



Collaboration, Innovation and Resilience: Championing a Digital Generation

Brisbane, Australia 6-10 April

# Progress towards fully digital cadastral survey data exchange in Australia and New Zealand

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**Presented today by  
Jeff NEEDHAM  
Adrian WHITE**



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## Overview of presentation

- Who are we?
- Standardisation and development of land boundary transfer specifications
- Development of the 3D Cadastral Survey Data Model
- Extensions to support 3D data
- Next steps and online resources



## Who we are? Australian and New Zealand surveying and mapping agencies

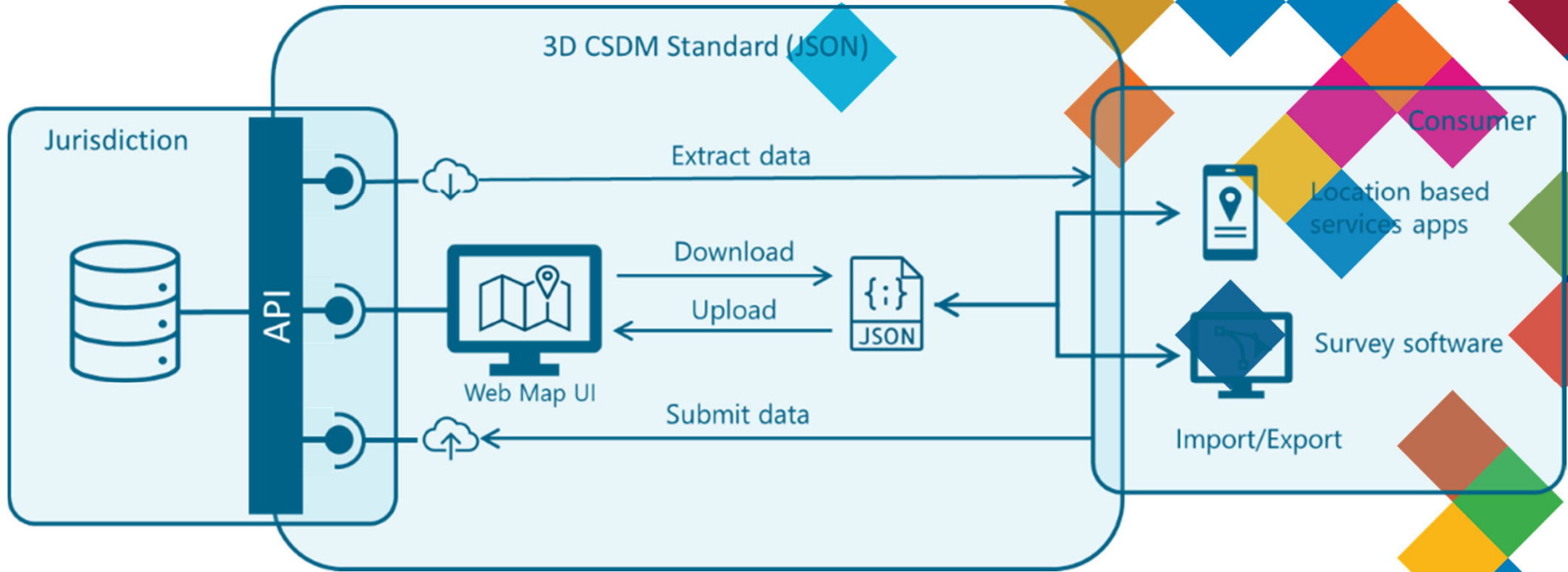


- Intergovernmental Committee on Surveying and Mapping (ICSM)
  - Inter-jurisdictional group of New Zealand and Australian state and territory surveying and mapping agencies
- Cadastral Working Group (CWG)
  - A sub-group to discuss and develop land boundary and land recording systems and processes
- Digital Plan Lodgement sub-committee (DPL)
  - New sub-group within CWG to focus on digital evolution of submissions to governmental agencies

## Standardisation and development of land boundary transfer specifications

- On review of current and future survey plan and survey field record requirements.
  - Australian jurisdictions and New Zealand have many similarities, although mixed approaches and adoption levels for digital submission of survey data (LandXML, CSD, dwg/dxf, CEXML)
  - Jurisdictions wish to enable Cadastre 2034 digital submission requirements
  - Jurisdictions wish to enable 3D submissions
- No nationally or internationally adopted digital data standard exists for the exchange of (digital) 3D cadastral survey information
- Decided to develop our own data standard
  - Utilise existing ISO and OGC standards
  - Leverage existing pre-published components
  - Interchangeable over time
  - Align with modern surveying practice

# 3D Cadastral Survey Dataset Model

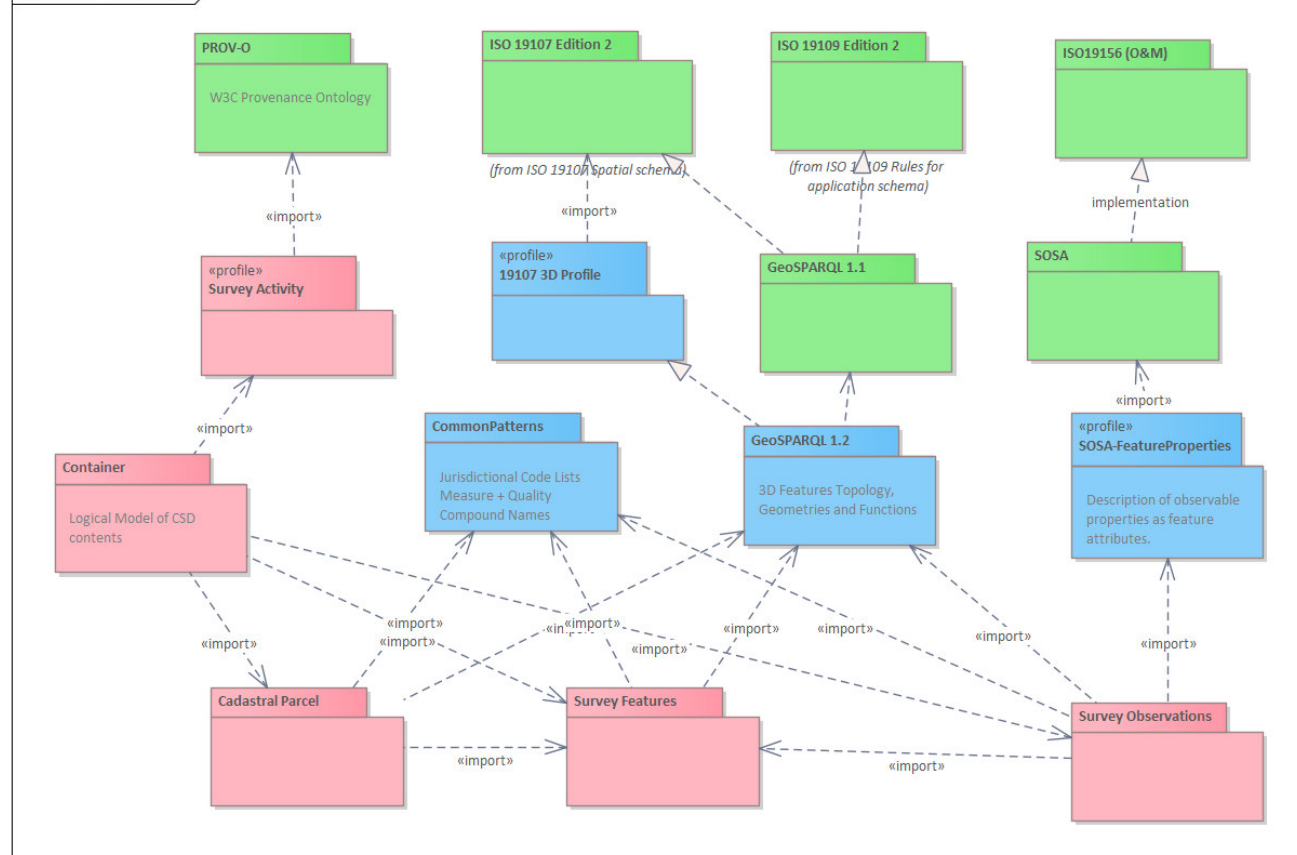


## 3D CSDM

Adopt elements from:

- International Standards
  - JSON-LD
  - SOSA
  - geoJSON
  - GeoSPARQL
- Australian/New Zealand Standards
  - ICSM Address Model
  - ICSM vocabularies
  - Local jurisdictional language

pkg Package Dependencies



[https://icsm-au.github.io/3d-csdm-design/2022/spec.html#\\_relationship\\_to\\_other\\_models](https://icsm-au.github.io/3d-csdm-design/2022/spec.html#_relationship_to_other_models)

## 3D CSDM – standards modification

- Adding 3D element to geoJSON format
- Surveying is relative
  - Modification of geoJSON from absolute positions to relative

```
"place": {
  "coordinates" : [ "399529.112", "6462628.624" ]}
```

```
"place": {
  "coordinates" : [ "399529.112", "6462628.624", "10.45" ]}
```

```
"geometry": { "type": "Point",
"coordinates": [116.0045347, -31.88682252]},
```

```
"geometry": { "type": "LineString",
"coordinates": [[116.0045347, -31.88682252],
[115.85307516, -31.95335671]]},
```

```
"feature": [ {
  "id" : "187", "place": {
    "coordinates" : [ "399529.112", "6462628.624", "10.45"
  ]}}},
  {
  "id" : "188", "place": {
    "coordinates" : [ "399560.451", "6462632.273", "10.45"
  ]}}}],
```

```
"features" : [{
  "id" : "106", "type" : "Feature",
  "geometry" : null,
  "topology" : {"type" : "LineString",
    "references" : [ "187,188" ]}],
```

Multi-Linestring example

```
"references" : [ "187,188,189,190,191,192" ]},
```

**Plan Information**

Finalised: Yes  
Plan Type: Strata Plan  
Plan Purpose: Subdivision

**Plan Heading**

LOTS 1-9 AND COMMON PROPERTY

**Strata Scheme Details**

Strata Name: 281 BELMONT AVENUE COVERAGE  
Lot/Section: 105

**Parcel Address**

281 BELMONT AVENUE CLOVERDALE 6105

**Locality and Local Government**

Locality: CLOVERDALE  
Local Government: CITY OF BELMONT

**Plan Examined**

Examined: [Signature] Date: 23 Feb 23

**Planning Approval**

Planning Approval Required: No  
Reference: [Signature] Date: 23 Feb 23

**Registered**

Registered: [Signature] Date: 23 Feb 23

**Survey Details**

Field Record: 101861  
Declared as Social Survey: NO

**Survey and Plan Notation**

1:3,600  
COMMON PROPERTY

**Survey Certificate - Regulation 54**

L. P. R. MATTISON  
I hereby certify that the plan is accurate and is a correct representation of the lot boundaries and

**Amendments**

| Version | Amendment Type | Amendment Description | Authorised By | Date |
|---------|----------------|-----------------------|---------------|------|
| 1       | Initial        | Initial               |               |      |

**Former Tenure**

| New Lot/Lot             | Parent Plan Number | Parent Lot Number    | Title Reference | Subject Land Description |
|-------------------------|--------------------|----------------------|-----------------|--------------------------|
| 1-9 AND COMMON PROPERTY | 4007-1000          | LOT 1 (ON OPEN LOTS) |                 |                          |

**Former Tenure Interests and Notifications**

| Subject | Purpose | Statutory Reference | Origin | Leid Burdened | Benefit To | Comments |
|---------|---------|---------------------|--------|---------------|------------|----------|
|         |         |                     |        |               |            |          |

**New Interests**

| Subject | Purpose | Statutory Reference | Origin | Leid Burdened | Benefit To | Comments |
|---------|---------|---------------------|--------|---------------|------------|----------|
|         |         |                     |        |               |            |          |

**New Memorials and Notifications**

| Subject      | Purpose | Statutory Reference | Origin     | Leid Burdened | Benefit To | Comments                |
|--------------|---------|---------------------|------------|---------------|------------|-------------------------|
| NOTIFICATION |         | SEC 70A OF THE TLA  | DOC #48371 | LOTS 4 & 5    |            | CLIP OF THE STRATA PLAN |

**Visiting Lots**

| Lot | Purpose | Statutory Reference | Origin | Comments |
|-----|---------|---------------------|--------|----------|
|     |         |                     |        |          |

**Lot Sheet Index**

| Lot | Total Area | Floors | Sheds |
|-----|------------|--------|-------|
| 1   | 226.47     | 0-1    | 3-4   |
| 2   | 264.47     | 0-1    | 3-4   |
| 3   | 264.47     | 0-1    | 3-4   |
| 4   | 217.47     | 0-1    | 3-4   |
| 5   | 217.47     | 0-1    | 3-4   |
| 6   | 261.47     | 0-1    | 3-4   |
| 7   | 211.47     | 0-1    | 3-4   |
| 8   | 211.47     | 0-1    | 3-4   |
| 9   | 227.47     | 0-1    | 3-4   |

```

{
  "Bcontext": "context to be added here",
  "id": "SP83687_1_1.5 (sp83687-[stage]_[version].[fileversion])",
  "name": "sp83687",
  "surveyDescription": "",
  "surveyDescriptors": [{"add key words here?}], "built-strata", "reg54", "st:
  "type": "FeatureCollection",
  "featureType": "wa-survey-documentation-type:3d-plan",
  "tenureType": "wa-parcel-type:freehold",
  "planType": "wa-survey-type:strata-plan",
  "purpose": "wa-survey-type:subdivision",
  "surveyType": "wa-survey-type:conventional",
  "time": "",
  "horizontalCRS": "epsg:7850",
  "bearingRotation": 0,
  "surveyTitle": "Lots 1-9 and Common Property",
  "adminUnit": {
    {
      "href": "city-of-belmont",
      "rel": "related",
      "role": "icm-admin-unit-type:localGovernmentArea"
    },
    {
      "href": "cloverdale",
      "rel": "related",
      "role": "icm-admin-unit-type:locality"
    }
  },
  "hasProvenance": {
  },
  "features": [],
  "points": [
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      "id": "BoundaryMarks",
      "type": "FeatureCollection",
      "featureType": "BoundaryMark",
      "features": [
        {
          "id": "5",
          "type": "Feature",
          "featureType": "BoundaryMark",
          "geometry": null,
          "time": "",
          "place": {
            "type": "O",
            "coordinates": [ "399524.793", "646222.014", "" ]
          },
          "properties": {
            "name": "",
            "purpose": "",
            "ptQualityMeasure": "0.02",
            "comment": "",
            "methodEstablished": "G",
            "monumentedBy": [
            ],
          },
        },
        {
          "id": "6",
          "type": "Feature",
          "featureType": "BoundaryMark",
          "geometry": null,
          "time": "",
          "place": {
            "type": "O",
            "coordinates": [ "399538.262", "6462635.800", "" ]
          },
          "properties": {
            "name": "",
            "purpose": "",
          },
        }
      ],
    }
  ],
  "parcels": [
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      "type": "FeatureCollection",
      "featureType": "PrimaryParcel",
      "properties": {
        "id": "1",
        "type": "Feature",
        "geometry": null,
        "topology": {
          "type": "Polygon",
          "references": [ "97", "98", "99", "100", "96" ]
        },
        "properties": {
          "appellation": {
            "label": "Pt.7 (courtyard)",
            "hasPart": [
              {
                "type": "ParcelType",
                "label": "wa-parcel-type:Part"
              },
              {
                "type": "ParcelIdentifier",
                "label": "7"
              },
              {
                "type": "ParcelSuffix",
                "label": "wa-parcel-suffix:courtyard"
              }
            ],
          },
          "floor": "ground",
          "min": "",
          "zmax": "",
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          "parcelType": "wa-parcel-type:freehold",
          "parcelPurpose": "wa-parcel-purpose:strata-lot",
          "parcelState": "created"
        }
      ],
    }
  ],
}

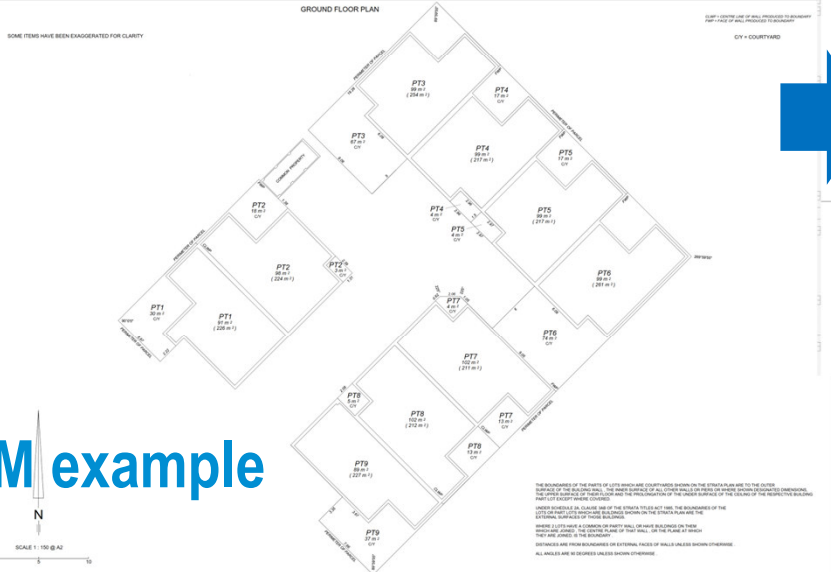
```

```

"features": [],
"points": [
  "vectorObservations": [
    "observedVectors": [
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        "id": "SubtendedAngle",
        "type": "FeatureCollection",
        "featureType": "SubtendedAngle",
        "features": [
        ],
      },
      {
        "id": "LocationVectors",
        "type": "FeatureCollection",
        "featureType": "observedVector",
        "features": [
          {
            "id": "106",
            "type": "Feature",
            "featureType": "observedVector",
            "geometry": null,
            "topology": {
              "type": "LineString",
              "references": [ "99", "100" ]
            },
            "properties": {
              "purpose": "lot-boundary",
              "comment": "PERIMETER OF PARCEL"
            }
          }
        ],
      },
    ],
  ],
  "parcels": [
    {
      "id": "GroundParcel",
      "type": "FeatureCollection",
      "featureType": "PrimaryParcel",
      "properties": {
        "id": "1",
        "type": "Feature",
        "geometry": null,
        "topology": {
          "type": "Polygon",
          "references": [ "97", "98", "99", "100", "96" ]
        },
        "properties": {
          "appellation": {
            "label": "Pt.7 (courtyard)",
            "hasPart": [
              {
                "type": "ParcelType",
                "label": "wa-parcel-type:Part"
              },
              {
                "type": "ParcelIdentifier",
                "label": "7"
              },
              {
                "type": "ParcelSuffix",
                "label": "wa-parcel-suffix:courtyard"
              }
            ],
          },
          "floor": "ground",
          "min": "",
          "zmax": "",
          "area": "4",
          "parcelType": "wa-parcel-type:freehold",
          "parcelPurpose": "wa-parcel-purpose:strata-lot",
          "parcelState": "created"
        }
      ],
    }
  ],
}

```

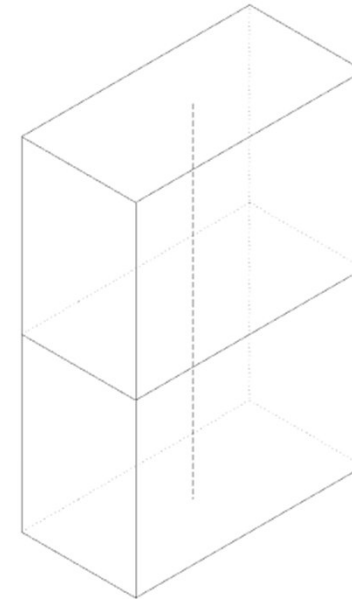
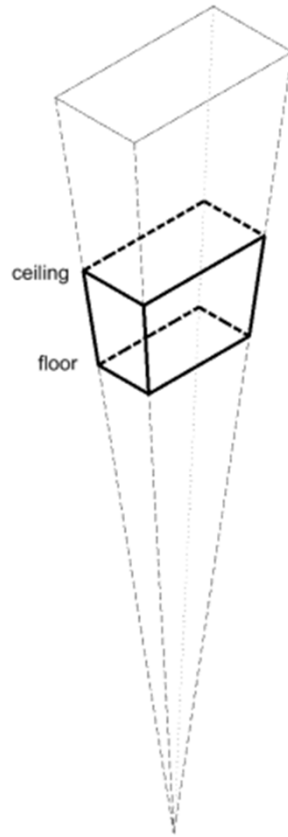
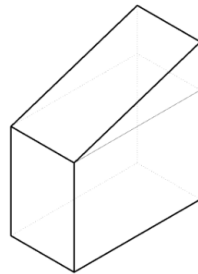
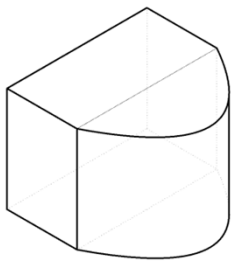
## 3D CSDM example





## Extensions to support 3D data

- 3D CSDM standard in 2.5D
- Development to true 3D schema



x1,y1,unlimited

x5,y5,GL:10.0

x9,y9,GL-60.96

## Digital Plan Lodgement next steps

- New Zealand and Australian jurisdictions working on implementation plans to adopt 3D CSDM
  - New Zealand, Victoria and Western Australia have developed jurisdictional profiles
  - NSW profile in development
- Continue engaging survey software vendors and providers
- 3D schema development

## What can you do?

- Check out the docs:
  - ICSM 3D CSDM repositories. Available online at <https://github.com/icsm-au>
  - ICSM Conceptual Model for 3D Cadastral Survey Dataset Submissions. Available online at <https://icsm-au.github.io/3d-csdm-design/2022/spec.html>
- Give us feedback

## Thank you for listening

Adrian White

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Customer Service

Chair, ICSM Cadastre Working Group

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Jeff Needham

Deputy Surveyor-General, Toitū Te Whenua – Land  
Information New Zealand

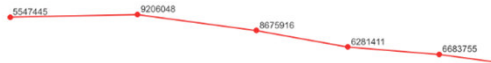
Lead, ICSM Digital Plan Lodgement sub-committee

[JNeedham@linz.govt.nz](mailto:JNeedham@linz.govt.nz)

# Spatial elements

## ▼ LineString Example

```
{
  "type": "LineString",
  "references": [
    "4047592",
    "8979167",
    "7954590",
    "7137005",
    "7515825",
    "9130050",
    "6683755",
    "6281411",
    "8675916",
    "9206048",
    "5547445"
  ]
}
```



## ▼ Arc Segment with Centre

```
{
  "type": "arcWithCentre",
  "startPoint": {
    "references": [
      "111"
    ]
  },
  "endPoint": {
    "references": [
      "222"
    ]
  },
  "centrePoint": {
    "references": [
      "333"
    ]
  },
  "radius": 10,
  "orientation": "ccw"
}
```

## ▼ Arc Segment by Chord

Same as LandXML.ReducedArcObservation definition

```
{
  "type": "arcByChord",
  "startPoint": {
    "references": [
      "111"
    ]
  },
  "endPoint": {
    "references": [
      "222"
    ]
  },
  "chordBearing": 35.0,
  "chordLength": 5.8,
  "radius": 10,
  "orientation": "ccw"
}
```

## ▼ Arc by Centre Point with Start and End Angles

```
{
  "type": "arcByStartEndFromCentre",
  "centrePoint": {
    "references": [
      "333"
    ]
  },
  "startAngle": 35.0,
  "endAngle": 123.0,
  "radius": 10,
  "orientation": "cw"
}
```

## ▼ Arc Length

```
{
  "type": "arcLengthFromStart",
  "startPoint": {
    "references": [
      "111"
    ]
  },
  "centrePoint": {
    "references": [
      "333"
    ]
  },
  "arcLength": 5.0,
  "radius": 10,
  "orientation": "ccw"
}
```

## ▼ Circle by Centre

```
{
  "type": "circleByCentre",
  "centrePoint": {
    "references": [
      "333"
    ]
  },
  "radius": 100
}
```



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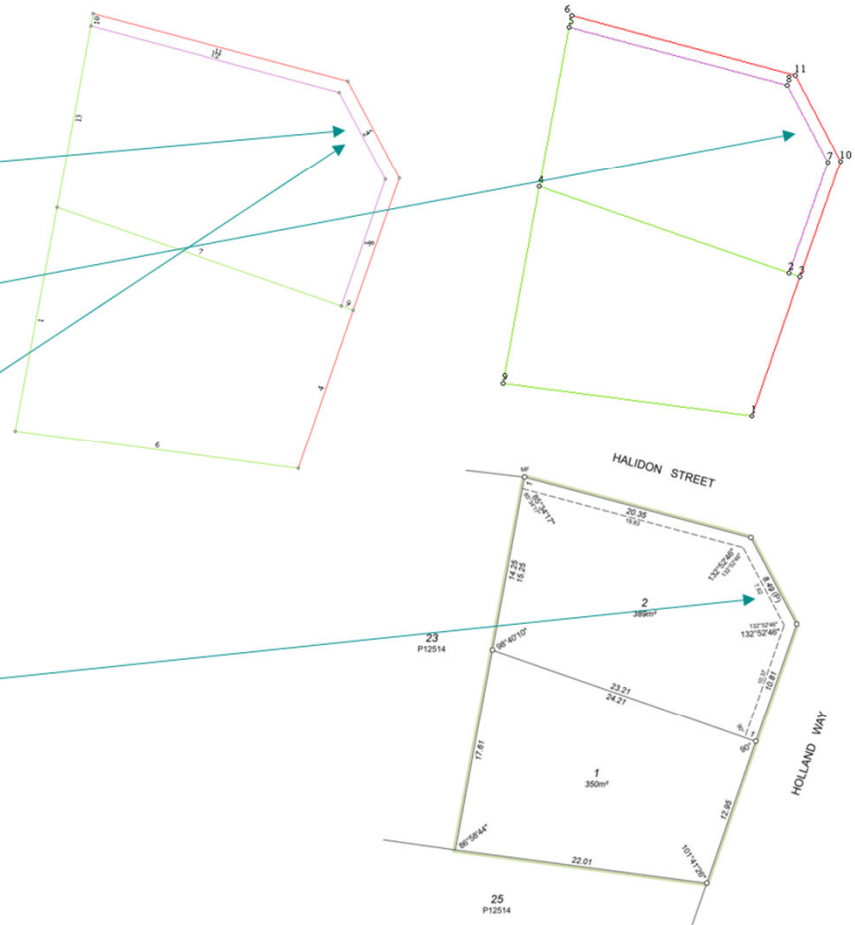


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```

"observedVectors" : [
  {
    "id" : "observedVectors",
    "type" : "FeatureCollection",
    "featureType" : "observedVector",
    "features" : [
      {
        "id" : "2",
        "type" : "Feature",
        "featureType" : "observedVector",
        "geometry" : null,
        "topology" : {
          "type" : "LineString",
          "references" : [ "8,7" ]
        },
        "properties" : {
          "purpose" : "interest-boundary",
          "comment" : ""
        }
      },
      {
        "type" : "Feature",
        "geometry" : null,
        "properties" : {
          "hasFeatureOfInterest" : "2",
          "resultTime" : "",
          "hasResult" : {
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            "angle" : null
          },
          "distanceType" : "icsm-distance-type:ground",
          "distanceAccuracy" : 4000,
          "angleType" : "icsm-angle-type:bearing",
          "angleAccuracy" : null
        }
      }
    ]
  }
]

```





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```

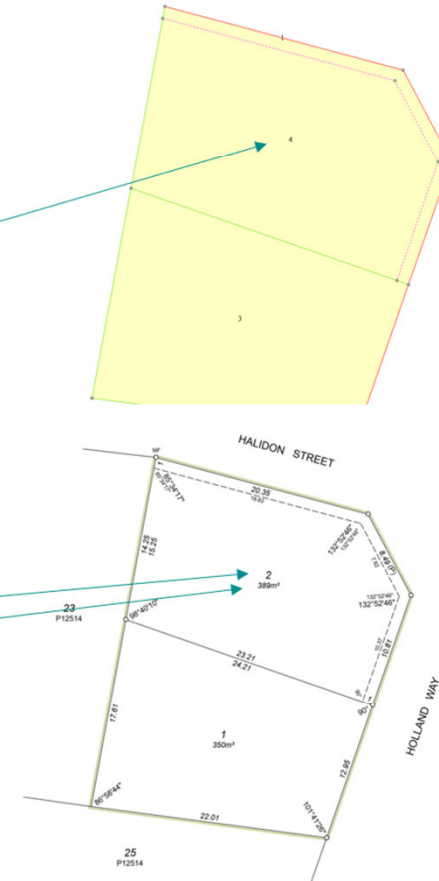
"parcels" : [
  {
    "id" : "PrimaryParcel",
    "type" : "FeatureCollection",
    "featureType" : "PrimaryParcel",
    "properties" : null,
    "features" : [
      {
        "id" : "SecondaryParcel",
        "type" : "FeatureCollection",
        "featureType" : "SecondaryParcel",
        "properties" : null,
        "features" : [
          {
            "id" : "4",
            "type" : "Feature",
            "geometry" : null,
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              "type" : "Polygon",
              "references" : [ "7", "13", "10", "11", "5", "8", "9" ]
            },
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                "hasPart" : "add back in as appellation subset"
              },
              "area" : "389",
              "parcelType" : "wa-parcel-type:freehold",
              "parcelPurpose" : "wa-parcel-purpose:lot",
              "parcelState" : "created"
            }
          }
        ]
      }
    ]
  }
]

```

```

"parcels" : [
  {
    "id" : "PrimaryParcel",
    "type" : "FeatureCollection",
    "featureType" : "PrimaryParcel",
    "properties" : null,
    "features" : [
      {
        "id" : "4",
        "type" : "Feature",
        "geometry" : null,
        "topology" : {
          "type" : "Polygon",
          "references" : [ "7", "13", "10", "11", "5", "8", "9" ]
        },
        "properties" : {
          "appellation" : {
            "label" : "2",
            "hasPart" : "add back in as appellation subset"
          },
          "area" : "389",
          "parcelType" : "wa-parcel-type:freehold",
          "parcelPurpose" : "wa-parcel-purpose:lot",
          "parcelState" : "created"
        }
      }
    ]
  }
]

```



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```

"observedVectors" : [
  {
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    "type" : "FeatureCollection",
    "featureType" : "SubtendedAngle",
    "features" : [
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        "id" : 130002,
        "type" : "Feature",
        "featureType" : "SubtendedAngle",
        "geometry" : null,
        "topology" : {
          "type" : "SubtendedAngle",
          "references" : [ "5,12,13" ]
        },
        "properties" : {
          "purpose" : null,
          "comment" : ""
        }
      }
    ]
  }
],
"features" : [
  {
    "type" : "Feature",
    "geometry" : null,
    "properties" : {
      "hasFeatureOfInterest" : 130002,
      "resultTime" : "",
      "hasResult" : {
        "distance" : "",
        "angle" : 85.57138888888889
      },
      "distanceType" : "",
      "distanceAccuracy" : "",
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      "angleAccuracy" : "0.0056"
    }
  }
]

```

