Permanent Survey Marks in NSW: From Manufacture to SCIMS

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ABSTRACT

This paper details the life cycle of Permanent Survey Marks (PSMs) in NSW, outlining the manufacturing process, distribution, preparation of Locality Sketch Plans (LSPs) and all of the metadata stored in the Survey Control Information Management System (SCIMS). The form and style of PSMs in NSW is legislated under the Surveying and Spatial Information Regulation 2024 (SSIR) and repeated in Surveyor-General's Direction No. 1 – Approved Permanent Marks (SGD1). DCS Spatial Services, a unit of the NSW Department of Customer Service (DCS), is responsible for the manufacture and distribution of PSMs in NSW. Before a mark is manufactured, its number is assigned to a particular PSM type. We then track where this number is through its full life cycle – distribution centre, organisation/individual, placement, destruction. The SSIR also outlines the requirements for the notification to the Surveyor-General of the placement of PSMs, via preparation and lodgment of a LSP to DCS Spatial Services. This process is described in Surveyor-General's Direction No. 2 – Preparation of Locality Sketch Plans (SGD2). DCS Spatial Services uses this LSP as the first initialisation of a PSM's coordinates in SCIMS and captures a variety of metadata associated with the mark that is then made available to the public via SCIMS Online, the DCS Spatial Services web-based service for ordering coordinates of PSMs. Due for completion in 2027, DCS Spatial Services is currently undergoing a transformative project for SCIMS that will see additional datasets, merging of datasets into the SCIMS schema, changes to the way LSPs are lodged, along with the way PSMs are ordered, resulting in a streamlined and authoritative Crown Jewel of NSW Government services.

KEYWORDS: *Permanent Survey Mark, State Survey Mark, SCIMS, Locality Sketch Plan, Surveyor-General's Directions*.

1 INTRODUCTION

DCS Spatial Services, a unit of the NSW Department of Customer Service (DCS), is responsible for the establishment and maintenance of the State Control Survey. Permanent Survey Marks (PSMs) provide the framework for all types of surveys to be brought onto this common network, as described by the Surveying and Spatial Information Act 2002 (SSIA). This provides a direct connection to the Geocentric Datum of Australia 2020 (GDA2020 – see Harrison et al., 2024) and the Australian Height Datum (AHD – see Janssen and McElroy, 2021).

To create a level of permanency and stability, a PSM is a stable and durable mark of a permanent nature that is uniquely identified by a combination of letters and numbers. These identifiers are used to store attributes of the mark, such as coordinates, height, characteristics and location details within the records of DCS Spatial Services. The form and style of PSMs are prescribed

by section 47(1) and schedule 4 of the Surveying and Spatial Information Regulation 2024 (SSIR) and repeated in Surveyor-General's Direction No. 1 – Approved Permanent Marks (SGD1 – see DCS Spatial Services, 2026).

The SSIR also prescribes the requirements for density, general location and construction requirements for each type of PSM. Some of the PSMs are made up of individual components such as brass plates, screws, cover boxes and pins. DCS Spatial Services takes the responsibility for the procurement, sale and distribution of PSM hardware to the surveying industry in NSW.

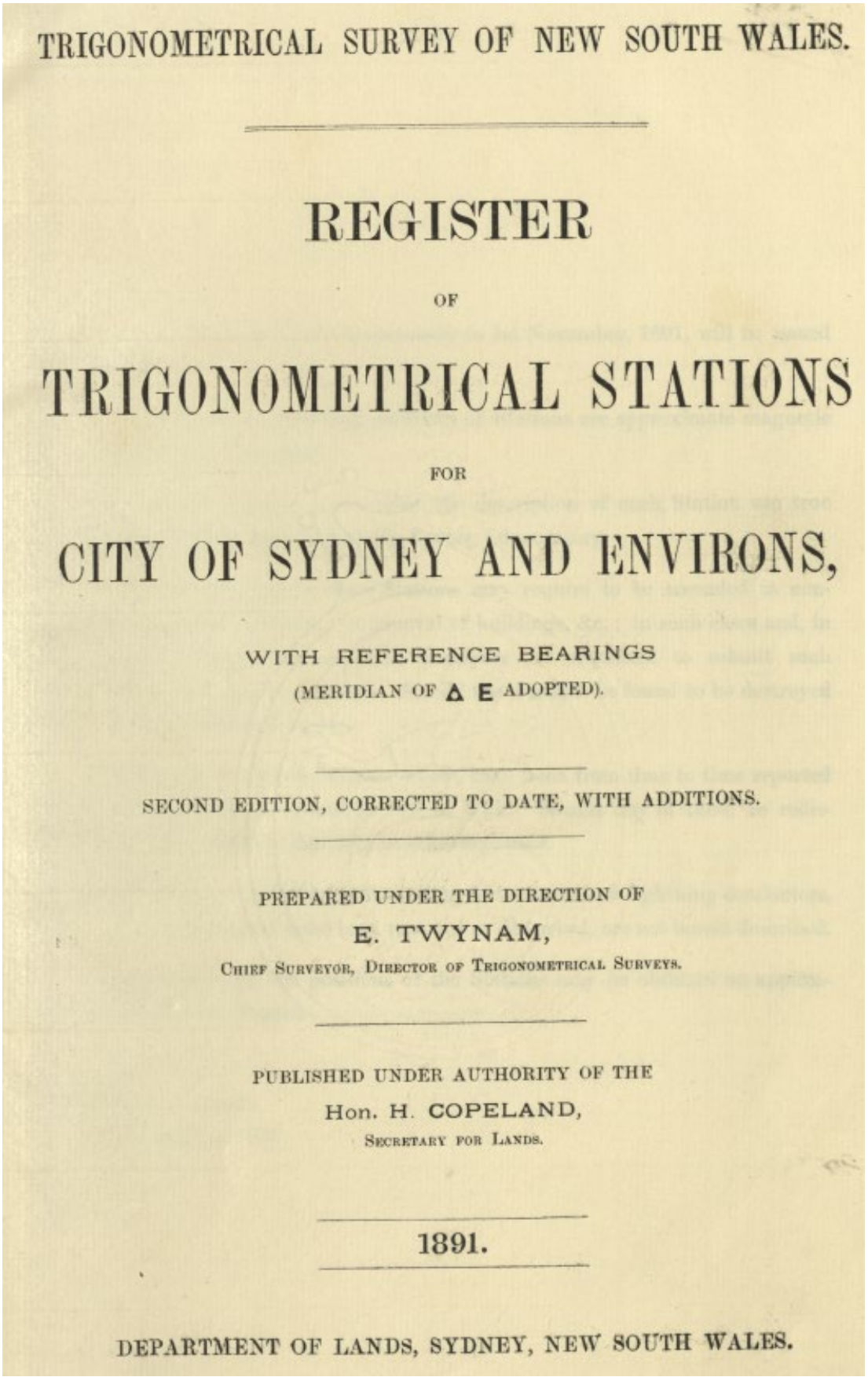
Through the NSW Crown Jewel database, the Survey Control Information Management System (SCIMS) and other internal bespoke databases, the metadata of each PSM is temporally (time dependently) stored. This paper tells the story of the life of a survey mark. Think of it as who, what, why, where, when and condition, every time something happens to a PSM. This paper explores how a mark goes from the manufacture and assigning of numbers through to the initial digital establishment of the mark in SCIMS. It also outlines some of the improvements that are coming to SCIMS in the not-too-distant future.

Whilst trigonometrical stations (approved PSMs 9-14) are listed as approved PSMs, the construction of these is performed exclusively by public authorities and therefore not covered in this paper. This paper is limited to exploring the story of mark from manufacture to its first occurrence in SCIMS, current at the time of writing. Installation and construction techniques, measurements and accuracy determinations are not covered.

2 HISTORY

Permanent marking of surveys began in Australia from the first surveys, however, was limited to identifying Crown grants. Early instructions to surveyors completing surveys for towns and Crown grants, required the marking of trees or the placement of trenches, rock cairns or holes in rock (NSW Government, 1864). The Survey Marks Act 1902 then prescribed an official government mark as the broad arrow. This act prescribed that the broad arrow was to only be used in official surveys, even going as far as imposing fines for the creation, use and destruction of broad arrows.

Numbered survey marks in NSW began with the Trigonometrical Survey of New South Wales, commencing 1867 (Gowans et al., 2015), with registers of trigonometrical stations recorded and published. Whilst those across the state were recorded by names, Sydney and its suburbs was too dense with marking, meaning that names would not be enough. In 1891, the Register of Trigonometrical Stations for City of Sydney and Environs (Figure 1) identified marks using alpha-numerical combinations as shown in Figures 2 & 3.



TRIGONOMETRICAL SURVEY OF NEW SOUTH WALES.

REGISTER

OF

TRIGONOMETRICAL STATIONS

FOR

CITY OF SYDNEY AND ENVIRONS,

WITH REFERENCE BEARINGS

(MERIDIAN OF Δ E ADOPTED).

SECOND EDITION, CORRECTED TO DATE, WITH ADDITIONS.

PREPARED UNDER THE DIRECTION OF

E. TWYNAM,

CHIEF SURVEYOR, DIRECTOR OF TRIGONOMETRICAL SURVEYS.

PUBLISHED UNDER AUTHORITY OF THE

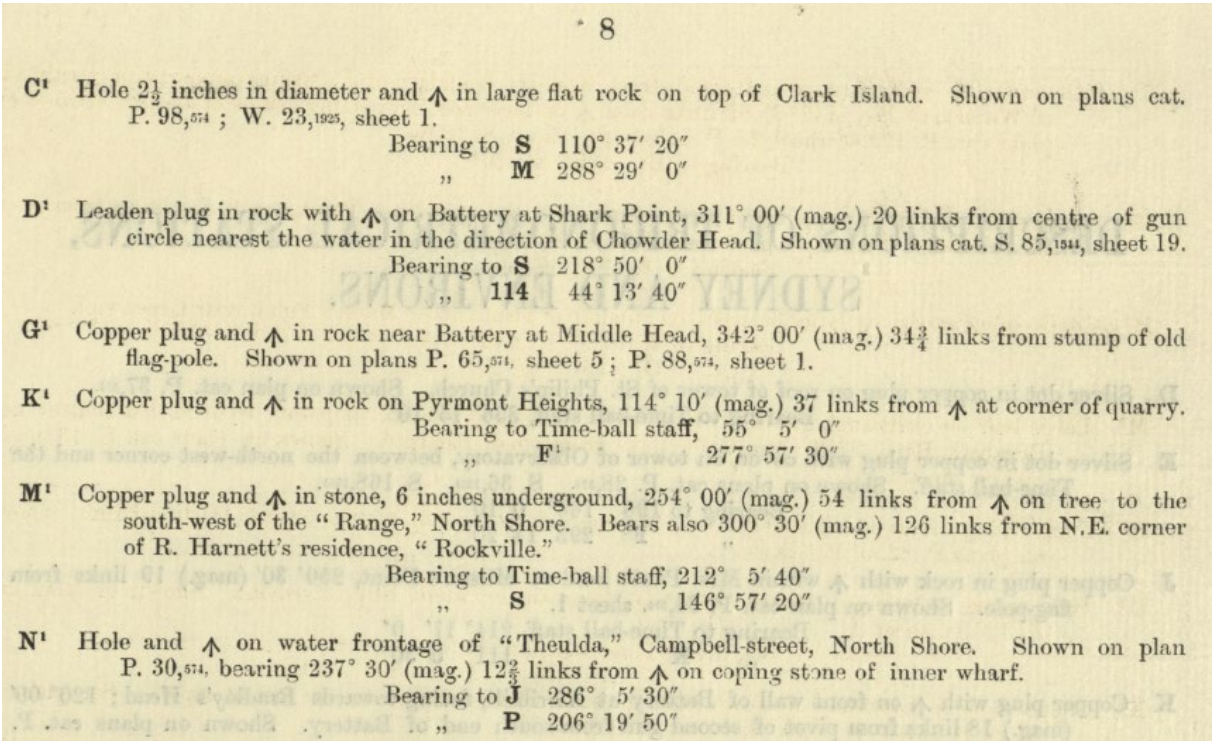
Hon. H. COPELAND,

SECRETARY FOR LANDS.

1891.

DEPARTMENT OF LANDS, SYDNEY, NEW SOUTH WALES.

Figure 1: Cover page of the Register of Trigonometrical Stations for City of Sydney and Environs (1891).



8

C¹ Hole 2½ inches in diameter and ⅄ in large flat rock on top of Clark Island. Shown on plans cat. P. 98,574 ; W. 23,1925, sheet 1.
Bearing to **S** 110° 37′ 20″
„ **M** 288° 29′ 0″

D¹ Leaden plug in rock with ⅄ on Battery at Shark Point, 311° 00′ (mag.) 20 links from centre of gun circle nearest the water in the direction of Chowder Head. Shown on plans cat. S. 85,1514, sheet 19.
Bearing to **S** 218° 50′ 0″
„ **114** 44° 13′ 40″

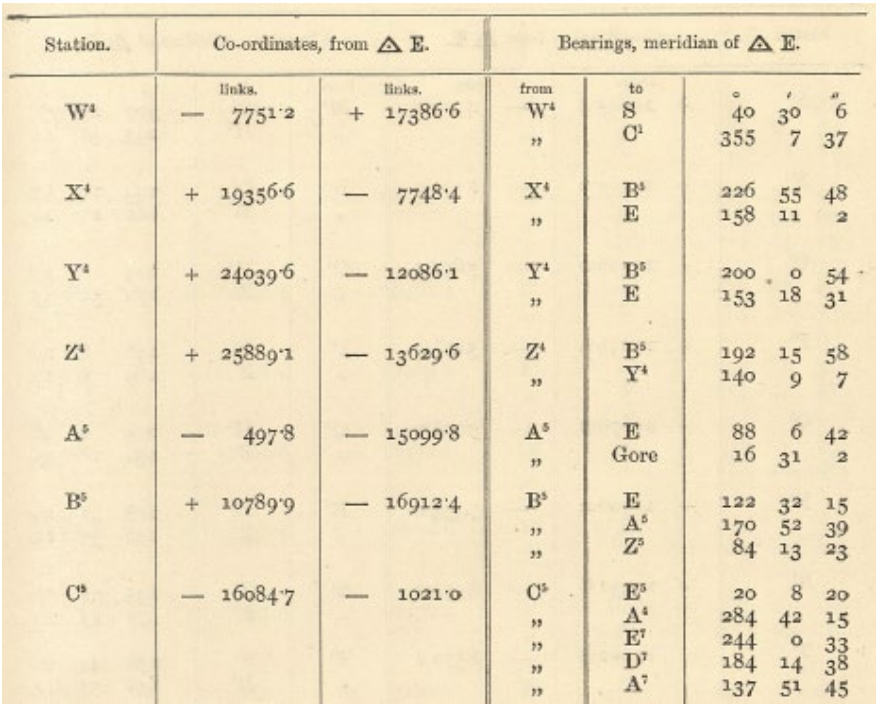
G¹ Copper plug and ⅄ in rock near Battery at Middle Head, 342° 00′ (mag.) 34¾ links from stump of old flag-pole. Shown on plans P. 65,574, sheet 5 ; P. 88,574, sheet 1.

K¹ Copper plug and ⅄ in rock on Pyrmont Heights, 114° 10′ (mag.) 37 links from ⅄ at corner of quarry.
Bearing to Time-ball staff, 55° 5′ 0″
„ **F¹** 277° 57′ 30″

M¹ Copper plug and ⅄ in stone, 6 inches underground, 254° 00′ (mag.) 54 links from ⅄ on tree to the south-west of the "Range," North Shore. Bears also 300° 30′ (mag.) 126 links from N.E. corner of R. Harnett's residence, "Rockville."
Bearing to Time-ball staff, 212° 5′ 40″
„ **S** 146° 57′ 20″

N¹ Hole and ⅄ on water frontage of "Theulda," Campbell-street, North Shore. Shown on plan P. 30,574, bearing 237° 30′ (mag.) 12¾ links from ⅄ on coping stone of inner wharf.
Bearing to **J** 286° 5′ 30″
„ **P** 206° 19′ 50″

Figure 2: Extract of Register of Trigonometrical Stations for City of Sydney and Environs (1891) showing descriptions and bearings.



Station.	Co-ordinates, from ⅄ E.		Bearings, meridian of ⅄ E.				
	links.	links.	from	to	°	′	″
W⁴	— 7751·2	+ 17386·6	W⁴	S	40	30	6
			„	C¹	355	7	37
X⁴	+ 19356·6	— 7748·4	X⁴	B⁵	226	55	48
			„	E	158	11	2
Y⁴	+ 24039·6	— 12086·1	Y⁴	B⁵	200	0	54
			„	E	153	18	31
Z⁴	+ 25889·1	— 13629·6	Z⁴	B⁵	192	15	58
			„	Y⁴	140	9	7
A⁵	— 497·8	— 15099·8	A⁵	E	88	6	42
			„	Gore	16	31	2
B⁵	+ 10789·9	— 16912·4	B⁵	E	122	32	15
			„	A⁵	170	52	39
			„	Z⁵	84	13	23
C⁵	— 16084·7	— 1021·0	C⁵	E⁵	20	8	20
			„	A⁴	284	42	15
			„	E⁷	244	0	33
			„	D⁷	184	14	38
			„	A⁷	137	51	45

Figure 3: Extract of Register of Trigonometrical Stations for City of Sydney and Environs (1891) showing coordinates and bearings.

Mark identification allocation initially started with alpha characters (A, B, C…) and moved to adding numbers (A1, B1, C1… A2, B2, C2), completing a further 24 sets (648 marks). After Z24, it moved to consecutive mark numbering reaching 1147 at the time of publication of the above documents. These publications were not limited to Sydney but also published by counties (including maps, see Figures 4-6), limited to trigonometrical stations.

Figure 4: Map showing control marks for Sydney and its environs.

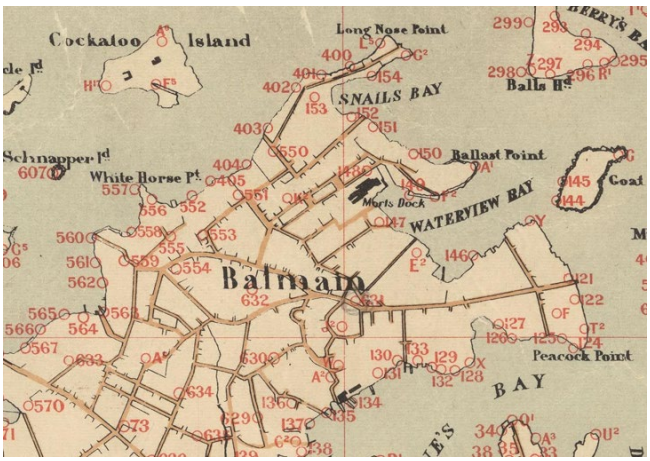


Figure 5: Focused area of Figure 4, with monument identifiers visible.

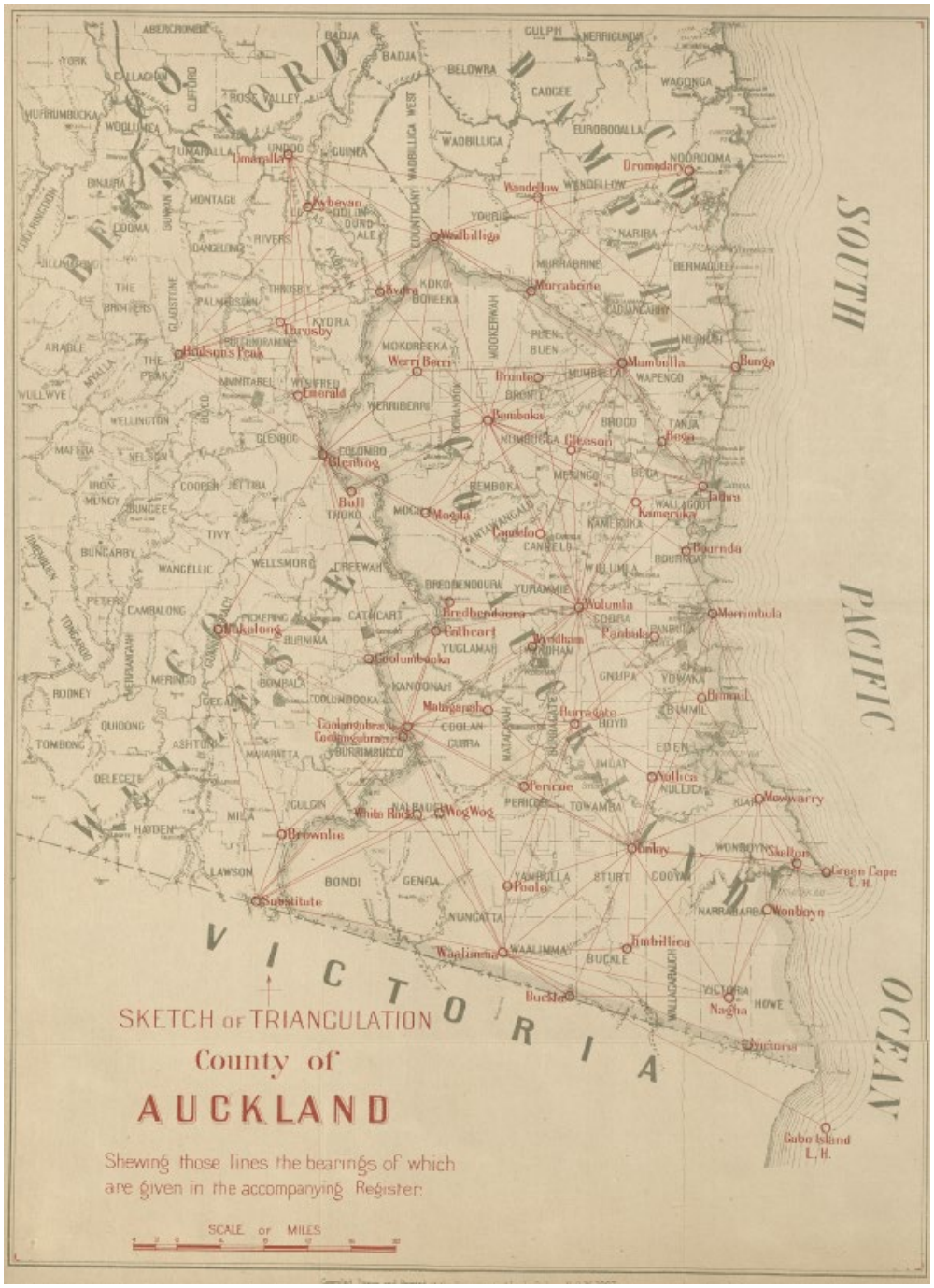


Figure 6: Map of the Trigonometrical Survey of NSW for the County of Auckland (1910).

For each register, there were two main publications:

- A list of the station identifier with a description of the monument and general location.
- A list of the station and coordinates (for Sydney a nominated zero and Cassini coordinates) with bearings to other stations.

World War I interrupted the efforts at continued publication of the maps and did not see all counties published (only 24 of the 141 counties were completed). The marks identified in Figures 2, 3 and 5 are sometimes in SCIMS and sometimes not. Where they are in SCIMS, the numbers for the registers will not match those as shown in SCIMS, but the history is traceable though the original identifier being recorded in the “Alias” or “Name” field for the mark (Figure 7). Efforts are being made to transfer the remaining marks to SCIMS.

SURVEY MARK		
Mark	Name	Alias
TS 10902	293	

Status	Date	Comments

Location	Monument	Date Placed	Placed By
GROUND LEVEL	HOLE IN ROCK		

Figure 7: Extract of metadata for original mark 293, now identified in SCIMS as TS10902.

The real effort at a consolidated numbered register of survey marks began with the Survey Coordination Act 1949. This document prescribed the requirement to either connect to existing PSMs or place PSMs. This act also outlines the notification of the placement and updated condition of PSMs to the Surveyor-General. The Department of Lands achieved this with the establishment of a Permanent Mark Register (Figure 8). These manual registers recorded the name of the surveyor or organisation that the mark type and number was allocated to. These books were eventually digitised and became the Survey Services Database (SSDB), which will be explored in section 5.

Figure 8: The Permanent Mark Register books.

Despite the act coming into force in 1949, the first mark numbers were not allocated and distributed until 1955 for a State Survey Mark (SSM) and 1958 for a Permanent Mark (PM). The establishment of both national and state-wide datums and the attempt to propagate these datums across the state and nation saw concerted efforts at the installation of PSMs, particularly with regard to the Australian Height Datum. Levelling runs crisscrossing the entire state and country saw masses of PSMs installed as per specifications in advance of the observing teams. Unfortunately, we are still correcting the plotting of these marks and rediscovering them as the primary focus of positioning these marks was in the vertical. If you do come across one of these marks with a discrepancy in the plotting, please inform the SCIMS team of the updated position, so we can investigate and resolve the issue.

In conjunction with the Survey Coordination Act 1949, the NSW Department of Lands Survey Directions 1963 (Lands, 1963) made provision for boundary plans to be connected to PSMs as well as the placement of PSMs where none existed, further propagating the infrastructure. This practice has continued through changes in legislation to the current day, with the added

requirement of plans being connected to datum to assist with the positioning and alignment of all Foundation Spatial Data Framework (FSDF) datasets.

Whilst there was a register of marks issued, the coordinates of the PSMs also needed to be recorded. The aforementioned registers of the Trigonometrical Survey of NSW developed into the Geodetic Control Register with the Central Mapping Authority (CMA). SCIMS2000 was developed in 1999 and launched in July 2000, consolidating the registers and creating workflows for the purposes of control surveys (Kinlyside, 2013).

SCIMS is a relational database that stores the coordinates and metadata associated with the monument and origin of the coordinates. The SCIMS system is built on three elements:

- The SCIMS database schema (Figure 9).
- SCIMS2000, the forms that allow for interaction and workflows.
- SCIMS Online, the customer interface.

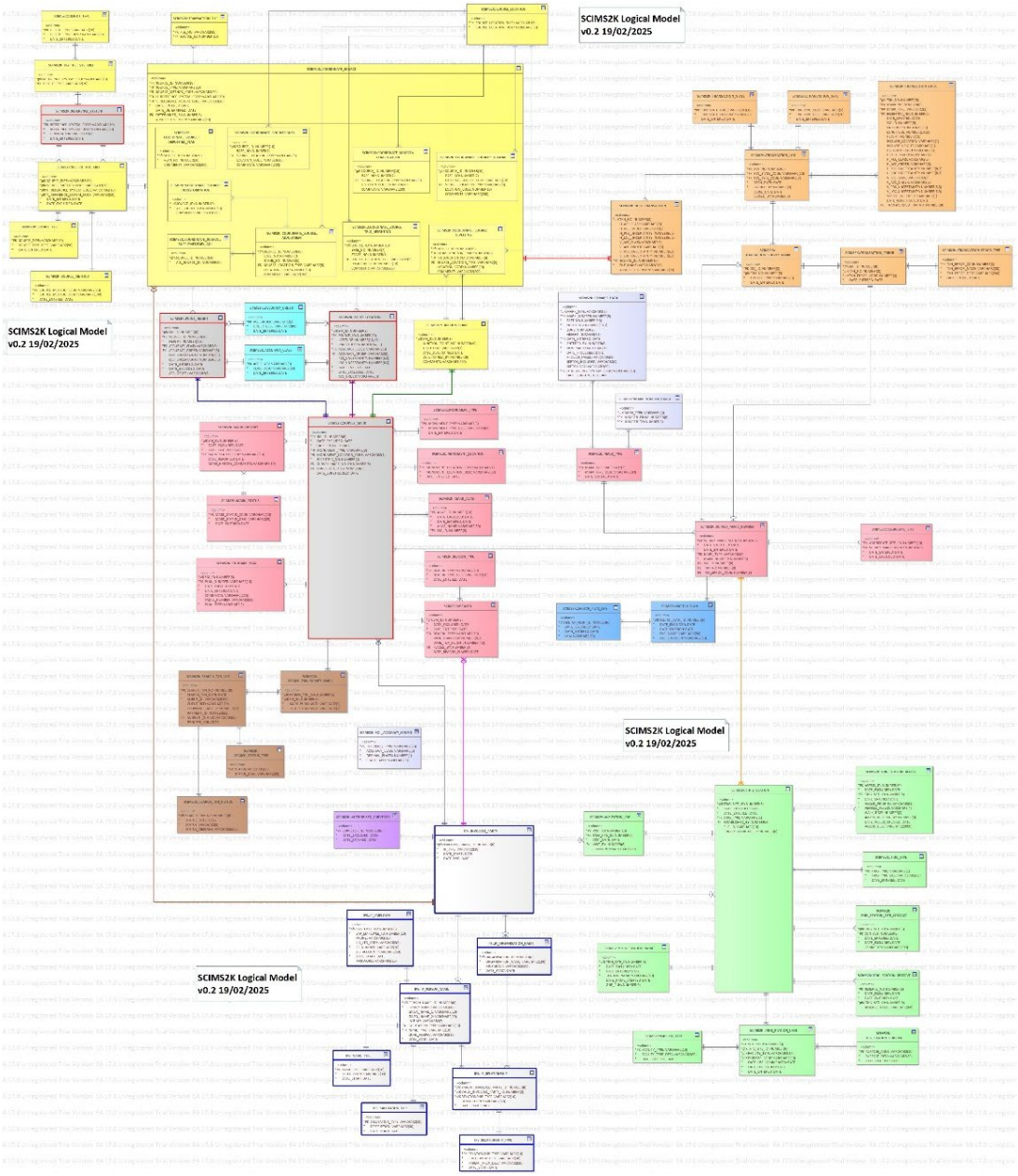


Figure 9: SCIMS schema as of February 2025.

3 FORM AND STYLE OF PSMS

From the start of distributing PSMs to industry, it was decided to standardise the form and style of PSMs. This was to ensure:

- Stability and durability in all environments.
- Ease of locating.
- Space to place an identifying number.
- A distinct point for repeatable occupation, both horizontally and vertically.
- Maintaining quality during mass production.

To achieve this, design drawings were prepared that also included broad installation instructions and were included in legislative control documents, specifically the SSIR and SGD1. Different types of PSMs allow for the varied situations they need to be installed in, i.e. mainly rural or urban. There were two main types developed: the SSM and the PM. SSMs were developed for quicker installation and in situations where they would be at ground level, generally at street corners along the kerb or footpath. PMs were for more substantial marking, used more in rural situations, but also for higher accuracy control traverses due to the higher probability of stability and less likelihood of destruction due to footpath or kerb and gutter replacement.

Urban PSMs (types 2 & 15) were developed to go into either existing structures, such as already built kerbs, gutters or footpaths, or the same structures while they are being constructed. They were smaller than their rural counterparts to allow for ease of installation, with only a battery-operated hammer drill, 5 mm masonry drill bit, hammer and epoxy resin required versus core drillers running off generators (Figure 10). This was the main reason behind the development of PSM type 15, a stainless-steel disc and pin (Figure 11). It should be noted that PSM type 15 should only ever be used in an urban situation, while PSM type 2 can be used in either a rural or urban environment. Type 1 and 16 PSMs can also be used in an urban situation, with type 16 having a minimalist design that could be used in town centre street scapes.

Figure 10: PSM type 2 – Urban SSM.

Figure 11: PSM type 15 – Urban SSM.

Rural PSMs were designed as a result of there not being existing structures for them to be installed into. Hence these PSMs needed to be more robust, as well as the method of installation being more significant (Figure 12).

Figure 12: Example of a PSM type 1 in situ – SS980 (November 2020).

PSM type 1 was designed for the two prongs on the stem to be bent out during installation in the setting concrete, providing mechanical fixing with no bonding agent required (Figure 13). These marks were primarily installed by NSW government agencies during the AHD levelling field work and have stood the test of time.

Figure 13: PSM type 1.

PSM type 16 was developed in response to increased damage to type 1 and 2 PSMs. The "nipple" that defined the height reference point is vulnerable to damage from slashers and lawn mowers, thereby ruining the reference point and making any previously determined coordinate or height suspect (Figure 14). The metal alloy used in the manufacture of type 1, 2 and 16 PSMs is malleable enough for slight modification, bending of the prongs and grinding off and restamping numbers, which is a distinct advantage. It does, however, mean it can be damaged "relatively" easily. DCS Spatial Services intends to phase out type 1 and 2 PSMs due to this vulnerability, to be replaced with only type 15 and 16 PSMs.

Figure 14: Example of a damaged PSM type 1.

The dome of the type 16 allows for there to still be a high point of the mark whilst minimising its profile and removing the step of the "nipple" that the slasher or mower blade can catch on (Figures 15 & 16). The size of the type 16 is a combination of both PSM type 1 and type 2, so that there is no change required for the tooling needed for installation. The hole drilled into the stem allows for a nail to be put through to provide mechanical fixing in setting concrete.

Figure 15: Example of PSM type 16 in situ – SS212248 (March 2024).

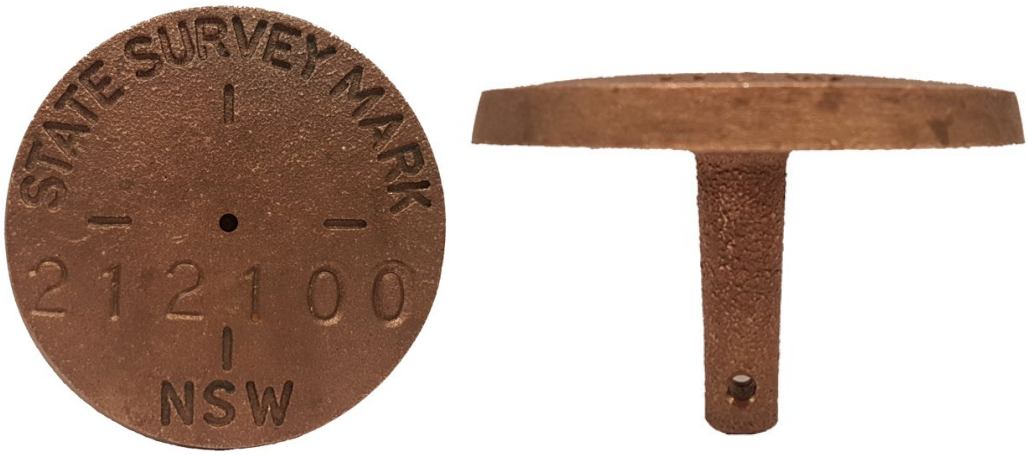


Figure 16: PSM type 1.

PSM types that have the PM prefix can also come in a variety of forms with two consistent features, a cover box and brass plate for identification (Figures 17 & 18). Each of the PM types are designed for where there is no existing structure for installation. The plastic cover box was developed to cater for significant cost increases of the cast iron cover box and safety, with less than 2 kg versus 7.5 kg per unit. The plastic cover box does have the limitation in that it should not be installed in trafficable areas due to its reduced strength.

Figure 17: PSM cast iron cover box with number plate.

Figure 18: PSM plastic cover box with number plate.

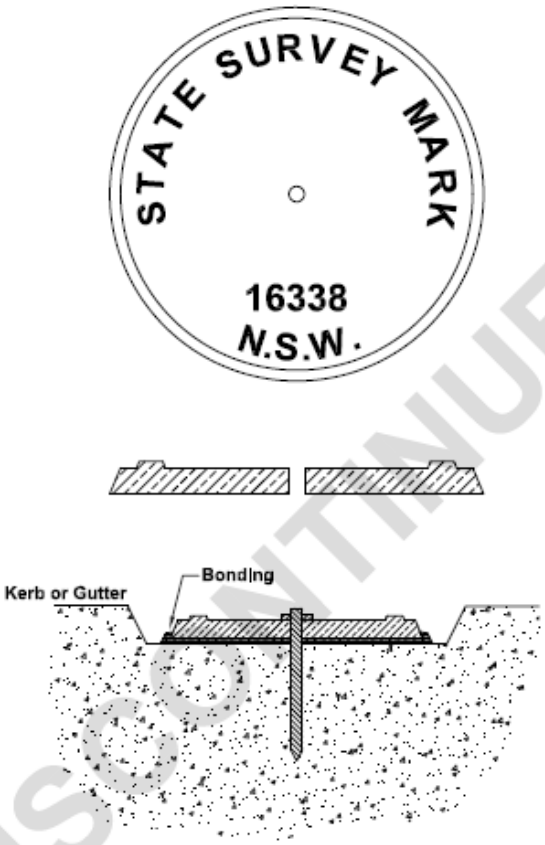
Again, the different monument types are to allow for different environments with some materials being more suited to different soil types or harsh environments. A galvanised star picket is not going to last long in a coastal environment, soils with high acid sulphate, saline or alkaline levels or even soils with high water content. In these situations, the PSM type 4 is preferred despite the extra volume of concrete required (Figure 19). The PSM type 6 requirement of a galvanised star picket has the advantage of non-bespoke monumentation. As star pickets are readily available from suppliers across the state, they are not supplied by DCS Spatial Services and its distributors.

Figure 19: PSM type 4 stainless-steel rod.

Most private and public surveyors install PSMs in relation to cadastral or infrastructure surveys. PSM type 8 (deep driven rod) is used exclusively for high-precision surveys like monitoring or in areas of instability. Installation of these is usually done on a large project basis and often requires the engagement of specialist contractors for the installation. Whilst DCS Spatial Services can assist industry with the design specifications of the rod, the product is not offered as an item for sale from its distributors and no product is kept in stock.

Some PSM types have gone through design evolutions throughout the years to cope with larger identifying numbers (specifically PSM type 1), whilst others have been discontinued entirely. While the discontinued PSMs are no longer approved for installation, they were legally approved at the time of installation, i.e. if they exist in SCIMS then they are still a PSM and can be used as such.

PSM type 3 was discontinued due to its lack of durability (Figures 20 & 21). This was partly due to poor installation (not recessing the mark), but primarily due to poor mechanical fixing from the design.



DISCONTINUED

NOTE:-
Where an existing structure (kerb & gutter or solid rock) is available, these marks may be used in lieu of larger SSM.

Fixation is by drilling and bonding with an approved epoxy-resin compound or fixed by power driven stainless steel nail & brass washer of minimum length 40mm, with plate bonded to concrete.

Figure 20: Discontinued PSM type 3.

Figure 21: Example of a PSM type 3 in situ – SS96799 (March 2025).

PSM type 5 was discontinued for a variety of reasons (Figure 22). The broad arrow itself is indication of ownership by the Crown. Yes, convicts were technically owned by the Crown, hence the broad arrow on their clothing. Whilst used in marking in a historical context, with the change in titling systems allowing for personal ownership, the use of the broad arrow was no longer appropriate.

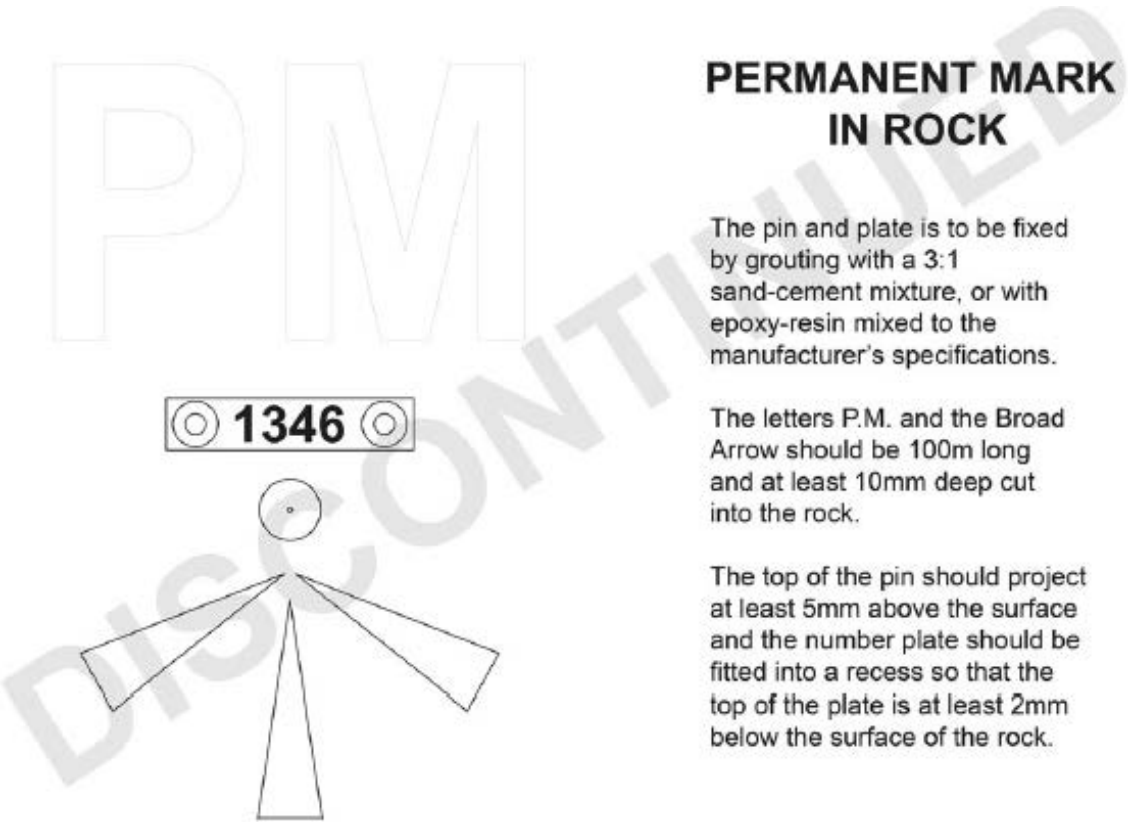


Figure 22: Discontinued PSM type 5.

PSM type 7 was discontinued due to its lack of stability (Figure 23). The Feno spike was an off-the-shelf product that was deemed suitable at the time it was introduced. Installation was completed by driving the rod into the earth and then driving another rod through the centre to push the anchors out of the centre of the main rod. When they were available, rural surveyors used these extensively, as they were cost-effective and efficient in their installation. As other surveyors started to use these for their connection to datum and control surveys, it was discovered that they were very unstable, in some cases finding them tilted significantly from their original position.

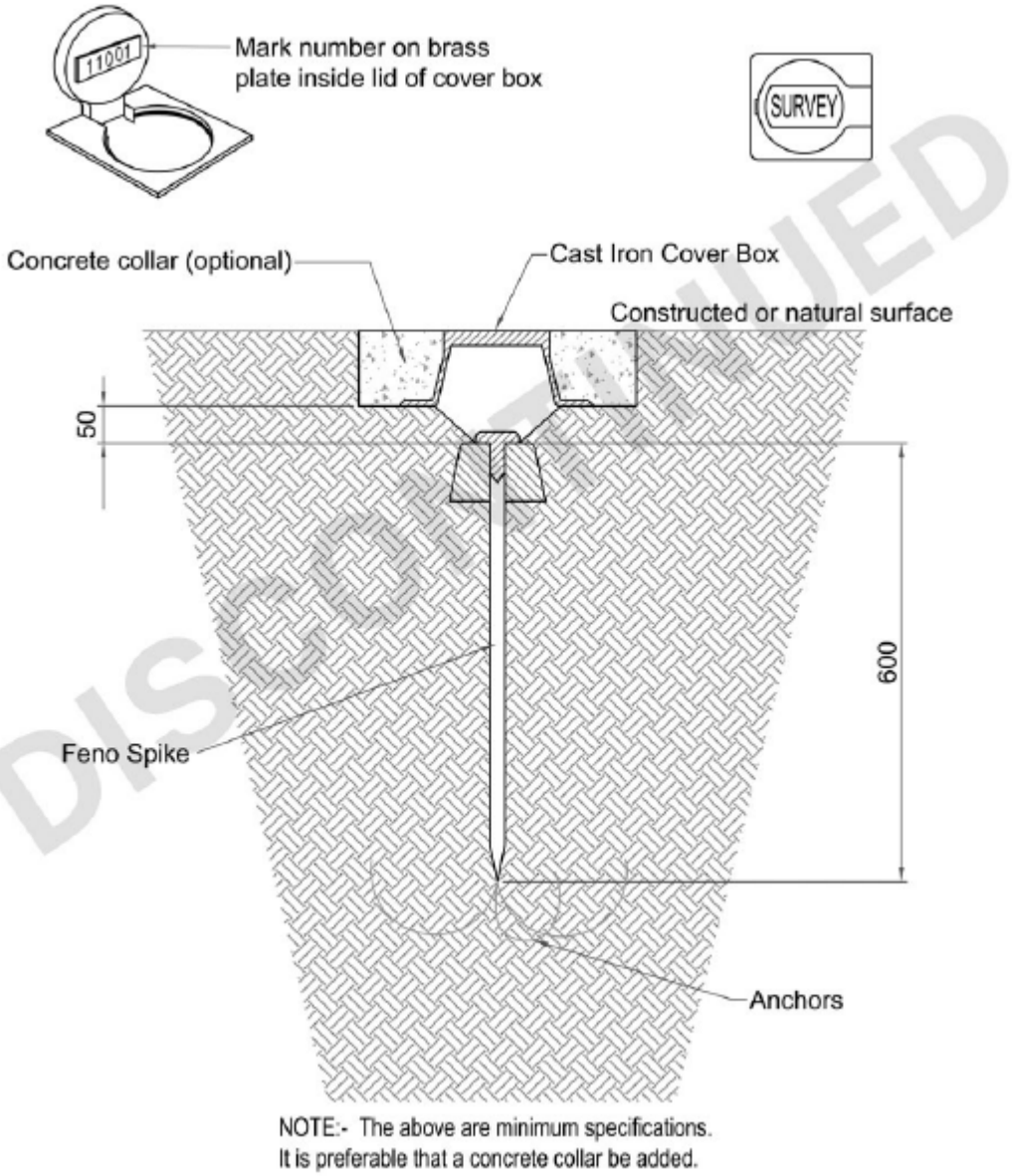


Figure 23: Discontinued PSM type 7.

4 MANUFACTURE OF PSMS

Procurement of each style of PSM starts with a tender and contract for each type or element of PSM. DCS Spatial Services has an annual operating budget assigned specifically for the procurement of marks for resale. Each tender must be publicly available to ensure a range of prices. The procurement rules around value limits with one supplier are constantly evolving to address risks around fraud and to ensure open market competitiveness. Due to the uniqueness of some of the components, set-up costs, quality control issues and relatively small volume, there are preferred suppliers of some elements. DCS Spatial Services sells marks as a cost recovery exercise with the price of most products only rising by the published consumer price index (CPI) values each year. There are instances of the prices changing significantly due to the increased costs associated with the procurement. One example of this is the cast iron cover box. The cost to procure these rose by 237% between 2017 and 2023, meaning we had to readjust our prices beyond CPI. Even with this steep price increase, the current supplier is still cheaper than others.

Each PSM goes through a different manufacturing process, sometimes with multiple steps. Technical drawings for each PSM type or individual component beyond those supplied in the SSIR and SGD1 have been prepared to supply to the tenderers (Figure 24). Each procurement order generally includes 1,000 to 2,000 units to meet both industry demand and ensure the allocated budget for procurement is not exceeded.

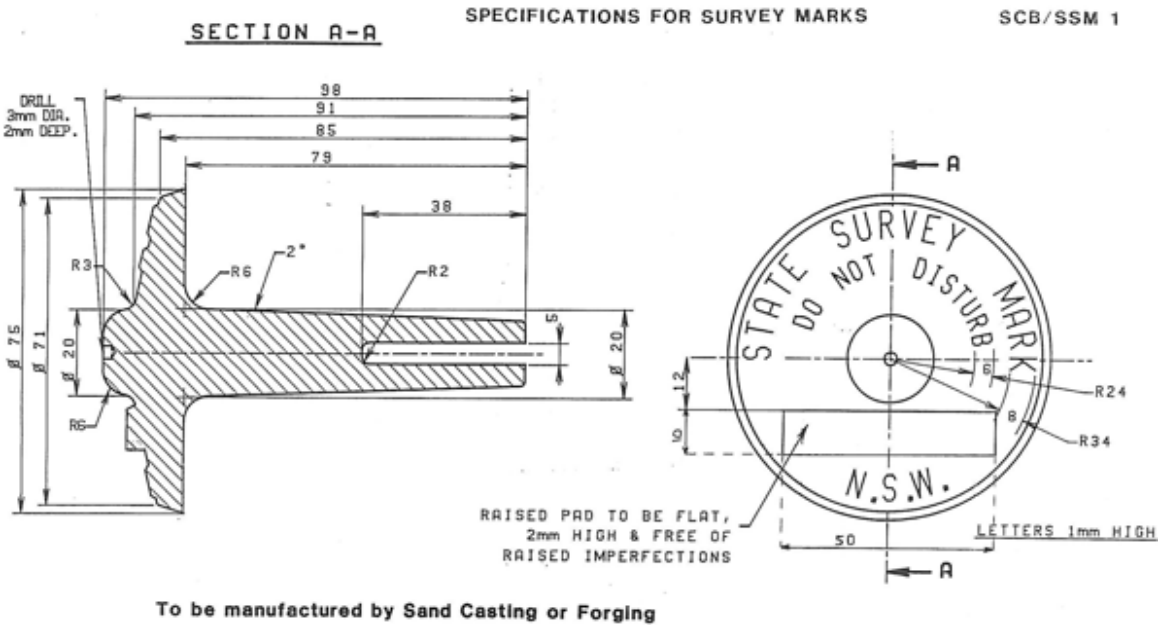


Figure 24: PSM type 1 technical drawing.

4.1 Type 1, 2 and 16 SSM Casting

Before manufacture can begin, there is a cost associated with setting up the casting moulds for each type of SSM (Figures 25 & 26). If the design changes, the mould changes, resulting in additional costs for the recreation of the mould. DCS Spatial Services purchases the right to own these moulds to be able to use with different suppliers. However, there have been quality control issues leading to a preferred supplier. Issues with quality control from the cheapest supplier have led to an overall more expensive product due to corrective procedures having to be implemented before distribution.

Figure 25: PSM type 1 mould topside.

Figure 26: PSM type 1 mould underside.

The moulds are then used in the process of sand casting. This involves compressing a block of sand on both sides of the mould to create the voids, separating the top and bottom, removing the mould and then placing the two halves back together (Figures 27-29).

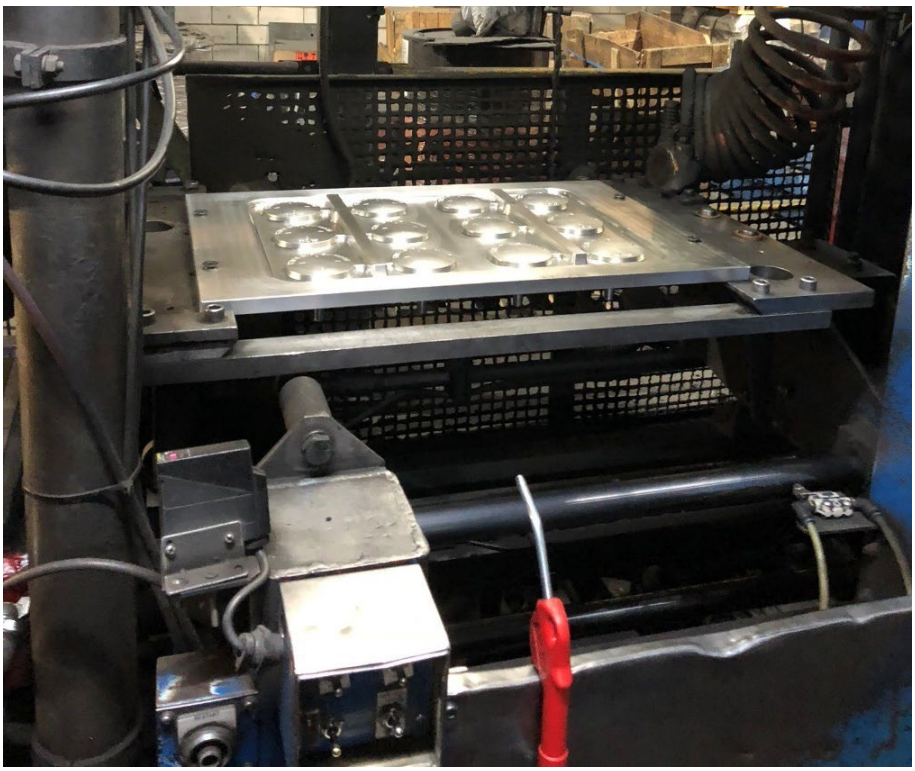


Figure 27: PSM type 16 mould staged for sand.

Figure 28: The two halves of sand blocks of PSM type 16.

Figure 29: A queue of joined blocks of sand ready for pouring.

Bar stock of the alloy used for the final product is heated until molten and then poured into the moulds. The alloy used is DCB3 brass, primarily a 60 % brass and 40% zinc mixture with small amounts of aluminium, iron, nickel, manganese, lead, tin and silicon (Figures 30 & 31).

Figure 30: Bar stock of the alloy for casting.

Figure 31: Sand blocks with molten alloy poured.

Once cooled, a measure of fresh pure sand is added to the top of each block before it is taken to a shaker, where the sand is shaken off the cast product and the sand recycled for the next round of casting. The cast products are then stacked ready for dressing and final elements (Figures 32-34).

Figure 32: The cooled blocks with fresh sand added to some blocks.

Figure 33: Machine shaking the sand off the cast products.

Figure 34: Stack of freshly cast type 16 PSMs ready for final staging.

The excess elements of the casting process are then cut off, with edges de-burred and general buffing. The final stage of this part of the manufacturing for the type 16 is for the centre to be drilled out for the reference point and a hole drilled in the stem for anchoring. An individual number cannot be included during mass casting, so the marks are then shipped off to another supplier to do the numbering. That said, the casting stage has included as much of the standard information as possible.

The process is essentially the same for PSM type 1, 2 and 16. The prices to manufacture each differ due to volume of material, complexity during “dressing” and any additional steps (e.g. holes drilled).

4.2 SSM Numbering

Each mark must be stamped with a unique number. During the first stages of PSM manufacture there were duplicate numbers for SSMs and PMs, until mark number 87,000. From that number forward, there is a unique number (i.e. if there is a SS212100, there cannot be a PM212100). This is primarily due to occurrences of the same number but different mark types being located very close to one another and causing confusion.

For PSM type 1 and 2, an auto-advancing sequential 6-digit stamping die is used. A jig is used to seat each SSM in place for orientation, then a hydraulic press pushes the die onto the SSM with a set force. As the press lifts, the number is advanced by one.

The PSM type 16 has added complications in that it has a curved surface and there are no auto-advancing dies manufactured to ensure an even stamp into the SSM. DCS Spatial Services had specific tooling manufactured to seat individual number stamps with shims to correctly orientate the stamp (Figures 35 & 36). Again, a jig is used to individually seat the SSM at the correct orientation, and then a hydraulic press is used to push the stamps down. As the press is lifted, an operator has to replace the current digit(s) with next number(s) manually.

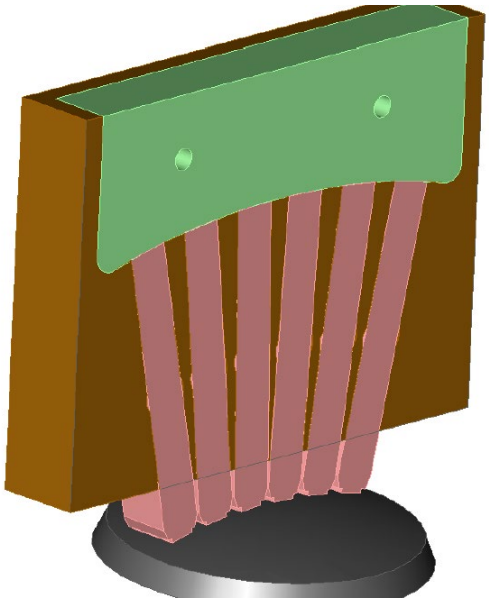


Figure 35: Stamp press block design for stamping PSM type 16.

Figure 36: Proof of concept of stamping a PSM type 16.

4.3 Type 15 SSM Manufacture

The PSM type 15 was developed through an existing product used for marking in a variety of industries. The general design of a stainless-steel washer and nail with unique features stamped into the disc has been used marking footpath seating limits for outdoor eating, identifying where underground utilities are and as boundary and cadastral reference mark tokens. What makes the type 15 unique from these others is, again, the individual number for each disc and the hole drilled into the head of the nail to allow for seating of a pole for surveyors.

The first batches of type 15 PSMs were created using dies to cut and stamp in the one process. The nails are modified off-the-shelf products with the recess drilled into the top as per the specifications. The most recent batches saw a different supplier and different technique with Computer Numeric Control (CNC) cutting and engraving used for the manufacture of the discs.

4.4 Brass Number Plate

The brass number plate used for PMs was traditionally created from bar stock with the counter sunk holes drilled into them on jigs (Figure 37). Once the blank plates were received, they were sent off for stamping as per the process outlined in section 4.2. This required two lots of procurement for the two different activities and suppliers. The most recent batches of plates have again used CNC engraving for the cutting of the plates and the numbering. The bar stock is placed into jigs for seating during engraving (Figure 38).

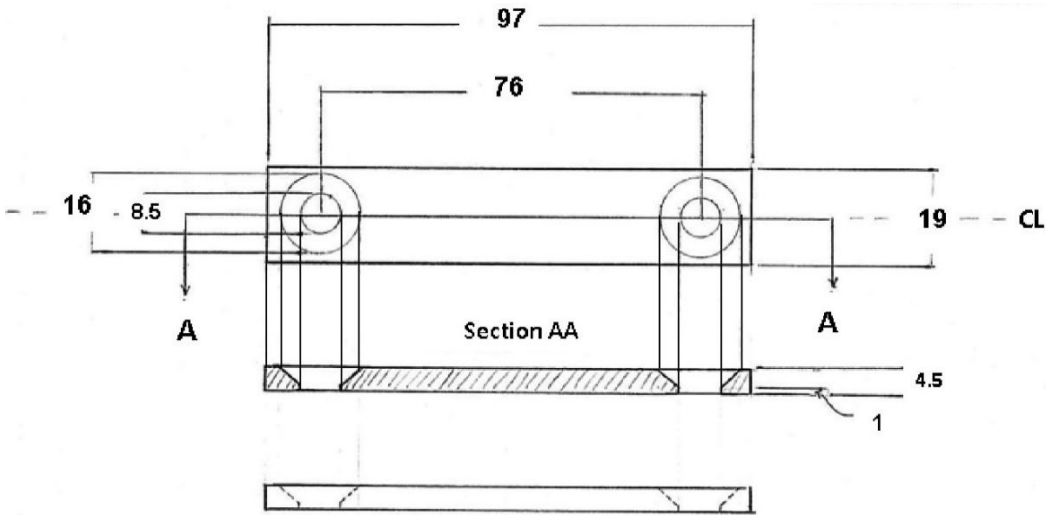


Figure 37: Technical drawing of a brass number plate.

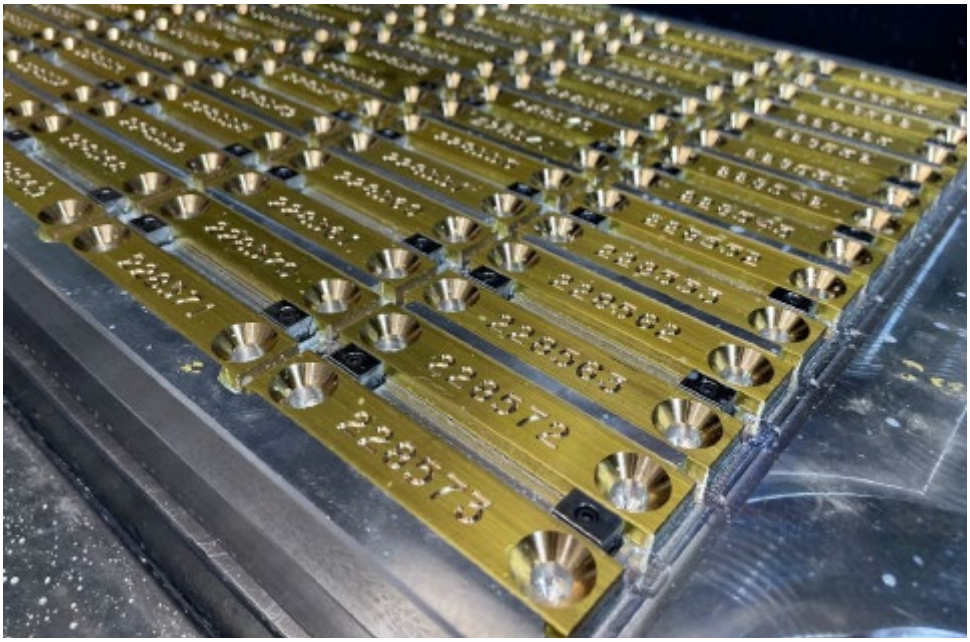


Figure 38: Jig and final product for PM number plates.

These brass plates are also procured for Cadastral Reference (CR) marks that have had cover boxes placed over them and then a number allocated for inclusion in SCIMS. The number range of 500,000 to 599,999 has been assigned to CR marks exclusively for ease of identification. It is not intended for all CR marks to be included in SCIMS, as we would very quickly reach 7-digit figures, but there are special cases warranting their inclusion.

Number plates can also be generated ad-hoc for SSMs that have ended up being covered due to construction or general build-up of material. In these cases, a cover box can be placed at ground level over the top of the SSM and the number identified on a plate.

4.5 Type 4 Stainless-Steel Pins

The stainless-steel pin used in PSM type 4 is created from a 316-grade stainless-steel bar with a machining jig to cut the shape, rotating at high speeds with a lubricant to keep the product cool. This method is very common and used in a variety of manufacturing processes. This product has been sourced from a variety of different suppliers throughout the years (Figure 39).

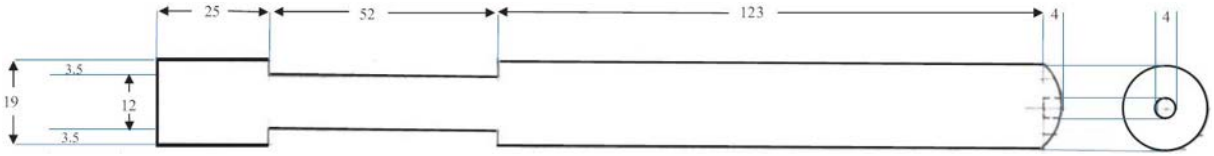


Figure 39: Technical drawing of a type 4 pin.

4.6 Screws for Number Plates

The screws used for affixing the brass plate to the lid of the cover box are 5/16 British Standard Whitworth (BSW) thread at a ½ inch length, with a flat-head screwdriver groove. As they are not a common off-the-shelf product, they are made via machining from bar stock of either 316-grade stainless-steel or brass. The stainless-steel option is used for harsher environments with increased probability of corrosion – due to the adhesion of the screw with the cast iron rather than the number plate corroding (Figure 40).

Figure 40: Brass screws for affixing the number plate to the lid of the cover box.

4.7 Cast Iron Cover Boxes

The cast iron cover boxes used for PMs and other marks (Figure 41) are manufactured in a similar process to the type 1, 2 and 16 PSMs. Because of their weight and size, they are not kept in large quantities at distributors and are instead kept in backorder at the supplier for a given purchase order. They are delivered to distributors in crates of 50 weighing in at 368 kg, representing its own challenge in manoeuvring and storing.

Again, because of their weight, DCS Spatial Services has a policy of not couriering cast iron cover boxes, and they are only available via pick-up from a distributor. For large orders, we recommend ordering a crate of 50 delivered directly to an organisation if the capacity to store them is available.

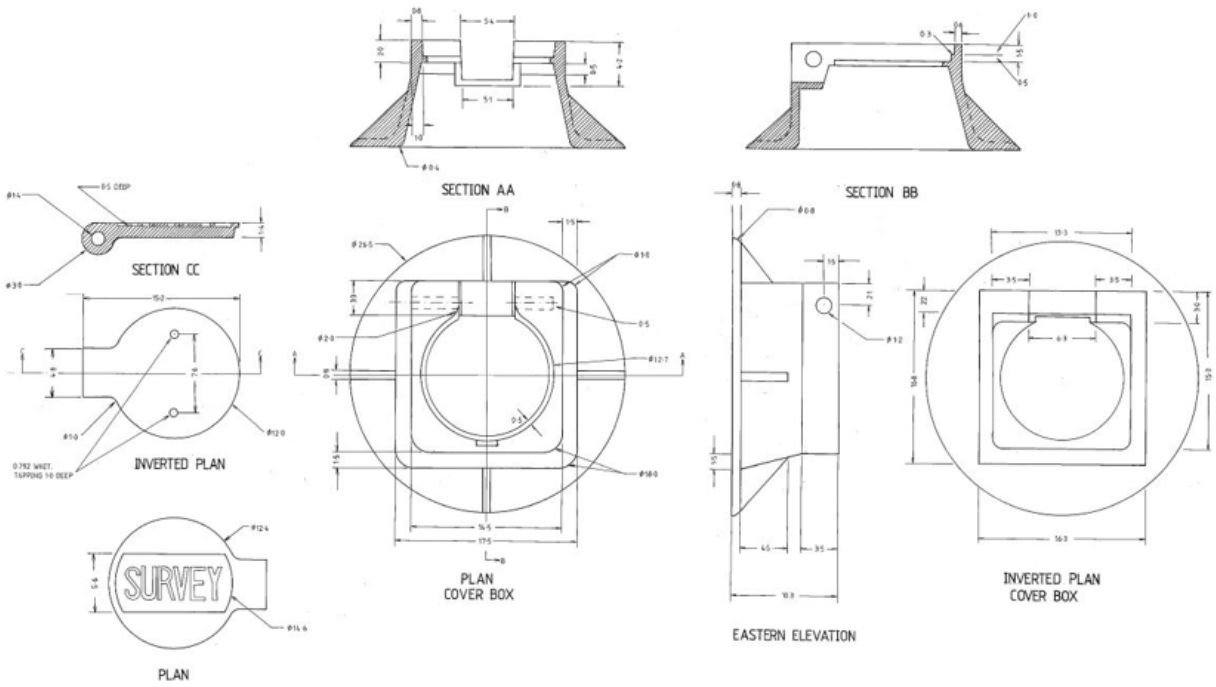


Figure 41: Technical drawing of a cover box.

4.8 Plastic Cover Boxes

Plastic cover boxes are manufactured using injection moulding. Similar to the casting process, there are initial set-up costs to create the mould used in the manufacture. The difference in the moulds for plastic injection is that rather than the mould being one piece creating a cavity in the sand, the plastic moulds are two pieces squeezed together to create a void within the mould to be filled (Figure 42). As there are two separate components to a cover box (i.e. box and lid), there a total of four moulds.

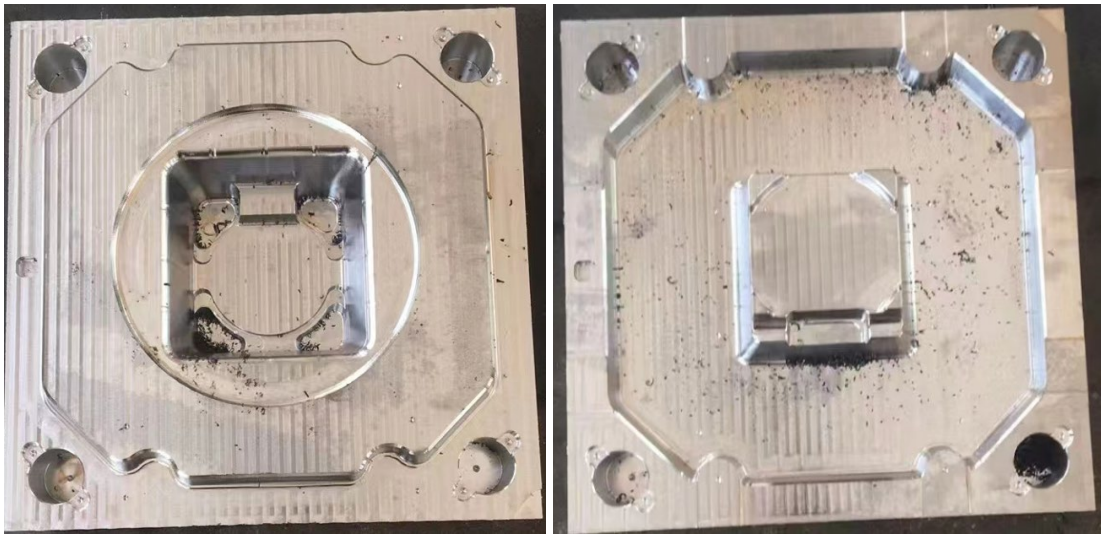


Figure 42: The top and bottom moulds for the cover box.

Plastic pellets are then dried, heated and compressed to a molten state and pushed in the moulds. The plastic has had additives introduced for colour and ultra-violet light stabilisation. The box and lid are then drilled out for the introduction of a hinge, for which a stainless-steel pin is used to help find the monument with a metal detector when obscured by grass or soil (Figure 43).

Figure 43: Plastic cover box showing the stainless-steel hinge pin.

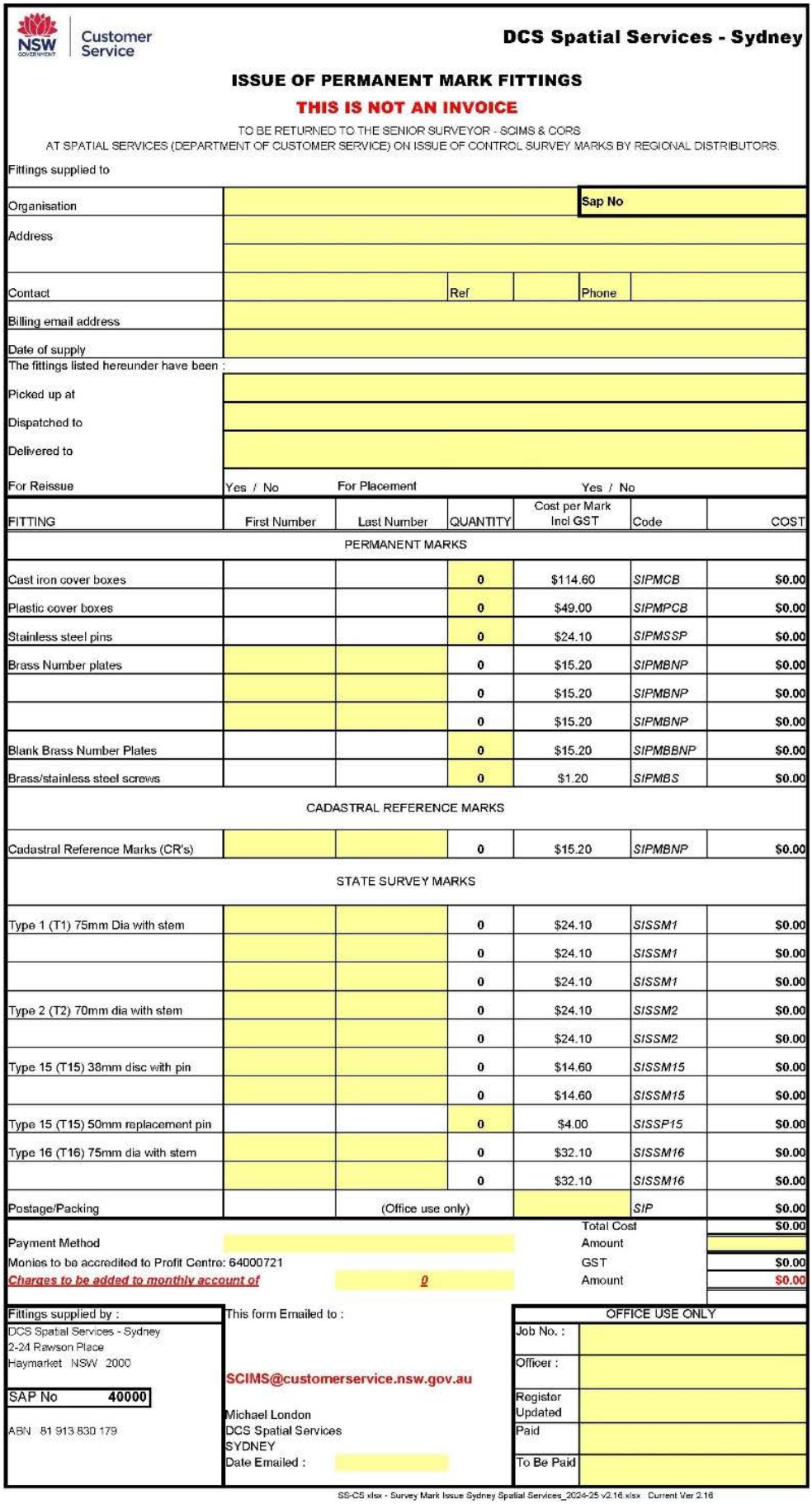
5 DISTRIBUTION OF PSMS

DCS Spatial Services is responsible for the distribution and sale of PSM hardware in NSW. This is done through either DCS Spatial Services regional offices or through partnered local private firms, with the SCIMS team under the Office of the Surveyor-General responsible for overall coordination. The full list of distributors in NSW is maintained as an appendix in SGD1 and is subject to change regularly. The current price list is updated at the start of each financial year and available on the Information Sheets page of the DCS Spatial Services website.

Customers order hardware either by emailing the SCIMS team or contacting the local distributor. Orders are prepared with quantities of each product and where appropriate the PSM numbers that have been issued. Payment is made by account system with invoices emailed on a monthly basis. For each order, a mark issue sheet is prepared by the distributor, recording the customer and the hardware included in the order. This is a spreadsheet with calculations and checks in place to ensure correct quantities (Figure 44). The data entry for numbered marks is for the first and last numbers issued and the quantity is automatically calculated.

These mark issue sheets are then sent though to the SCIMS team for entry into the Survey Services Database (SSDB). As stated in section 2, this is the electronic version of the manual Permanent Mark Register, with added metadata and features. SSDB not only records who PSMs were issued to and at what cost but also generates the sales file for uploading into the accounting system that automatically sends out the monthly invoices. SSDB is also used for tracking general distribution (where stock is) and to record when a Locality Sketch Plan (LSP) has been received for an issued mark.

SSDB has gone through many versions over the years, starting out as a spreadsheet and then transitioning to a relational database built in Microsoft Access with macros, and is now a Microsoft PowerApps application. Since financial year 2017-18, on average there are 2,960 (23,700 total to financial year 2024-25) numbered marks distributed to industry per year. In the same time period, we received an average of 2,415 (19,326 total to financial year 2024-25) LSPs from industry.



NSW Customer Service

DCS Spatial Services - Sydney

ISSUE OF PERMANENT MARK FITTINGS

THIS IS NOT AN INVOICE

TO BE RETURNED TO THE SENIOR SURVEYOR - SCIMS & CORS
AT SPATIAL SERVICES (DEPARTMENT OF CUSTOMER SERVICE) ON ISSUE OF CONTROL SURVEY MARKS BY REGIONAL DISTRIBUTORS.

Fittings supplied to

Organisation				Sap No	
Address					
Contact		Ref		Phone	
Billing email address					
Date of supply					
The fittings listed hereunder have been :					
Picked up at					
Dispatched to					
Delivered to					
For Reissue	Yes / No	For Placement		Yes / No	

FITTING	First Number	Last Number	QUANTITY	Cost per Mark Incl GST	Code	COST
PERMANENT MARKS						
Cast iron cover boxes			0	$114.60	SIPMCB	$0.00
Plastic cover boxes			0	$49.00	SIPMPCB	$0.00
Stainless steel pins			0	$24.10	SIPMSSP	$0.00
Brass Number plates			0	$15.20	SIPMBNP	$0.00
			0	$15.20	SIPMBNP	$0.00
			0	$15.20	SIPMBNP	$0.00
Blank Brass Number Plates			0	$15.20	SIPMBBNP	$0.00
Brass/stainless steel screws			0	$1.20	SIPMBS	$0.00
CADASTRAL REFERENCE MARKS						
Cadastral Reference Marks (CR's)			0	$15.20	SIPMBNP	$0.00
STATE SURVEY MARKS						
Type 1 (T1) 75mm Dia with stem			0	$24.10	SISSM1	$0.00
			0	$24.10	SISSM1	$0.00
			0	$24.10	SISSM1	$0.00
Type 2 (T2) 70mm dia with stem			0	$24.10	SISSM2	$0.00
			0	$24.10	SISSM2	$0.00
Type 15 (T15) 38mm disc with pin			0	$14.60	SISSM15	$0.00
			0	$14.60	SISSM15	$0.00
Type 15 (T15) 50mm replacement pin			0	$4.00	SISSP15	$0.00
Type 16 (T16) 75mm dia with stem			0	$32.10	SISSM16	$0.00
			0	$32.10	SISSM16	$0.00
Postage/Packing		(Office use only)			SIP	$0.00
				Total Cost		$0.00
Payment Method				Amount		
Monies to be accredited to Profit Centre: 64000721				GST		$0.00
Charges to be added to monthly account of		*0*		Amount		$0.00

Fittings supplied by :	This form Emailed to :	OFFICE USE ONLY	
DCS Spatial Services - Sydney 2-24 Rawson Place Haymarket NSW 2000	SCIMS@customerservice.nsw.gov.au	Job No. :	
SAP No 40000	Michael London	Officer :	
ABN 81 913 830 179	DCS Spatial Services SYDNEY	Register Updated	
	Date Emailed :	Paid	
		To Be Paid	

SS-CS xlsx - Survey Mark Issue Sydney Spatial Services_2024-25 v2.16.xlsx Current Ver 2.16

Figure 44: Example of a blank mark issue sheet.

6 LOCALITY SKETCH PLAN AND SCIMS

The first instance of a PSM in SCIMS is, as a general business rule, from an LSP. The SSIR requires that the Surveyor-General be notified within 2 months of the placement of the PSM or the same day as lodgment of a plan for registration (section 73(3)). This is done via the lodgment of a LSP to the SCIMS team. Guidelines for the preparation and lodgment of LSPs can be found in Surveyor-General's Direction No. 2 – Preparation of Locality Sketch Plans (SDG2). LSP forms and templates in a variety of electronic formats (including CAD files) can be found on the DCS Spatial Services website in the Surveyor-General's Directions section (DCS Spatial Services, 2026).

LSPs provide connection to real-world features to help locate the survey mark (Figure 45). Whilst not critical in urban areas, they are extremely useful for finding previously installed marks in rural and remote areas, especially when working in areas with no mobile phone coverage or low sky visibility limiting the ability to use real-time positioning services. The main advantage of LSPs in urban environments is determining if the mark has been relocated or disturbed. Changes in the surrounding features and the measurements to those are strong indicators that a survey mark has been disturbed.

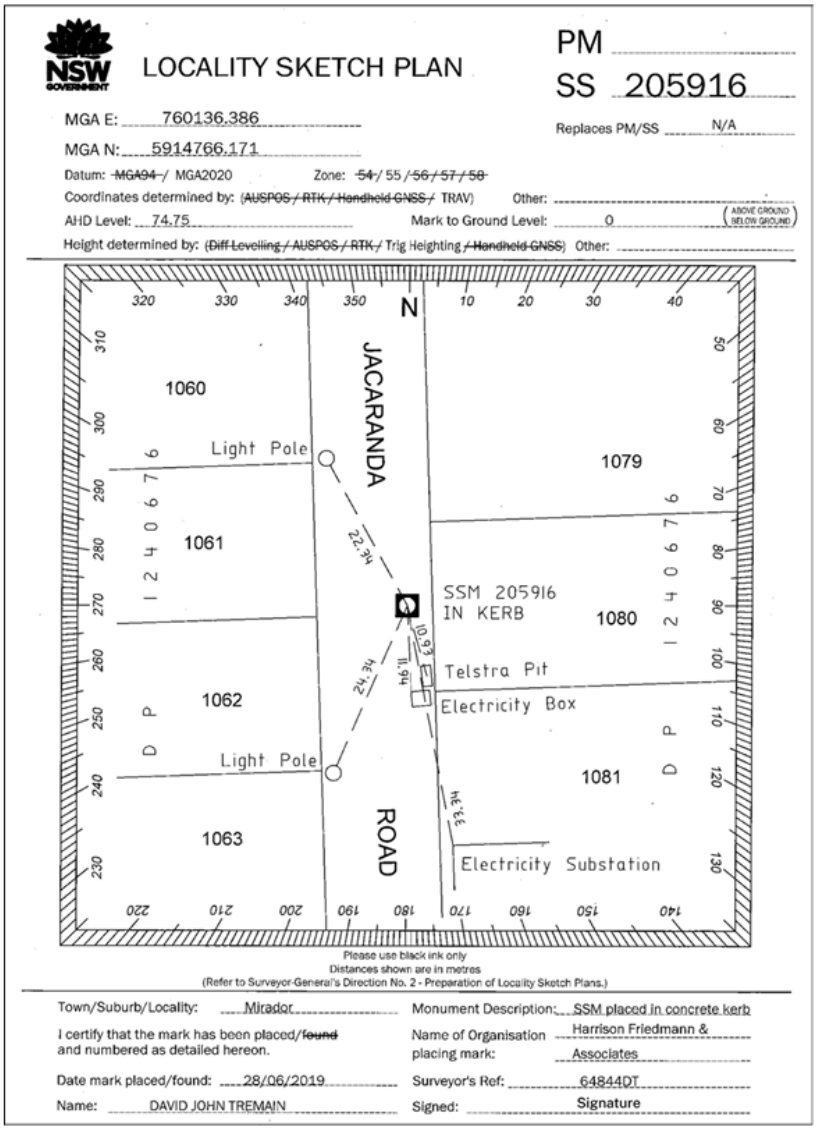


Figure 45: Example of a LSP.

Once a LSP has been received by the SCIMS team, there are requirements for the PSM metadata (specifically coordinates) and LSP to be publicly available, specifically through SCIMS Online and associated webservices.

The SCIMS team performs quality assurance on the submitted LSP, including:

- Does the mark already exist in SCIMS?
- Does the LSP comply with SDG2 specifications, i.e. could someone find the mark from the information given?
- Is the LSP free of errors?
- Has the LSP been submitted by the same organisation that purchased the mark?
- Converting the supplied file into the required format and specifications (*.tiff, black & white, 200 dpi).
- Ensuring the file name matches the mark type and number.

Upon passing these checks, the SCIMS team then uses EDMARK, an in-house mapping product based off DCS Spatial Services' SIX platform, to plot the new mark (Figures 46 & 47). Plotting provides quality assurance on the correctness of the information supplied on the sketch, such as coordinates, street names and suburb. EDMARK also enables the calculation of a height value from the Digital Elevation Model (DEM), helping to validate the height value supplied (to be used with caution in new subdivisions that have undergone significant earth works) or to provide a height when one has not been supplied on the sketch.

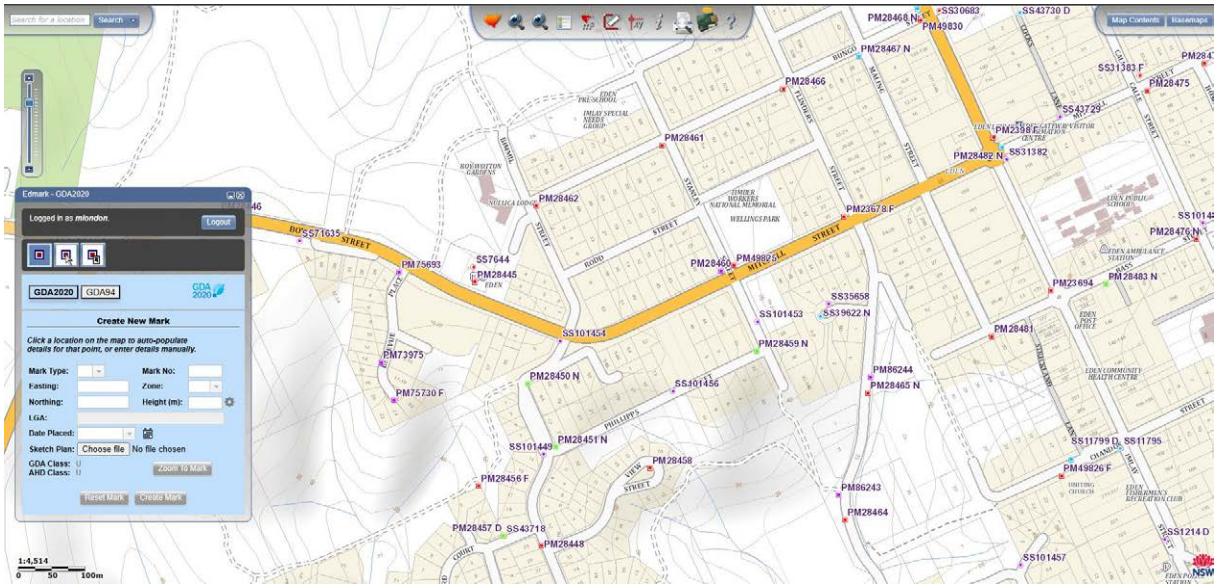


Figure 46: DCS Spatial Services' in-house plotting tool EDMARK.

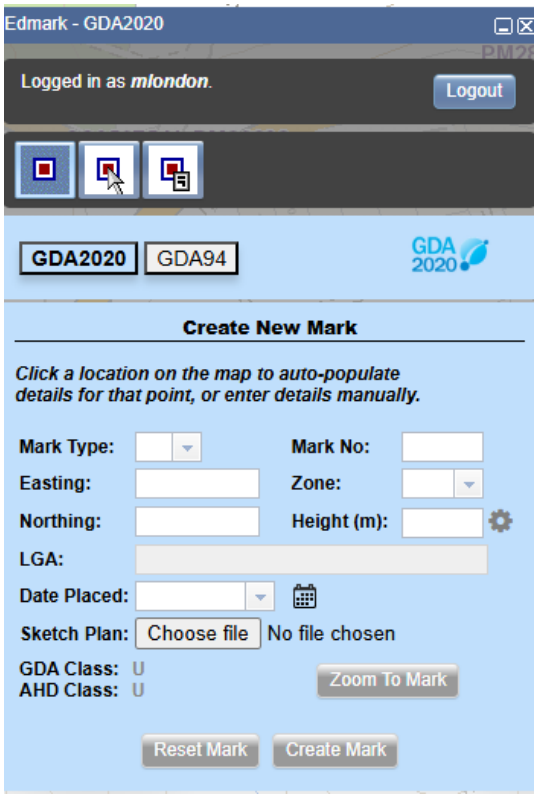


Figure 47: EDMARK form for plotting new PSMs and loading LSPs.

Marks plotted then sit in a staging table within SCIMS2000 (Figure 48) and are checked again by another staff member to ensure no gross errors (e.g. incorrect sketch loaded for a particular mark) are present. Then they are loaded into SCIMS, allowing the public to order coordinates and the LSP for the mark through SCIMS Online or associated webservices and (mobile) applications.

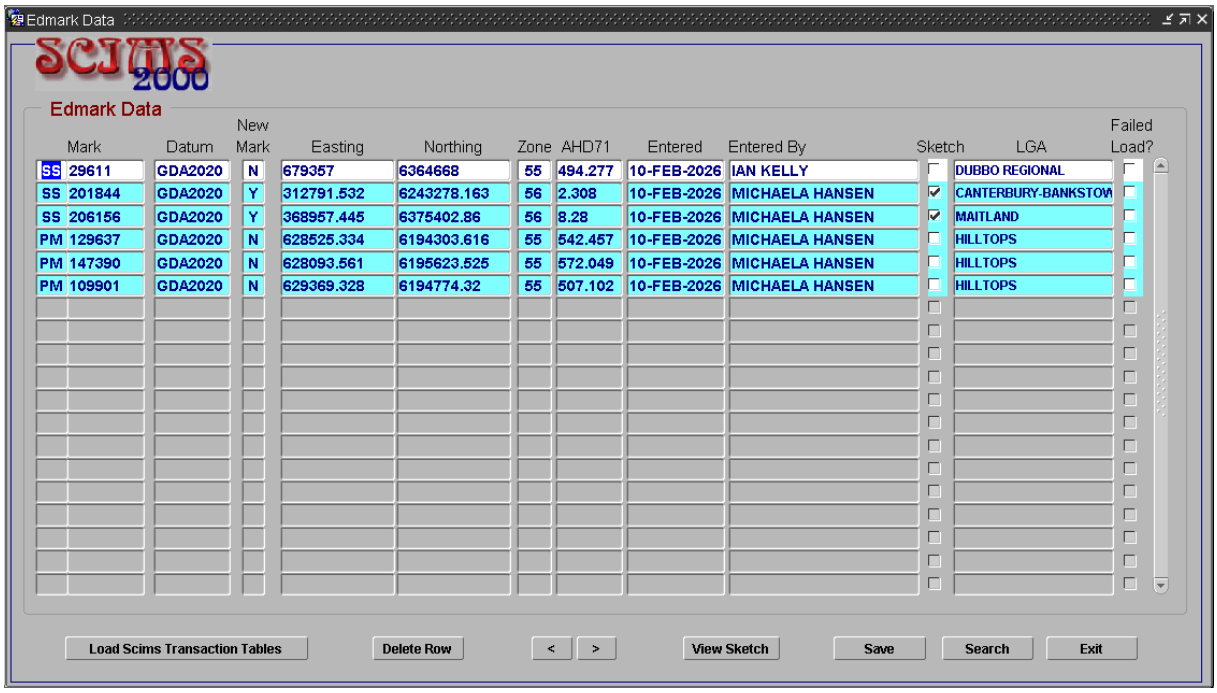


Figure 48: Example of the SCIMS2000 EDMARK staging table.

All marks plotted with EDMARK have the one source ID (job number) and are given an accuracy Class U both horizontally and vertically. This intentionally low accuracy classification reflects the fact that the coordinate values supplied have not gone through a rigorous least squares network adjustment to determine Class and Positional Uncertainty (PU).

In this context, it should be noted that customers have the opportunity (and are encouraged) to submit static Global Navigation Satellite System (GNSS) datasets of at least 2 hours duration collected on the new mark to DCS Spatial Services via its Customer Hub for inclusion in the monthly SCIMS update based on AUSPOS, Geoscience Australia's free online Global Positioning System (GPS) processing service. Assuming sufficient data quality and appropriate sky view conditions, this generally results in updating the coordinates and accuracy classification of the mark to Class D in a timely manner (Janssen and McElroy, 2022).

Once stored in SCIMS, the team completes the remaining metadata entries for the new mark in SCIMS2000 and SSDB. This includes:

- Date placed.
- Placed by (organisation).
- Monument type (generally PSM type).
- Monument location (generally ground level).
- LSP date.

Some readers may have noticed that we refer to State Survey Marks as SSMs but then on forms and in SCIMS only refer to SS. This is because the schema of SCIMS only allows for two-digit identifiers for mark type (i.e. SS, PM, TS, CR, CP, GB, MM).

The organisation placing the mark is publicly available information in SCIMS and stated on the LSP, along with being identified on a Deposited Plan (DP) if the mark has been placed by associated work. Consequently, the quality of the mark installation and the LSP is essentially advertising for the organisation and/or surveyor.

Sometimes the first notification of the placement of a PSM occurs when DCS Spatial Services is processing a DP for entry into the Digital Cadastral Database (DCDB). The coordinate schedule on the plan identifies the PSMs shown on the plan and issued to accurately plot the boundaries. If the PSMs shown in the coordinate schedule are not present in SCIMS, this is flagged with the DCDB team and results in the SCIMS team being notified. The SCIMS team then uses the DP information to plot the mark and sends a request to the surveyor for the submission of an LSP for the mark. If you come across a PSM in SCIMS and discover that no LSP is available, no LSP has been submitted by the organisation or surveyor that placed the mark. If you should observe such a mark, it is good practice to produce and submit an LSP of the mark found.

Early LSP forms did not have fields for coordinates, so the initial coordinates determined would be scaled off topographic maps. Due to scaling errors, some marks were mis-plotted, sometimes by hundreds of metres. If one of these marks is discovered, the revised spatial position can be supplied to the SCIMS team either through a Mark Status notification or submission of an updated LSP. The team will then use EDMARK to update the mark and load the updated LSP.

7 THE FUTURE OF SCIMS

As described by this paper, PSM metadata is rich in information and spread across a variety of data sources. DCS Spatial Services has begun a capitally funded project to completely rebuild the SCIMS system in order to bring all the datasets under the one schema and consolidate the platforms used to interact with the data from both an administrator and customer point of view under a single sign-on. This is not the first time that DCS Spatial Services or its predecessors have attempted to develop a revamped SCIMS, with many of the design concepts and datasets carrying over from those proposals (Kinlyside, 2013).

The SCIMS 3 project will also bring in new datasets that are not yet publicly available, e.g.:

- Photos of PSMs.
- Mark-to-ground-level height.
- Survey measurements.
- Connected plans.

The project also intends to improve the customer experience, particularly with regard to ordering and purchasing PSM hardware. An online shop will be developed where the customer will be able to select the quantities of each product and pay for the order via credit card. They will be able to nominate their distributor for pick-up or delivery options for smaller orders. This will also provide significant improvement for DCS Spatial Services with reduced data entry due to the consolidation of systems and improved record keeping.

Another big change for the customer will be the availability of an EDMARK-type tool embedded into SCIMS Online. Currently, the preparation of the LSP requires the user to provide entries for all the fields on the form, while the SCIMS team then repeats this data entry for inclusion into SCIMS. The intent is that the user will enter the data into an online form, under their login details and only load the diagram part. The system will then create an LSP by combining the supplied information and the sketch. This should significantly reduce time and effort for all parties while increasing the quality of the products for all.

This section has only provided a small description of the intended future of SCIMS. Further engagement with industry will occur as development progresses, with the planed go live of the new system being June 2027.

8 CONCLUDING REMARKS

What appears like a simple piece of brass on the street corner is actually highly complicated, from manufacture and installation via the rich metadata for each and every PSM through to the variety of systems storing and disseminating this data. PSMs are an integral piece of infrastructure for NSW, providing the connection to a common datum for the work undertaken by a variety of industries.

This paper has outlined the story of the life of a survey mark, from manufacture and assigning of numbers through to distribution, installation and the initial digital establishment of the mark in SCIMS. Some of the improvements that are coming to SCIMS in the not-too-distant future have also been described. The form and style of PSMs is continuously evolving, and DCS Spatial Services welcomes any feedback on potential improvements or alternatives to consider.

ACKNOWLEDGEMENTS

Due to privacy and contract impacts, the organisation names of suppliers and manufacturers are not mentioned in this paper. All the same, the author would like to thank the suppliers of PSM hardware. Their continued service, desire to improve the product and the supply of information around the manufacturing process is greatly appreciated.

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