Only Points. This will create Points e.g. 1-10 in the Project Explorer. They have no additional coordinates only the Top Level Point which has the normal Grid Only properties.
2. If you then export to SCS900 Job Site and then do a Site Calibration, when you resolve the conflict created at the Jobsite level and utilize the SCS900 Site Calibration data, the Points 1 – 10 are upgraded to Grid Points, and the coordinate used by the Site Calibration (from the original source coordinate) is added as a Coordinate value on the point. At this stage there is only one coordinate value (indicated as sourced from the CAL file). At this stage there are also now Points GPS\_1 to GPS\_10 which are the Measured GPS coordinates which have a Global Coordinate LLH and an ECEF Coordinate value (Computed). At the Point level, the point has a derived N,E,Elev a derived Local LLH and the derived Global LLH. The derived N,E,Elev values for the GPS point will not match exactly the coordinates of the Control Points that you started with. Both the GPS and Source Point now have the Survey Quality.
3. If you now modify the Site Calibration and Re-compute it e.g. by changing the Horizontal and Vertical use of the GPS points to Horizontal Only, Vertical Only or Ignored, then the re-computation will update the derived N,E,Z coordinate for the GPS points in the Calibration. The original Control points are left unaffected by the re-computation of the Site Calibration. No additional Coordinate values are assigned to any of the control points in this process.

Note: You can review the Point Derivation report to see how the top level point coordinate record has been derived from the coordinate record values assigned to it.

Once you have your Control and Site Calibration as you want it, you should lock those values in the project so that you cannot inadvertently update any Control Point Values or Site Calibration results to any controller that already has the Control File or Site Calibration File. To lock these use Project Settings – Computations – Field Data and set the values for all three settings to Yes (enable protection). This will prohibit BC-HCE from overwriting data on controllers relating to Existing Control, Existing Calibration and Existing Designs where they are already on the controller.

You should try to avoid changing any properties of any Control Point or the Site Calibration if you do not want to have to do Conflict Resolution at the Jobsite level. If you subsequently do something to any property of a Control Point, you will generate a Conflict that has to be resolved – because the BC-HCE Change Manager will detect any change to any control point property as a potential conflict that has to be resolved. In this case the Resolve Conflict will have to be carried out before you can send out any more data to your machines or SPS Crews using the field data workflow.

The only way that I have been able to create multiple coordinate values on any of the control points is by subsequently importing

1. A renamed CAL file
2. Importing the Control Points.csv as Grid Points (not Grid Only Points)
3. Adding Coordinate Records to a point manually.

With the correct workflows you should only have one coordinate record on each of your control points unless you have done one of the above things. Creating a Point using the Create Point command will stop you from creating a new point with the same name as a Grid Point that already exists – you can only use the Add Coordinate function or import another Grid Point with the same name to create that additional Coordinate record on a Grid Point.

## Possible Defect in SCS900

A possible defect in SCS900 was found during review of a customer dataset where the CAL file contained all of the Stakeout Points that were in a Design Folder as Stakeout Points. The Control File did not have those Stakeout Points, so the only way that the Stakeout Points could have been added to the CAL file was through use of SCS900 / Siteworks as far as I can tell. This has been passed to the SCS900 Product Manager for review and comment.

## Enhancements Requested for BC-HCE

1. In the Create Point command provide the ability to create a Grid Only point
2. Make the Text of the Jobsite or Design Red when a Conflict is encountered to make them more obvious to the user especially users working with “Small Icons” where the red spot is less apparent to the users. (this has already been implemented for November release).
3. Provide Support and Workflow for Field Control files so that Field Control Points can be added to a Project and then added to an Office Control Points file for all users on the project
4. Provide support at the Design level to export Designs for Siteworks Controllers only in a VCL format – currently this is unsupported
5. Provide support to Export (using the Machine Data Export Function) to an Earthworks DSZ file format. Add the Earthworks Machine type to the list of supported machines and when selected write a DSZ file in preference to an SVD/SVL file.
6. For SCS900 As Staked Record data, provide the workflow to add those As Staked Records for
	1. Stake Point
	2. Stake Line
	3. Stake Alignment
	4. Stake Surface
	5. Stake Corridor

So that we can utilize the As Staked properties and As Staked reporting functions in BC-HCE in addition to the SCS Report Utility.