Frontier Resources Ltd
Stormont Gold + Bismuth Project
Resource Estimate
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Grant MacDonald

Frontier Resources Ltd

134 Beveridges Lane,

Hagley, 7290

Tasmania

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Executive Summary

Resource

An Indicated Resource has been estimated for the Stormont gold and bismuth deposit.

At a **0g/t gold cutoff** the deposit contains **157,144 tonnes** at **2.78g/t gold** for 14,047 ounces gold and **0.17% bismuth** for 264 tonnes bismuth.

At a **1.5g/t gold cutoff** the deposit contains **84,536 tonnes** at **4.38g/t gold** for 11,906 ounces gold and **0.23% bismuth** for 197 tonnes bismuth.

The silver component of the deposit remains as an Inferred Resource of 3.77g/t silver at the 0g/t gold cutoff, and 4.48g/t silver at the 1.5g/t gold cutoff due to unresolved poor repeatability in umpire check assaying.

Geological model

The Stormont Au+Bi deposit is a skarn type (largely) stratiform/stratabound deposit hosted by the Ordovician Transition Beds (informal unit), a unit of calcareous sandstones at the top of the Moina Sandstone and immediately underlying the Gordon Limestone.

Mineralisation occurs largely as free gold (minor maldonite) and bismuth and bismuthinite in disseminations associated largely with garnet and actinolite.

The deposits overall dimensions are up to 32m vertical thickness, 35m horizontal width and a length of 160m. Mineralisation is found in the core and on the limbs of a sub-horizontal F2 syncline.

The resource outcrops for the most part, the southern portion being obscured in its centre by a stratigraphically overlying unit of black clay and with a thin Tertiary cover at its south-easternmost end.

Whilst the distribution of mineralisation has a clear stratiform morphology, significant mineralisation is also focussed along the Stormont Adit Fault, a northwest striking, 65°-70° southwest dipping strike slip fault/fault zone.

Geostats

Whilst statistically the correlation coefficient between Au and Bi is 0.42, visually the two are closely associated.

High grade outliers of Au, Bi and Ag have been dealt with by top cutting to 25g/t Au, 1.2% Bi and 15g/t Ag.

Variography, carried out on 2m composites, shows very similar ranges for each of Au and Bi (insufficient data for Ag), therefore the variogram model for Au was adopted for all three elements. The variogram model shows a low nugget effect of 15%. The variogram model shows a strike of 135° (true) in the z-plane, 0° in the x-plane and 0° in the y-plane with a short range of 15m and an overall range of 70m.

Reassaying 2008 Frontier pulps confirmed that the initial BRL gold assays were undercalled by ~10% and have been replaced in the database.

Block model

A block model with parent size 5m (north) x 5m (east) x 5m (RL) was generated with sub-blocks of 1.25m x 1.25m x 1.25m.

Grades were estimated by Ordinary Kriging using the SURPAC estimation software. 3 passes were used with a minimum 12 and maximum 30 samples in the first two passes, minimum 6 and maximum 12 for the third pass. The first pass had a search ellipse of 15m x 5m x 3m, the second 25m x 9m x 4m and the third 70m x 25m x 12m.

An overall bulk density of 2.9g/cm3 calculated from 84 core samples measured by the water immersion method was used in determining tonnages.

Recommendations

Whilst the resource as estimated is considered quite robust a number of recommendations have been made to the end of increasing this robustness in preparation for mining.

- Further silver umpire assaying is required to allow the silver component of the resource to be upgraded to indicated status.
- Trenching and sampling across the projected southwestern and northeastern margins of the deposit will improve confidence in the placement of the ore boundary on both sides and in particular clarify the nature of the material in the unattributed wedge along the northeastern side.
- Domaining the deposit into oxidised and fresh material and then estimating density into the block model will improve the tonnage estimation.
- Infill drilling (grade control) may allow domaining into Upper High Grade, Low Grade, Lower High Grade and Fault domains to be modelled with sufficient confidence.
- Further petrology and some detailed check re-logging may provide further insights into the macroscopic visual recognition of higher grade material to optimise "high grading" the +1.5g/t Au cutoff material.

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Appendices

1.0   Introduction

1.1   Scope of work

This report details and justifies the calculation of a robust Indicated Resource Estimate for the Stormont gold+bismuth deposit near Moina in Tasmania's central north.

The previous resource estimate which classified the Stormont gold+bismuth deposit as an Inferred Resource (MacDonald, 2009) made a number of recommendations regarding further work, (including drilling and channel sampling) required to elevate the resource to Indicated status. That work has been largely completed.

This report details those aspects of that work relevant to the determination of this new resource estimate.

1.2   Principal sources of information

The principal sources of information were.

(1) All new 2011 data, i.e. SFD17 to SFD45 and channel samples FRSTC05 to FRSTC11 was generated by the author and other Frontier personnel.

(2) All previous data had been supplied to the author whilst working independently by then Frontier exploration manager Rob Reid of Frontier Resources Ltd who supplied initial geological interpretation, coded drill logs, drillhole and channel sampling data (collars and surveys) and assays in comma delimited files in 2009. Whilst the geology interpretation has been superceded, as has drillhole collar and old workings surveys, the assay database generated from this work was carried through and updated with the 2011 data.

(3) Hard copies of previous reporting including geological interpretations, descriptive drill logs, drillhole and channel sampling data and assays were downloaded from Mineral Resources Tasmania's website.

(4) Surveying of drillhole collars and old workings was done by Len McKenna, a certified surveyor.

1.3   Project location and access

The Stormont gold + bismuth deposit is located in Tasmania's central north approximately 40km south-southwest of Devonport (see figure 1.1). The deposit lies at an elevation of between 600m and 700m A.S.L on the northwestern flank of Stormont (1007m A.S.L) just above the Lea River. Rainfall ranges from 1500 to 2000 mm p.a. and light winter snow is not uncommon.

Access to the deposit is by the sealed Cradle Mountain Road to the Moina turn-off, then by approximately 3 kilometres of well formed public gravel road (2WD), then by 3 kilometres of all-weather 4WD gravel road belonging to Forestry Tasmania making up the last section (see figure 1.2).

1.4   Tenure and land use

The deposit lies within EL 42/2010 "River Lea" held by Frontier Resources Ltd. The licence was granted on 3rd April 2011 for a period of 5 years, expiring on 3rd April, 2016.

The land on and around the deposit is classified as State Forest and whilst subject to forestry activities is available for mining. The deposit itself lies at the very western end of a plantation managed by Forestry Tasmania which runs along the ridgeline on the south side of the Lea. Forestry Tasmania had been aware of the mineral potential of the deposit and deliberately excluded its surface footprint from being planted.

Furthermore whilst the bulk of the plantation is a Forestry Tasmania/Gunns Limited J.V. that part of the plantation closer to Stormont was kept separate from the J.V. by Forestry Tasmania. The

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Figure 1.1: Location of Frontier's Moina Project tenements showing the location of EL 42/2010 and the Stormont resource (note Torque Mining Ltd. is a newly created subsidiary of Frontier Resources Ltd.).
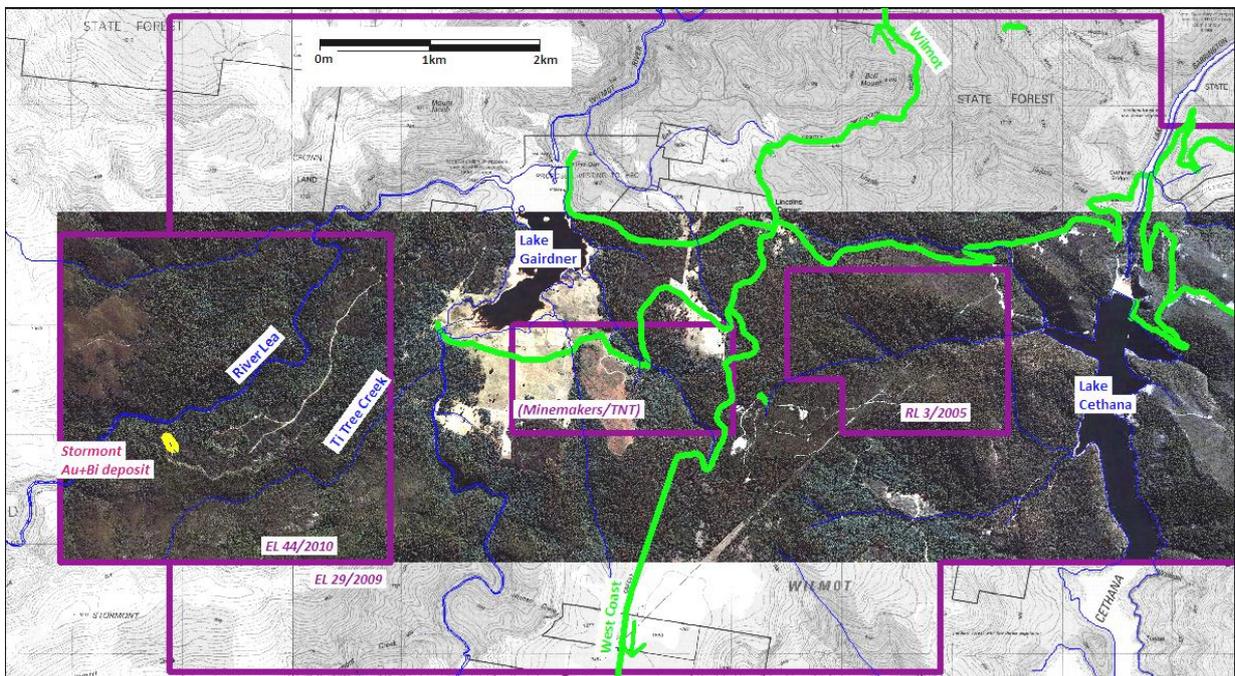
Figure 1.2: Location of Stormont Au+BI deposit with tenements on orthorectified airphoto. Green lines are more significant roads, blue is rivers and creeks, purple is tenement outlines.

Stormont deposit itself is covered by wet sclerophyll bush with a small intermittent creek running down the centre.

An Aboriginal heritage study sufficient to allow drilling to take place was conducted with no evidence of aboriginal habitation on the site, though evidence of habitation is found along the ridgeline traversed by the access road.

The old workings themselves have European heritage value which has not yet been assessed. The northern end of the high grade zone lies in and around the old open cut and underground workings. Any mining activity would necessitate the removal of these. The fact that these old workings date from the late 1920's is likely to downgrade any heritage concerns.

2.0   Project background

Frontier Resources Ltd originally held the Stormont prospect as part of its EL 29/03 "Gowrie Park" granted in 2003.   Frontier relinquished all but the Narrawa Creek and Stormont areas in 2005 converting these to retention licences.   In 2009, following the aftershocks of the GFC, the retention licence was relinquished and reapplied for under the ETA system in which Frontier was the successful tenderer.

2.1   Exploration and mining history

2.1.1   Discovery and early production

The Stormont Au + Bi deposit was originally discovered in 1925 by the prospector Richard Mages (McKintosh-Reid 1927).

It is important here to distinguish the Stormont Au + Bi mine from the similarly named Stormont Au mine which lies ~700m to the south-southwest of the Stormont Au + Bi deposit. This geographically and geologically distinct gold mine has been inadvertently confused with the Stormont Au + Bi mine in a number of earlier reports on exploration at Stormont.

At the Stormont Au + Bi deposit trenching and the mining of an adit commenced in 1927 (Scott, 1929) with the production of a bismuth + gold concentrate commencing in 1928 (Burns, 1959). Production records were supplied informally by P.Doyle to Burns (1959) and listed in the appendix to his report. They indicate the production of 6.33 tonnes of concentrate averaging 435 g/t Au for a total of 86 oz Au and an average of 62.4 % Bi for 3.96 tonnes Bi between October 1928 and April 1934.   These figures differ somewhat from those detailed in Keid (1943) as 59 oz Au and 4.35 tonnes Bi but he states that production only occurred between 1930 and 1933 and so the figures of Burns are considered more reliable. Certainly at the time of Keid's visit in 1934 the mine lay dormant.

In early 1934 government geologist E. Broadhurst's visited the (then active) mine, however, his report (Broadhurst, 1934) focussed more on the nature and genesis of the Bi and Au mineralisation (with the significant conclusion that better Bi and Au grades are associated with fractures within the skarn) but provides no details regarding any recent or ongoing mining or production.

The principal (producing) old workings consist of an open cut, ~40m long ~25m wide and up to ~10m high, which extends into the northwest nose of the ridge. At the southeastern end (deepest) of the open cut an adit extends into the hill in a southeasterly direction for ~42m with short cross-cuts branching at approximately 16m in to the southwest (12m long) and northeast (6m long). The total volume of material removed from these workings combined is ~4000 m3 though clearly from the scale of the production figures not all of this material was treated as ore.   Loosely stockpiled material on the northeast side of the open cut would appear to represent at least some of this material.

In 1929 government geologist J.B. Scott (Scott, 1929) visited and described the then current operation of the Stormont Au + Bi mine (~1 tonne/hour operation) and the problems of the gravity method underpinning the ore separation which Scott concluded was weakened by the partially oxidised nature of the ore. Scott (1929) describes gold as being associated with native bismuth as well as hosted within bismuthinite with the other ore minerals consisting of bismuthite (carbonate of bismuth) and bismite (oxide of bismuth). Scott concludes that whilst gravitational separation was not efficient in the partly oxidised ore it should improve in unoxidised material but further recommends that oil flotation be investigated.

Figure 2.1: Photograph looking southeasterly into the thickly overgrow old open cut

Figure 2.2: Northeast wall looking southeasterly to mouth of adit (obscured by ferns)

Figure 2.3: Photograph inside adit at point where cross-cuts commence to right and left – inside high grade zone.

Figure 2.4: South-easternmost small adit into northeast wall of open cut, collar position SFD46 just right of centre.

2.1.2   Recent exploration

Introduction

The following history of recent exploration around the Stormont Au + Bi prospect is focussed on those aspects which have direct relevance to the resource itself, i.e. drilling, channel sampling, surveying and petrology.

Comalco (1979) – channel sampling

Roberts (1987) says Comalco (Askins, 1979) collected 2 grab rock samples from open cut which assayed >2 g/t Au and also channelled (2m samples) a length of the open cut and 10m's into adit but only 3 of these channel samples were apparently assayed with the samples 3124W, 3144W and 3164W assaying 1.95, 2.1 and 5.1g/t Au respectively. These samples have not been included in the resource estimation though the tenor of their reported values does not contradict subsequent sampling results.

Goldfields (1987) – channel sampling

Gold Fields Exploration Pty. Limited (GFEL) held the ground containing the Stormont Au + Bi deposit from 1983 to 1991. In 1987 (Roberts, 1987) GFEL systematically channel sampled the southern wall of the open cut and most of the walls and some the backs of the underground workings. Samples were taken horizontally over nominally 2m contiguous intervals using a pneumatic chisel. 26 samples for 52 metres in total were taken from the open cut and 41 samples for 77.1 metres were taken from the underground workings.

53 of these channel samples (for 102.1m) have been included in the resource estimate. GFEL ascribed names describing their locations to contiguous channel samples. These have been coded as GFSTC01 to GFSTC15 in this resource estimate. Significant results are detailed in Table 2.1.

Two samples of mineralised garnet + actinolite skarn collected from the old mine workings were submitted to H.W. Fander at Central Mineralogical Services for polished section analysis, one of which contained gold (Fander in Roberts, 1987).

RGC (1988) – diamond drilling SD1 to SD6

In 1988 Renison Goldfields Consolidated (RGC), who had evolved corporately from GFEL, carried out a 6 hole diamond drilling programme around the Stormont Au + Bi mine (SD1 to SD6) for a total of 446.0m (Fleming, 1988). All holes were vertical with a triconed top, followed by HQ then NQ core.

Three of these holes (SD1, SD3 and SD5) were drilled to the southeast of the old open cut. All intersected mineralised skarn. Hole SD4 was drilled into an area of outcropping skarn to the southwest of these holes with holes SD2 and SD6 drilled into an area of outcropping skarn to the northeast. These three areas of skarn, which have been shown by mapping and later drilling to correspond to three distinct synclinal cores, are referred to herein as the central, western and eastern zones respectively. Significant results are detailed in Table 2.1.

The high grade resource estimated and described in this report occurs wholly within the central zone at its northwestern end and is referred to herein as "the high grade zone".   Significant intersections in the central zone to the southeast of the estimated resource indicate the potential to extend this resource and are noted below.

Holes SD1 and SD3 made significant intersections used in this resource estimate. Hole SD5 made a significant intersection in the central zone which was not used in this estimate. Significant results are detailed in Table 2.1.

RGC (1990) – diamond drilling SD7 to 21

In early 1990 RGC carried out further drilling in the Stormont area, drilling holes SD7 to SD21 (for 571.2m) (Castro, 1990) with most holes drilled on gridline 5800N (nominally AMG east-west grid with line 5800N ~5405800mN) in areas of elevated magnetism considered due to skarn. Only holes SD7 to SD11 were drilled in the central zone with the other holes drilled into the western (SD20 & 21) and eastern (SD13 to 19) zones. All holes were vertical with a triconed top, followed by HQ then NQ core.

None of these holes are used in the resource. Holes SD8 and SD10 made significant intersections in the central zone not included in this resource estimate. Holes SD7, 9 and 11 intersected unmineralised skarn in the central zone. Significant results are detailed in Table 2.1.

RGC also carried out petrological studies of mineralisation with Dr Scott Halley (who had done his PhD on the contemporaneous Mt. Bischoff skarn) giving a detailed description of the paragenesis and location of gold within the skarn assemblage.

RGC relinquished the Stormont Au + Bi prospect at the end of 1990.

Goldstream/Titan (1996/97) – diamond drilling SD30 to SD61

In September 1992 Goldstream Mining N.L. (Goldstream) pegged the area including the Stormont Au + Bi prospect as EL 20/92 and entered a joint venture with Titan Resources N.L. (Titan). After focussing on skarns elsewhere in the licence the Goldstream/Titan J.V. carried out an initial drilling programme in 1995/96 drilling holes SD30 to 42 (for 711.5m) (Newnham, 1996). All core was HQ.

Holes SD36 and SD39 made significant intersections used in this resource estimate. Hole SD33 made a significant intersection in the central zone not included in this estimate. Holes SD30, 31, 32, 34, 35, 37, 38, 40 and 41 intersected unmineralised skarn in the central zone. Significant results are detailed in Table 2.1.

In 1996/97 Goldstream/Titan drilled a further 16 holes SD43 to SD61 (for 711.5m) (Newnham, 1997) in and around the Stormont prospect. All core was HQ.

Hole SD44 made a significant intersection in the central zone not included in this estimate. Hole SD43 intersected unmineralised skarn in the central zone. Significant results are detailed in Table 2.1.

Jervois (2000) – diamond drilling ST01 to ST04

In August 1999 EL 20/92 was transferred to Jervois Mining N.L. (Jervois). In early 2000 Jervois drilled 4 holes (NTW size = 64mm) in the Stormont prospect (Purvis, 2000). Holes ST01, ST02 and ST03 were drilled at the southeastern end of the central zone with ST04 drilled into the western zone. All holes were drilled vertically. Both ST01 and ST02 intersected unmineralised skarn. ST03 was drilled apparently east of the Stormont fault. The results of the three holes in the central zone were poor but appear to have closed off the main mineralised zone between SD44 and ST01. ST04 in the western zone intersected 2.0m at 3.5g/t Au. Significant results are detailed in Table 2.1.

Frontier (2008) – diamond drilling SFD001 to SFD016 and channel sampling

After initial work on the Higgs Skarn at Narrawa Creek Frontier commenced work on the Stormont prospect in early 2008, completing diamond drillholes SFD001 to SFD016 (for 543.9m). All holes were drilled HQ/NQ. Frontier also carried out further channel sampling in the open cut with 16 samples for 21.8m. Contiguous channel samples were named FRSTC01 to FRSTC04.

Holes SFD1 to 13 made significant intersections which have been included in this resource estimate. Holes SFD 14 to 16 made significant intersections in the central zone not included in this estimate.

14 of the channel samples for 17.8m have been included in this resource estimate. Significant results are detailed in Table 2.1.

Frontier submitted 227 samples of drill core for bulk density determination of which 84 were from the high grade zone.

Four samples were analysed by XRD with one of these also studied by polished thin section by MRT mineralogist, Dr Ralph Bottrill (in Reid, 2009).

Frontier (2011/12) – diamond drilling SFD17 to SFD47, channel sampling etc.

The 2009 Inferred Resource geostatistics indicated that a number of deficiencies in the data set needed rectification before an Indicated status would be warranted. These were:

- *"Infill drilling on 12.5m sections with holes using the current fan geometry.*

- *Drilling angled holes towards the southwest on 12.5m spaced sections designed to intersect the Stormont Thrust before passing into the high grade zone on the eastern limb of the syncline.*

- *Further more thorough channel sampling of the old workings with both walls of the underground workings channel sampled and another tier of channel sampling along the walls of the open cut.*

- *Surface trenching again on 12.5m sections over the area of outcropping mineralisation.*

- *Umpire re-assaying of existing and new sampling.*

- *Conventional surveying of existing drillhole collar and channel sample locations including the old open cut and underground workings.*

- *Creation of a more accurate surface DTM*

- *More thorough relogging of existing drill core and mapping of exposures with foci on (1) mineral assemblage control an Au and Bi mineralisation, and (2) geological structure, both in order to understand any structural control on mineralisation and for geotechnical purposes. Given the possible relationship between retrograde magnetite and Au + Bi mineralisation magnetic susceptibilities should be measured for all drill core. The use of PIMA which may be able to map out retrograde actinolite, probably associated with Au + Bi mineralisation."*

Frontier set to addressing these deficiencies carrying out the following work;

- Drilling 31 holes named SFD17 to SFD47 for 872.1m.

- Drilling a number of these holes targeted to intersect the Stormont Thrust Fault before passing into mineralised skarn. Two holes were drilled specifically to test the Stormont Thrust Fault and Stormont Adit Faults to the immediate north-east of the adit.

- Channel sampling 38.7m along the north-eastern walls of the old open cut. Channel samples were named FRSTC06 to FRSTC11.

- Re-assaying pulps from the 2008 drilling and channel sampling in order to confirm the error in the gold grades as assayed by Burnie Research Laboratories.

- Conventional surveying of most existing drillholes as well as 3D surveying of the old open cut and old adit sufficient to allow creation of wireframes of each. This too allowed creation of a better surface DTM.

Further details of this work are provided in section 4.0.

Table 2.1 All significant intersections						
Hole_ID	From (m)	To (m)	Length (m)	Au (g/t)	Bi (ppm)	Ag (g/t)
Used in resource estimate						
SFD001	2.3	11.5	9.2	2.36	2632	8.21
SFD002	4	10	6	2.88	6370	17.8
SFD003	1.5	13.5	12	0.43	1327	2.33
SFD004	1.7	13	11.3	3.38	3074	6.19
inc SFD004	8	11	3	11.3	3079	6
SFD005	7.9	26	18.1	6.49	2555	4.49
inc SFD005	21.4	26	4.6	24	3991	5.96
SFD006	1.8	19.3	17.5	1.46	817	2.53
SFD007	0	7.5	7.5	2.48	1597	1.57
SFD008	0	9	9	1.88	827	1.3
SFD009	0	16.1	16.1	6.05	6821	5.06
inc SFD009	3.1	11	7.9	12.1	13752	9.52
SFD010	0	24.5	24.5	0.446	92.8	1.07
SFD011	1	18	17	3.54	1227	3.11
inc SFD011	11.5	16	4.5	8.86	3077	4.18
SFD012	4.8	16.1	11.3	0.09	23.7	0.177
SFD013	3.5	21.2	17.7	0.39	259	2.34
SFD014	27.7	32	4.3	0.212	213	2.16
SFD17	0.7	17.9	17.2	0.219	1100	1.99
SFD18	1.05	18	16.95	0.44	1322	2.62
SFD19	0.6	16	15.4	1.27	955	2.25
SFD21	0.4	26.8	26.4	7.59	3534	4.1
inc SFD21	7.5	12	4.5	37.3	14692	10.4
SFD22	6.7	15	8.3	5.14	910	0.12
inc SFD22	12.5	15	2.5	13.4	1076	0
SFD20	0.5	28	27.5	4.83	615	2.7
inc SFD20	4.5	18	13.5	8.34	1066	4.64
and SFD20	22.35	28	5.65	2.76	364	1.08
SFD23	1.2	16	14.8	0.6	1216	2.11
SFD24	1.5	13.5	12	5.58	1857	5.5
inc SFD24	10.5	13.5	3	11.5	6018	12.5
SFD25	1.5	15.2	13.7	2.92	1183	3.52
inc SFD25	9	11.6	2.6	8.05	2636	6.58
SFD26	0.3	18	17.7	0.43	69.6	0.91
SFD27	6	26.7	20.7	4.76	2365	2.03
inc SFD27	11.5	24	12.5	7.77	3913	3.36
SFD28	5.8	30	24.2	0.736	3220	3.71
SFD30	8	25.3	17.3	2.4	2639	1.39
inc SFD30	10	17	7	5.39	6476	3.43
SFD33	10	26.8	16.8	8.02	5000	5.23
inc SFD33	14	18	4	18.6	10039	9.5
and SFD33	23.1	25.3	2.2	25.8	17250	14
SFD35	0.2	30.2	30	0.96	2513	3.34
inc SFD35	3.44	8	4.56	2.7	3787	3.67
SFD36	13.5	25.5	12	0.6	824	0.75
SFD39	13	27	14	3.6	1180	0.83

SFD41	9.1	12.7	3.6	0.18	25	0.8
SFD42	0	11.35	11.35	0.2	47.1	1.67
SFD43	0.5	20.3	19.8	1.04	1271	2.07
SFD44	0.5	19.3	18.8	11.3	3354	4.43
inc SFD44	3.8	6	2.2	12.1	3240	6
and SFD44	13	17	4	39.3	8430	9.25
SFD45	0.55	4	3.45	1.42	1331	2.68
SFD46	4.5	12.5	8	0.668	672	1.06
SFD46	22.5	29.4	6.9	0.0545	400	0.594
SFD47	15	26.2	11.2	3.33	1107	2.71
inc SFD47	17	20	3	9.97	1358	0.6
SD1	4.5	19.5	15	3.58	3993	0.522
SD36	0	16.7	16.7	2.07	299	0
inc SD36	14.2	16.7	2.5	8.63	1296	0
SD34	13.9	17.3	3.4	0.006	2.21	0
SD39	0	19.6	19.6	2.87	915	0
inc SD39	15.6	17.6	2	16.8	5550	0
FRSTC01	2	10	8	1.09	2942	5.25
FRSTC02	0	2.5	2.5	2.2	3340	5.6
FRSTC03A	0	2.2	2.2	2.95	3353	7.82
FRSTC03B	0	5.8	5.8	4.21	1551	4.93
FRSTC04	0	1.3	1.3	25.4	5464	8
FRSTC06	2	5	3	1.55	2228	3.33
FRSTC07	0	15.2	15.2	2.44	2390	3.84
FRSTC08	0	3.5	3.5	1.49	423	2.29
FRSTC09	4	11	7	8.9	3138	8.71
FRSTC09	0	11	11	6.01	2107	6.27
FRSTC10	0	0.7	0.7	5.65	435	2
FRSTC11	0	1.9	1.9	0.682	220	1
GFSTC01	0	19	19	10	7735	4.16
GFSTC02	0	4	4	3.1	1860	2
GFSTC03	0	24	24	10.1	5188	6.54
GFSTC04	0	12.5	12.5	4.63	2642	4.16
GFSTC05	0	7	7	46.9	10967	11.7
GFSTC06	0	1.2	1.2	36.53	11000	6
GFSTC07	0	1.2	1.2	36.47	5300	5
GFSTC08	0	1.2	1.2	12.46	5000	2
GFSTC09	0	1.2	1.2	6.29	2400	3
GFSTC10	0	1.2	1.2	11.2	4700	3
GFSTC11	0	1.2	1.2	8.48	2500	7
GFSTC12	0	1.2	1.2	3.71	1300	3
GFSTC13	0	1.2	1.2	3.44	690	2
Not used in resource estimate						
SD8	28.1	29.4	1.3	2.99	0.02	
SD10	18.6	23.0	4.4	12.70	0.11	
SD33	27.5	29.0	1.5	9.00	0.17	
SD44	13.5	21.5	8.0	1.81	0.06	
SFD49	11.7	12.7	1.0	2.80	0.27	
SFD49	22.4	24.4	2.0	1.27	0.05	
SFD50	21.0	23.8	2.8	4.70	0.08	

2.1.3 Academic work

The Stormont deposit has been the subject of two academic studies i.e. Taylor (1990) and Cockerton (2011), both Honours projects, the former at the University of Tasmania, the latter at Monash University in Melbourne.

Taylor's (1990) thesis is titled "Gold Bearing Skarns from the Moina Area, Northwest Tasmania" and involved roughly equal study of the three known outcropping skarn bodies at Ti Tree Creek, Fletchers Adit and Stormont. Taylor worked on drillcore samples from SD1, 3, 5 and 6 from Stormont and used petrology, scanning electron microscopy, trace element geochemistry and oxygen isotopes.

It is apparent that Taylor had two foci

- to determine whether Stormont fits the gold skarn model,
- to contrast the three skarn bodies

To the former Taylor concludes it is a gold skarn due to its high pyroxene/garnet ratio, deficiency of base metal sulphides, abundant retrograde alteration, late stage reduced mineralising fluids, positive Au/Bi, Au/Pb and Bi/Pb correlations and common bismuthinite and bismuth.

Taylor concluded that the gold was derived from leaching of underlying Cambrian volcanics and was transported as a bisulphide complex with precipitation of Bi and Au by drop in temperature and f02.

Cockerton's (2011) thesis is titled "The Liquid Bismuth Collector Model: an analysis of the Stormont prospect, northwest Tasmania". Cockerton's aim was to determine whether Stormont showed the characteristics of a deposit consistent with the liquid bismuth collector model. In such a model bismuth, present as a liquid in the hydrothermal fluid, acts to collect and thus high grade gold in solution. These transport and precipitation mechanisms are in contrast with Taylors more classic model.

2.2 Previous resource estimates

The Stormont central zone resource has been estimated three times previously, the first two times by (admittedly in both instances) quite rough methodology, the latter more thorough job being Frontier's 2009 Inferred Resource estimate (MacDonald, 2009).

In the first instance, in 1996 by Goldstream (Newnham, 1996) immediately post their 1995/96 drilling programme, the resource was estimated as a Au only resource. Their resource estimate extends further southeast, incorporating intersections in SD8 and SD10, than the high grade zone estimated herein.

In the second instance, in 2000 (Purvis, 2000) by Jervois immediately post their drilling of ST01 to ST03 the resource was roughly estimated as a Au + Bi resource. Their resource estimate corresponds broadly with the high grade zone estimated herein.

In the third instance, in 2009 (MacDonald, 2009) by Frontier after completion of drillholes SFD01 to SFD16 and channel sampling FRSTC01 to FRSTC05, the resource was estimated as a gold resource with bismuth credits using a nominal 0.5g/t Au cut-off in defining the orebody wireframe bounds. The orebody was estimated from section 1987.5mE to section 2162.5mE (actually 2165mE) incorporating drillholes SD3 and SD33.

Goldstream's estimated is detailed herein

> "Whilst more data is required to elevate this deposit to the resource category, it is clear that a deposit of pre-resource mineralisation has been identified, and an approximate grade and tonnage can be estimated as follows:

A central section extending 90m, southeast of the open cut, embracing the intersections in SD1, SD36, SD39, and the underground sampling: SD1 13.0 v.m. @ 4.12g/t Au, SD36 9.5 v.m. @ 2.7g/t Au and SD39 18.4 v.m. @ 2.95 g/t Au and underground samples averaging 9.5g/t Au. Assuming an average width of 30m, a thickness of 13m and an S.G. of 2.5, this section would contain 88,000 tonnes. The weighted average of the drillholes is 3.2 g/t Au.

A northern section extending around the western side of the open cut and beneath the open cut. This section is about 30m along strike, 30m wide and may average about 4m thick (0-20m). Using a 2.5 S.G., this section may contain 9,000 tonnes. Channel sampling in the open cut averaged 4.8 g/t Au.

A southern section extending 80m southeast of the central section embracing intersections in SD3, SD33 and influenced by SD8, SD10, further to the south: SD3 2.1m @ 12.8 g/t Au, SD33 10.5m @ 1.4g/t Au (inc. 1.5m @ 9.0), SD8 74m @ 0.67 g/t Au (inc. 1.3m @ 2.99) and SD10 14.45m @ 0.95 g/t Au (inc 4.4m @ 2.9). Assuming a width of 15m, thickness 4m and an S.G. 2.5, this section would contain 12,000 tonnes. This may be conservative because of poor recoveries above the indicated interval in SD3. The average grade could be anywhere between say 2-5 g/t Au.

Combined these three sections indicate a mineralised body of approximately 100,000 – 150,000 tonnes with an average grade in the range 2-4g/t Au. This estimate is arguably conservative because of the low SG used, and the interpretation placed on several drillholes." (Newnham, 1996)

Jervois's estimate is detailed herein:

"Three drillholes and channel samples of the old workings provide data for the resource calculation:

Open cut west wall:	32m @ 4.8 g/t Au, 0.56% Bi	along strike
No.2 Cross-cut	10m @ 5.34 g/t Au, 0.31% Bi	across strike
SD1: (vertical)	13m @ 4.12g/t Au, 0.46% Bi	(4.5m – 17.5m)
SD36: (vertical)	16.7m @ 1.98 g/t Au, 0.03% Bi	(0 – 16.7m)
SD39: (-70 to ENE)	19.6m @ 2.95 g/t Au, 0.09% Bi	(0 – 19.6m)"

"Channel sampling along-strike in the adit, although within the resource, has not been used as it was apparently driven on a relatively narrow unrepresentative high-grade zone:

Adit east wall:	42m @ 9.56 g/t Au, 0.50% Bi	along strike

The main body of the resource extends 90m SE from the open cut, incorporating the adit, SD1, SD36 and SD39. Forty-one metres SSW of SD36, SD3 intersected 2.1m @ 12.8 g/t Au & 0.35% Bi (16.9m – 19m). This was beneath an interval of clayey skarn that was triconed (unsampled) to 11m and had only 10% recovery from 11-14m.

The southern boundary of the resource has been drawn midway between SD36 and SD3, but there is a good chance there are additional resources in the vicinity of SD3.

The average width of the body outlined above is 30m (this is conservative to allow for the synclinal shape). The average thickness, from the true width of the three drill intersections, is 17m. Grade obtained from the weighted average of the cross-cut channel results and the three drillholes.

Results are as follows:

Length: 90m

Width:	30m
Thickness:	17m
SG:	2.75 (assumes 15% magnetite and 10% oxidation loss)
Tonnage and grade:	126,000 tonnes @ 3.34 g/t Au & 0.19% Bi

Remnant ore exists around and beneath the old open cut, in a wedge with a total length of 40m and a width at the SW end of 25m. This remnant zone is estimated at between 9,000t and 14,000t, depending on the thickness of skarn below the open cut. Grade, from the open cut channel samples, is 4.8 g/t Au & 0.56% Bi.

Overall Stormont Resource total: 135,000 tonnes @ 3.44g/t Au and 0.21% Bi." (Purvis, 2000)

Frontier's 2009 Inferred Resource estimate is summarised in the Executive Summary reproduced here:

An inferred resource was estimated for the Stormont deposit using the results of all drilling and channel sampling data from all exploration. The orebody was modelled in 3D in Surpac from 2D sectional (Mapinfo/Discover) interpretations supplied by Frontier geologist Rob Reid. The estimation was done using Ordinary Kriging.

The wireframe was constrained on its northeast side by the Stormont Thrust Fault, its base was constrained by grade with stratigraphic control. Its southeastern end was constrained by grade extending to 2165mE.

The executive summary is as follows:

"An inferred resource (using a 1.5g/t Au cut-off grade) of 91,400t @ 4.57g/t Au, 0.30% Bi and 3.52g/t Ag for 13,430 oz Au, 277t Bi (error – 2009 report said 27.7 but it should have been 277t Bi) and 10,340 oz Ag has been estimated for the high grade zone at Stormont.

Geological model

- o The high grade Au + Bi resource at Stormont is a skarn-style stratiform deposit hosted near the base of the Ordovician Gordon Group Limestone. The deposit which ranges in stratigraphic thickness between 10m and 15m (lying 8m to 15m from the base of the limestone) is located in the core and on the limbs of a shallowly southeasterly plunging syncline at its northwestern most end. The high grade resource outcrops for the most part with only the central most part of the southern half and the southernmost end of the resource covered by unskarnified limestone and Tertiary cover. A section of the northeastern edge of the high grade zone has been faulted off by the Stormont Thrust Fault (with subsequent erosion removing mineralised skarn from the up faulted northeastern block). The southeastern end of the high grade zone is the only gradational boundary and is defined by high grade mineralisation becoming less continuous.

- o The high grade zone is approximately 150m long and 30m wide on the surface as its widest point.

- o Any further structural control on high grade mineralisation is unclear and the high grade zone has been modelled as a stratiform body.

Geostats

- o There is a significant discrepancy between the Au assays of Frontier's supplied certified gold standard (Geostat G905-6). The certified value for the standard by fire assay is 5.96 g/t (standard deviation 0.26) yet 26 assays of the standard by Burnie

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Research Laboratories consistently assayed 10% below this averaging 5.34 g/t with a standard deviation of 0.02. This discrepancy raises into question all of Frontier's drill core and channel sample Au assays.

- There is only a moderate correlation between Au and Bi in the high grade zone with a correlation coefficient of 0.39. For this reason the resource should be seen as a primarily gold deposit with Bi (and Ag) credits.

- High grade outliers of Au, Bi and Ag have been dealt with by top cutting to 25g/t Au, 15,000 ppm Bi and 22g/t Ag.

- Variography, using a correlogram on 1m composites, showed similar ranges for each of Au, Bi and Ag. The variogram model shows a low nugget effect of 25%. The variogram shows a strike of 135º in the z plane, 0º in the x plane and 0º in the y plane with a short range structure with a range of 28m and an overall range of 55m.

Block model

- A block with parent cell size 10m (North) x 10m (East) x 5m (RL) with sub-blocks of 1.25m x 1.25m x 1.25m was constructed.

- Grades were estimated into blocks using ordinary kriging. 3 passes were used with a minimum of 12 samples and maximum of 30 samples in each pass. The first pass had a search ellipse of 30m x 8m x 8m, the second 60m x 16m x 16m and the third 120m x 32m x 32m.

- An overall average bulk density of 2.9 g/cm3 calculated from 84 ore samples measured by the water immersion method was used in determining tonnages.

Recommendations

- A prime recommendation is to address the apparently consistently inaccurate assay results for Frontier's supplied gold standard included in batches of drill core and channel samples assayed at Burnie Research Laboratories. There is a very strong possibility that all such drill core and channel sample assays may be undercalled by 10.5% in which case the gold grade of the resource would be elevated by the order of 7% to 9%. This work should be done regardless of whether any other recommendations are accepted and actioned.

To increase the status of the resource estimate from inferred to indicated the following work is required.

- Drilling density needs to be increased to 12.5m sections using current fan geometry with additional angled holes collared northeast of the thrust and drilled southwest to intersect the high grade zone on its northeast limb.

- Surface trenching should be carried out in all areas of outcrop again ideally on 12.5m sections.

- Further channel sampling should be carried out in the old workings to achieve a greater density of sampling. Both walls of drive should be sampled and both horizontally and vertically, ideally achieving a 2m x 2m mesh across all exposures.

- Drillhole collars and channel sample locations have been surveyed by a range of relatively inaccurate means and require conventional surveying.

- The surface DTM has a large component which has been determined by GPS surveying and needs to be surveyed by conventional means.

- Field duplicates of existing half core from previous drilling programmes should be obtained from Mineral Resources Tasmania's core store, probably as ¼ core, and assayed.

- Drillhole and channel assays have seen very limited field duplicates and a low percentage of in-house laboratory duplicates.

- All core should be re-logged and surface exposures should be mapped with a foci on (1) mineral assemblage control and Au and Bi mineralisation and (2) geological structure in order to understand the structural control on mineralisation and for geotechnical purposes."   (MacDonald, 2009)

Tons and grade figures at a range of gold cut-offs are listed in table 2.2.

| Table 2.2 Mineral Resource Summary - April 2009 | | | | | |
| Ordinary Kriging Grade Estimates Subdivided by Lower Cut-off Grade | | | | | |
Lower Cut-off Grade Au (g/t)	Resource Category	Tonnes (t)	Au (g/t)	Bi (ppm)	Ag (g/t)
0.5	Inferred	124300	3.65	2588	3.35
1	Inferred	112500	3.94	2718	3.41
1.5	Inferred	91400	4.57	3037	3.52
2	Inferred	75500	5.16	3175	3.32
2.5	Inferred	63200	5.72	3414	3.38
3	Inferred	54400	6.22	3531	3.39
3.5	Inferred	50800	6.43	3609	3.34

A number of deficiencies in the data, including geological, used in this estimation have been noted earlier. In summary the main aspects which carried the greatest risk can be seen in hindsight to have been the poor locational accuracy of the old workings and drillhole collars and the undercalling of gold assays by 10.5%.

3.0   Geological setting

3.1   Introduction

The current understanding of the geology, whilst still incomplete, is further advanced than that utilised in the 2009 work due largely to the benefit of a further 31 drillholes. This understanding builds on the geological work which preceded it, i.e. government geologists Scott (1929), Broadhurst (1934), Keid (1943) and Broadhurst (1934), and industry geologists Roberts (1987), Fleming (1988), Castro (1990), Newnham (1996 & 1997) and Purvis (2000).   Academically the deposit has been the subject of two Honours theses Taylor (1990) and Cockerton (2011) and the Economic Geology paper of Amy Cockerton and supervisor Andrew Tomkins (Cockerton and Tomkins, 2012).

The new geological work carried by Frontier geologists since the 2009 work consists of logging all new holes as well as some mapping in the old workings. That work has been largely carried out by the author with assistance by graduate geologist Chris Thaus.

3.2   Project geology - regional

Cambrian volcanics and associated sediments of the Mt. Read Volcanics, Ordovician sediments of the Denison and Gordon Groups and the Devonian Dolcoath Granite form the basement geology to the licence area and are the host and/or source of all known hard-rock mineralisation. These rocks are obscured over a significant portion of the licence by a thin veneer (<25m based on drilling) of unconformably overlying Tertiary basalt and lesser, commonly basal, sediment including clays (see figure 3.1)

Structurally the Cambrian-Ordovician sequence is gently folded about an east-west trending F1 syncline whose axis corresponds broadly with the path of the Lea River within the licence area and thus passes to the immediate north of Stormont. Superimposed on this F1 fold are northwest trending sub-horizontal F2 folds with wavelengths around 150m. Both episodes of folding occurred in the Middle Devonian Tabberabberan Orogeny. F2 folds formed later in the orogeny and parallel to and apparently associated with southwest verging thrust faulting. Northwest to north-northwesterly strike slip faults are also common and probably postdate thrusts. Late in the orogeny the Dolcoath Granite intruded into this faulted and folded terrane.

The Cambrian rocks are generally obscured by the overlying Ordovician and only outcrop in windows in the region. The rocks consist of crystal rich sandstones and rhyolitic volcanics and volcaniclastics typical of the uppermost Mt. Read Volcanics unit, the Tyndall Group.

These volcanics are unconformably overlain by the lowermost unit of the Ordovician sequence exposed in outcrop and drilling within the licence area, the Roland Conglomerate, a siliciclastic quartz pebble conglomerate of 10-20m thickness. This unit is conformably overlain by the quartzose Moina Sandstone which is ~200m thick. This unit is conformably overlain by a thin, approximately 40m thick sequence of interbedded calcareous siltstone with lesser calcareous sandstone and limestone known informally as the "Transition Beds". These three units together constitute the Denison Group. The "Transition Beds" are conformably overlain by the Gordon Limestone which is approximately 400m thick regionally. In the Stormont area the basal part of the Gordon Limestone (of the Gordon Group) is a pyritic black clay (see discussion below).

Regionally the Cambrian-Ordovician sequence has been intruded by the Middle-Devonian Dolcoath I-type Granite with formation of a number of discrete skarn type orebodies within the "Transition Beds" or basal Gordon Limestone units. Known skarn bodies consist of the Shephard and Murphy fluorite skarn, Hugo skarn, Fletchers Adit and Ti Tree Creek skarns. Within the Stormont RL the granite is not exposed in outcrop or drill core but is believed from gravity data to underlie the licence at a depth of <500m with a westwards trending ridge extending from the granites outcrop on Dolcoath Hill.

The Tertiary cover is apparently largely sheet-like with commonly a basal clay or gravel base overlain by basalt.
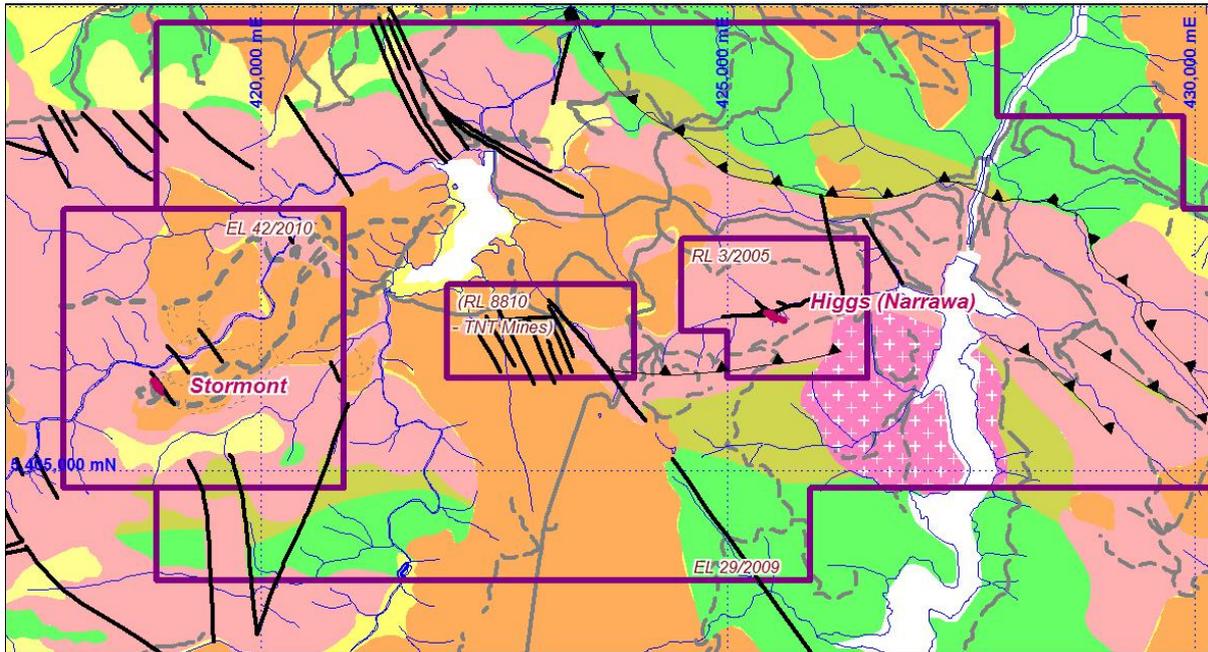
Figure 3.1: Moina Project area geology (legend in figure 3.2)
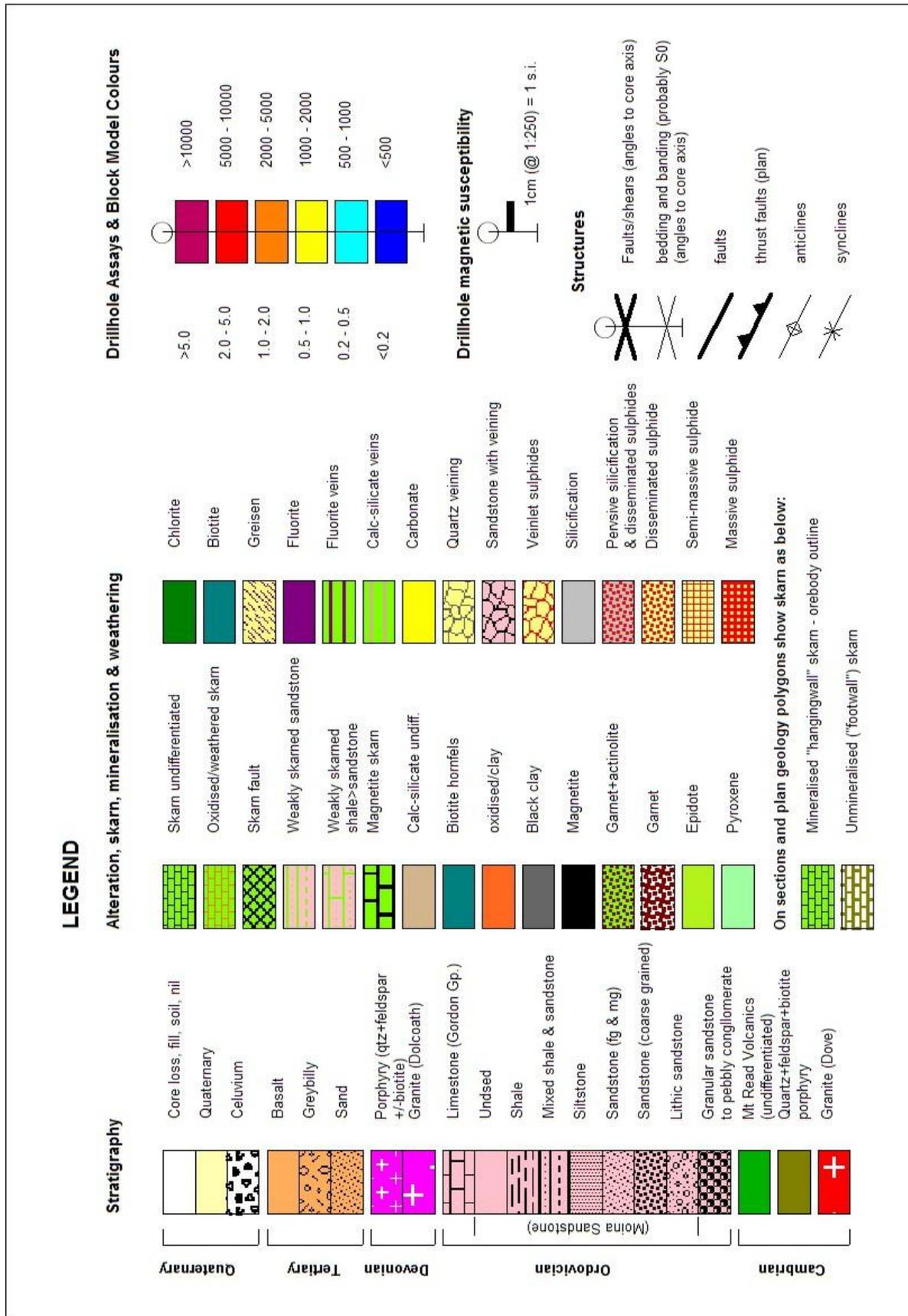
Figure 3.2: Legend for figures 3.1 and 3.4, sections 3.5 to 3.17, 3.23 to 3.35 and 10.3 to 10.28.

3.3 Deposit Geology

3.3.1 Introduction/Summary

The Stormont Au+Bi deposit is a skarn type orebody with gold and bismuth mineralisation hosted in a dominantly garnet+actinolite+/-magnetite +/-epidote+/-pyroxene skarn assemblage.

Skarn type mineralisation is formed by the alteration of precursor carbonate minerals to calc-silicate minerals by hydrothermal fluids derived from granitic intrusions at depth.

The precursor rocks to the skarn are interpreted by some workers (Newnham, 1993 and Reid, 2009) to be a unit of calcareous sandstones and finer sediments known informally as the Transition Beds, lying stratigraphically between the underlying Moina Sandstone and overlying Gordon Limestone. The informal Transition Beds name is due to the rocks being transitional between sandstones beneath and limestones above.

Earlier workers (Fleming, 1988) interpreted the skarn as replacement of more pure limestone at the base of the Gordon Limestone.

There are no recognisable gritty intervals (such as in the host rocks to the Higgs deposit interpreted as Transition Beds) though stratiform zonation of skarn mineral assemblages, particularly magnetite bearing, suggests an in-homogeneity in sediment and thus at least part of the skarn is hosted in impure limestone.

This debate is essentially an academic one of where to place the base of the Gordon Limestone stratigraphic unit in the area. The interpretation used herein is that the host to the skarn is the Transition Beds.

In the Stormont deposit the skarned rocks lie in the core of a sub-horizontal southeast-northwest trending F2 syncline where they have been preserved from erosion. The deposit lies near the axis of the much broader F1 syncline and hence the F2 fold is sub-horizontal in the immediate Stormont area.

Gold and bismuth mineralisation is intimately associated with gold occurring largely as free gold but with a minor amount in maldonite. Bismuth occurs largely as bismuthinite and native bismuth. Most mineralisation occurs as disseminations associated with garnet and retrograde minerals such as actinolite.

Economic gold and bismuth mineralisation is found stratiform and stratabound in the stratigraphic upper half of the overall skarned sequence with the lower half characterised by a somewhat different assemblage of calc-silicate minerals and with generally low gold and bismuth values apart from adjacent to the Stormont Adit Fault on the deposits northeastern margin.

Mineralisation is spatially associated (in part) with the north-northeast striking, ~70° southwest dipping Stormont Adit Fault, a single fault or series of fault elements, which passes along the northeastern limb of the syncline. Hydrothermal fluids from the Dolcoath Granite at depth have apparently utilised this fault as plumbing.

Mineralisation is asymmetric with respect to the fault with mineralisation on the southwest side of the fault extending between 20m and 30m away from the fault whilst on the northeastern side of the fault mineralisation extends no further than 10m from the fault and generally much less than this. This is in spite of the skarn sequence on either side of the fault being very similar.

Mineralisation is also associated to some degree spatially with the Stormont Thrust, a poorly understood fault, which has a similar strike but dips moderately(?) to the northeast. Some previous workers interpreted this structure to be the main fluid pathway but this interpretation is questioned by subsequent drilling and this fault is now considered to not be a significant control though it probably existed pre-mineralisation. Its position with respect to mineralisation is possibly simply

coincidental. Figure 3.3 shows the geology of the Stormont deposit in plan view. Figure 3.2 is the legend for this plan and the subsequent sections in figures 3.5 to 3.17, 3.23 to 3.35 and 10.3 to 10.28.

Figure 3.3: Mineralised skarn from channel FRSTC03 (sample# 434513) included in resource estimate – channel sampled 1.2m @ 13.5g/t Au, 9g/t Ag and 0.49% Bi. Pink garnet, green actinolite, light green hedenbergite and dark magnetite.
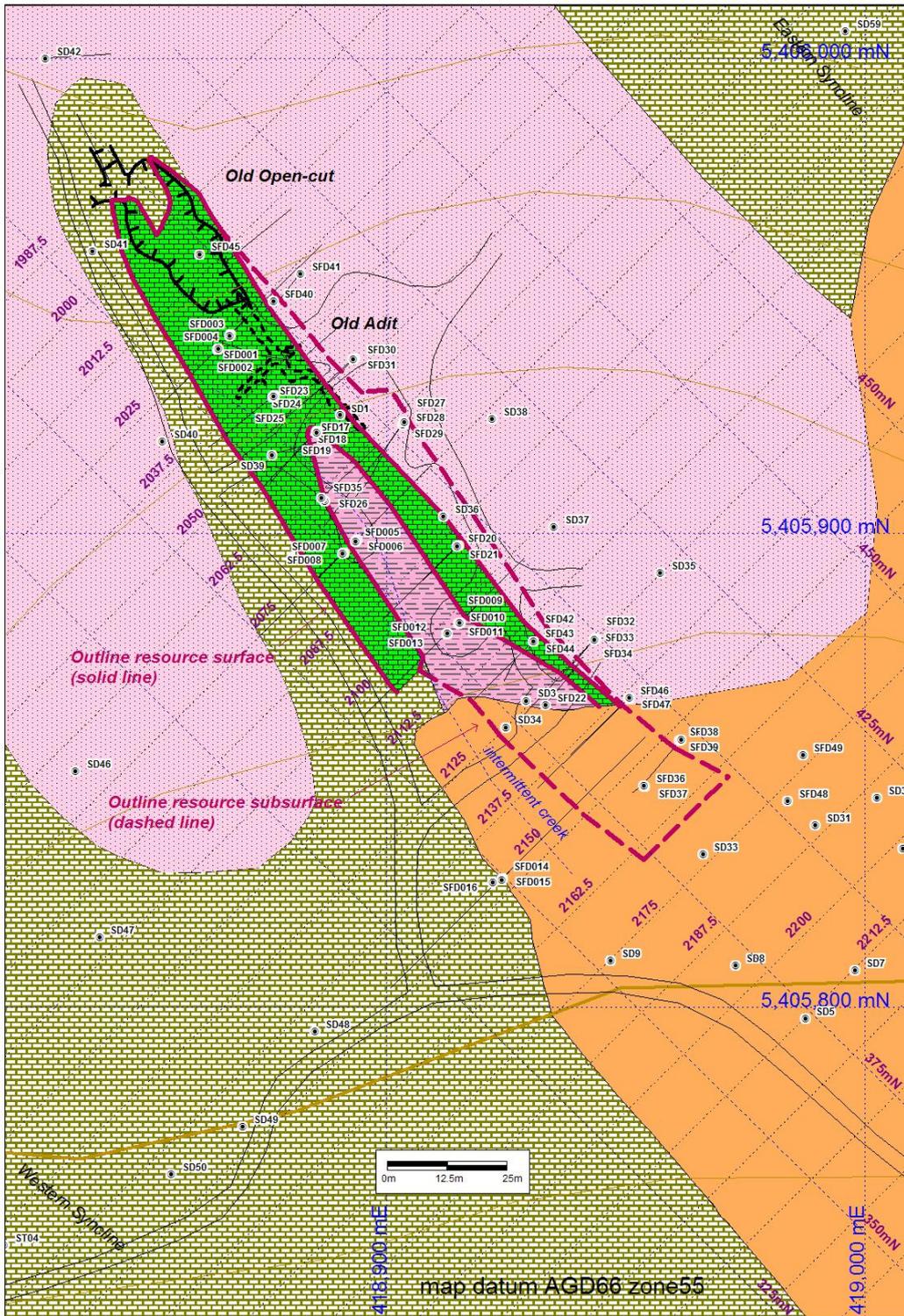
Figure 3.4: Geology of the Stormont Au + Bi deposit showing drillhole collars and traces, resource outline (surface and subsurface), , old workings, access, contours (10m contours), section lines and geology (legend in figure 3.2).
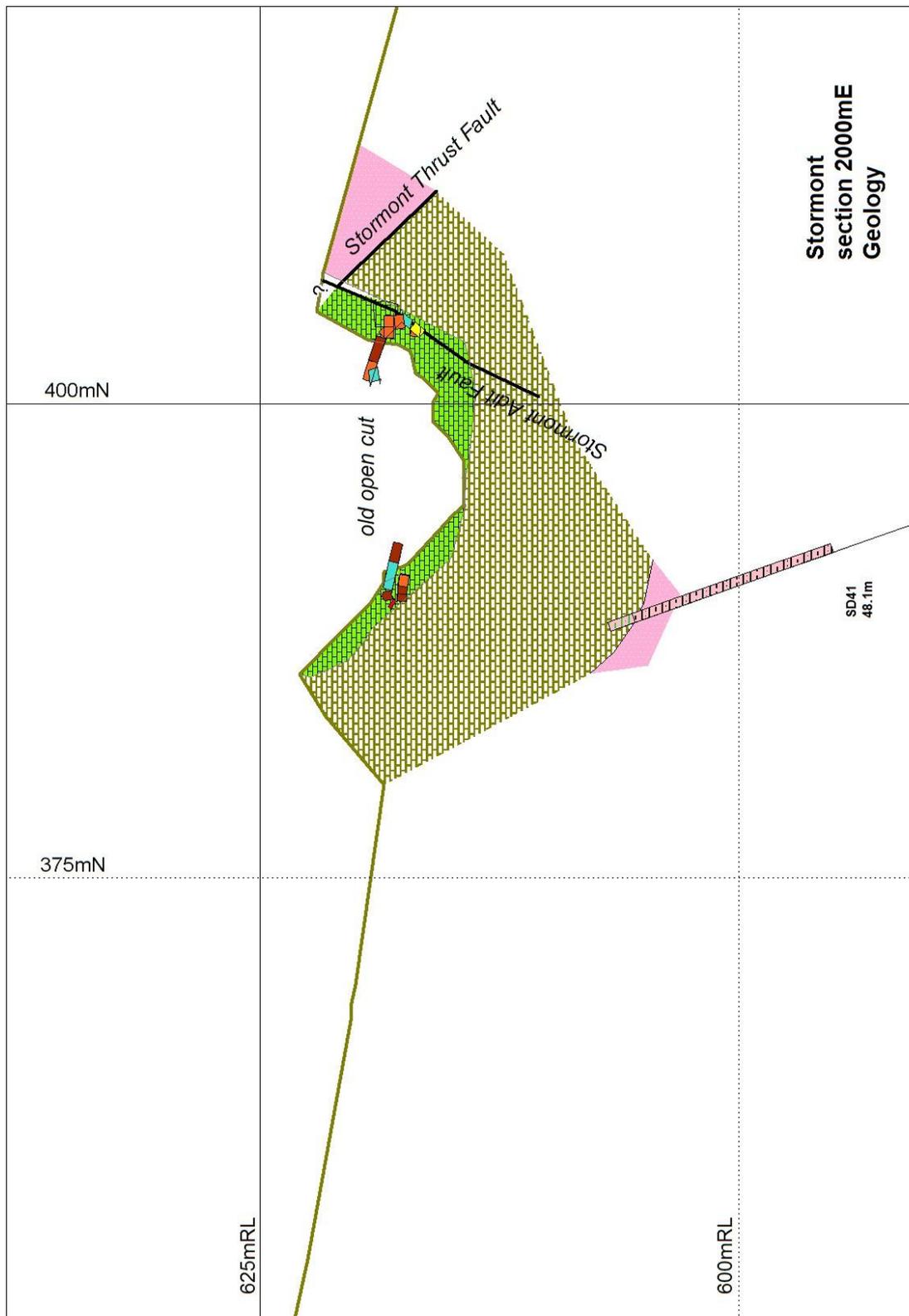
Figure 3.5: Stormont section 2000mE+/-6.25m – geology and gold grades.

Figure 3.6: Stormont section 2012.5mE+/-6.25m – geology and gold grades.
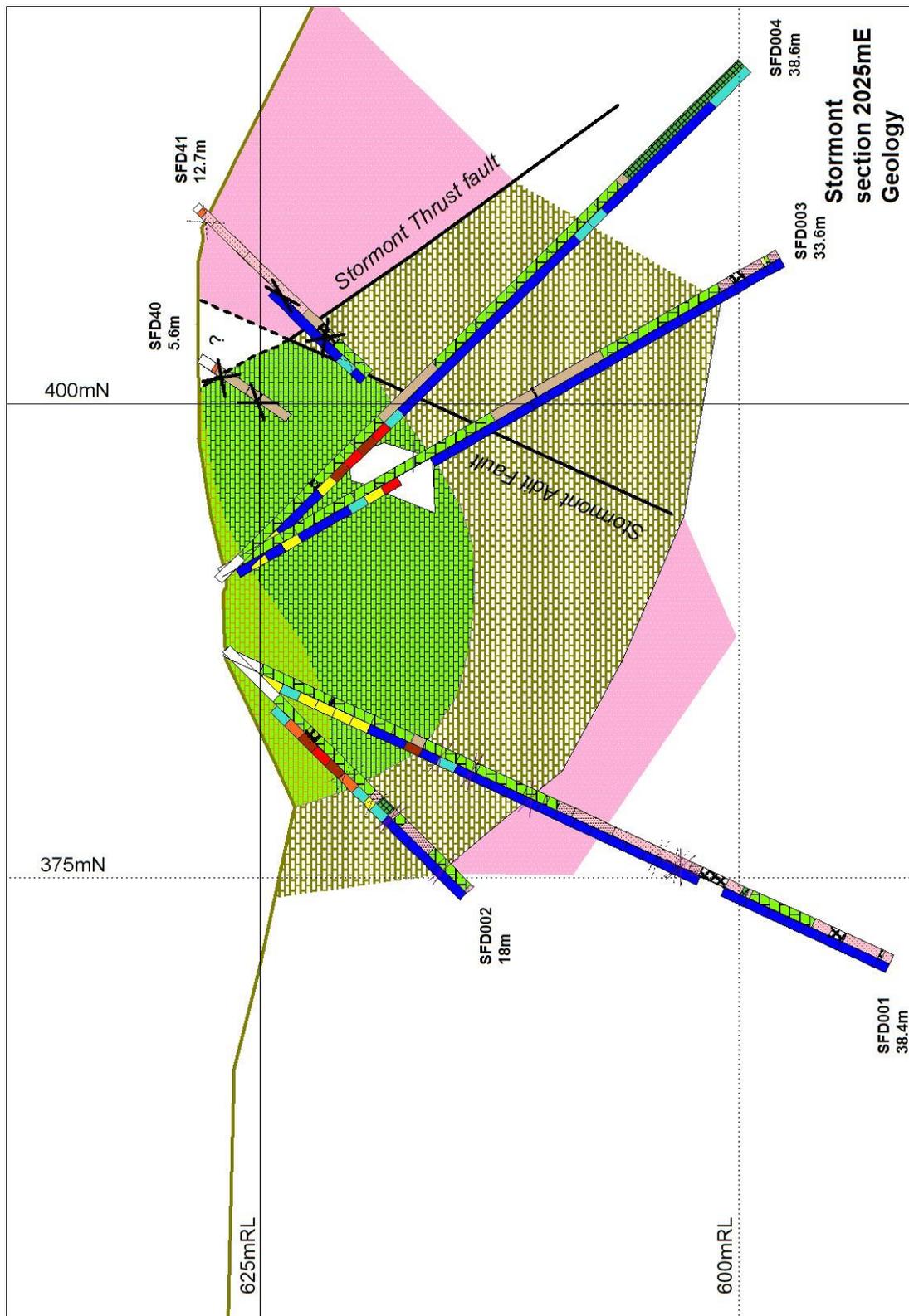
Figure 3.7: Stormont section 2025mE+/-6.25m – geology and gold grades.
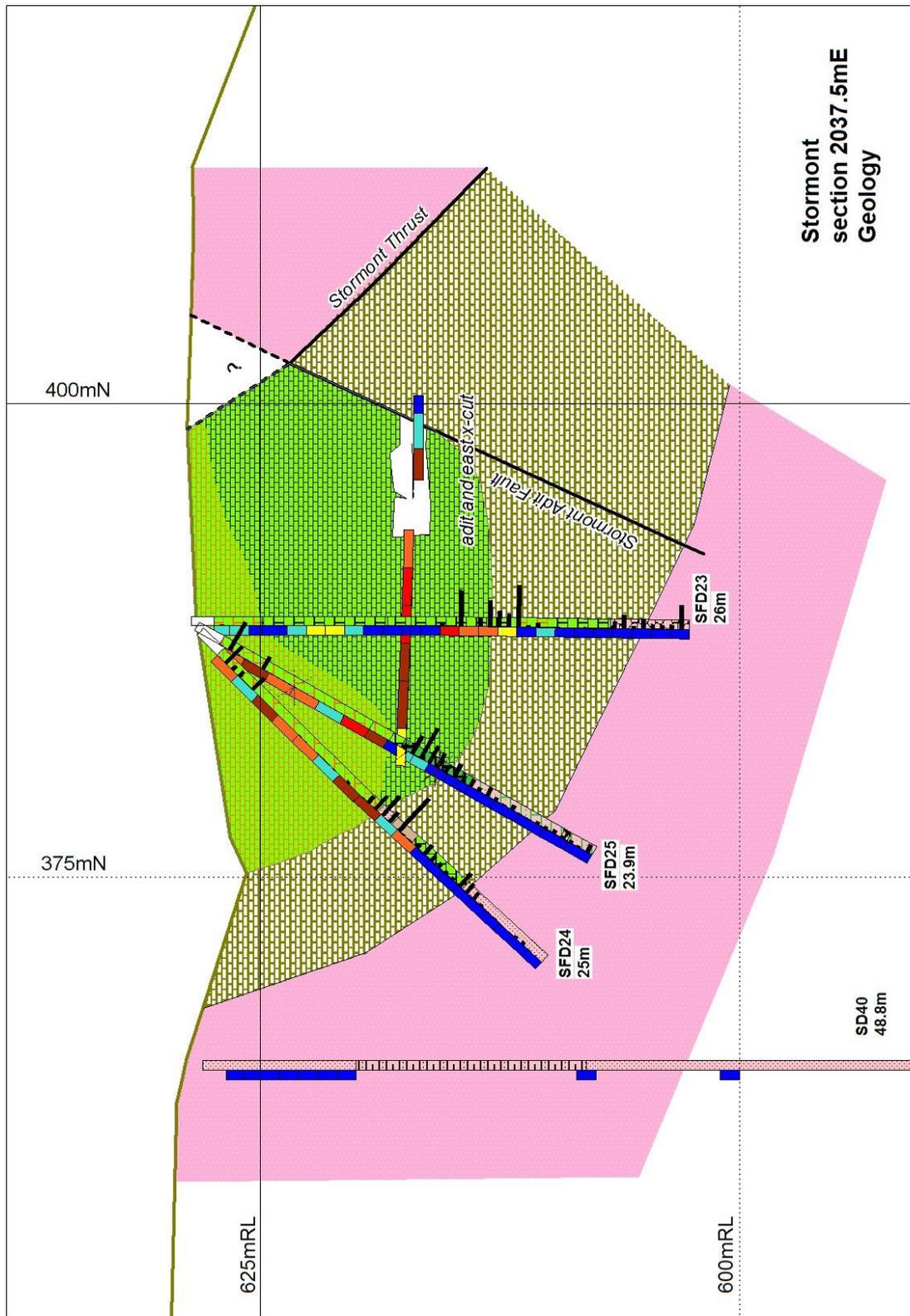
Figure 3.8: Stormont section 2037.5mE+/-6.25m – geology, magnetic susceptibility (SFD23-25) and gold grades.
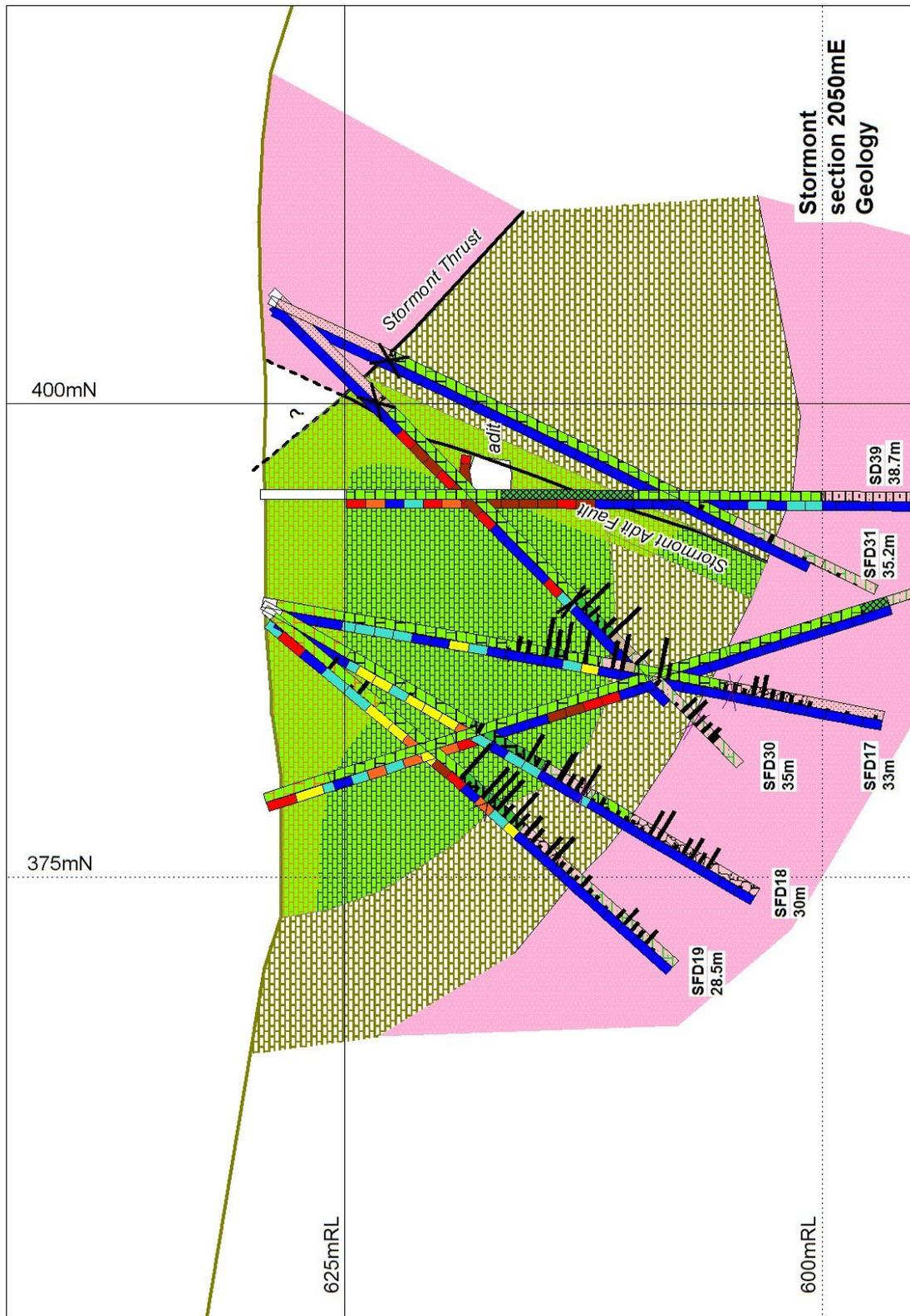
Figure 3.9: Stormont section 2050mE+/-6.25m – geology, magnetic susceptibility (SFD17-19 & 30, 31) and gold grades.
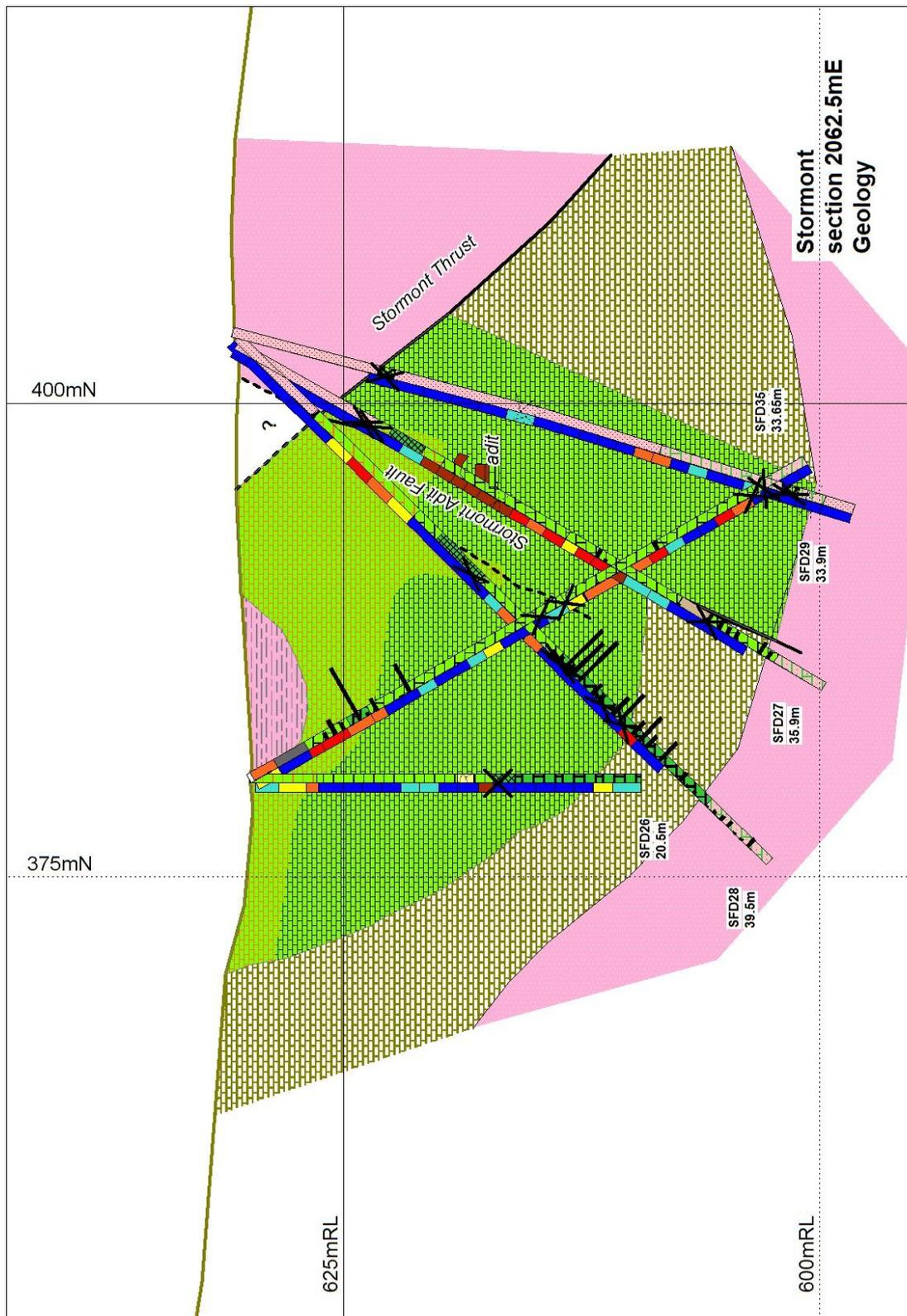
Figure 3.10: Stormont section 2062.5mE+/-6.25m – geology, magnetic susceptibility (SFD27-29 & 35) and gold grades.

Figure 3.10: Stormont section 2062.5mE+/-6.25m – geology, magnetic susceptibility (SFD27-29 & 35) and gold grades.
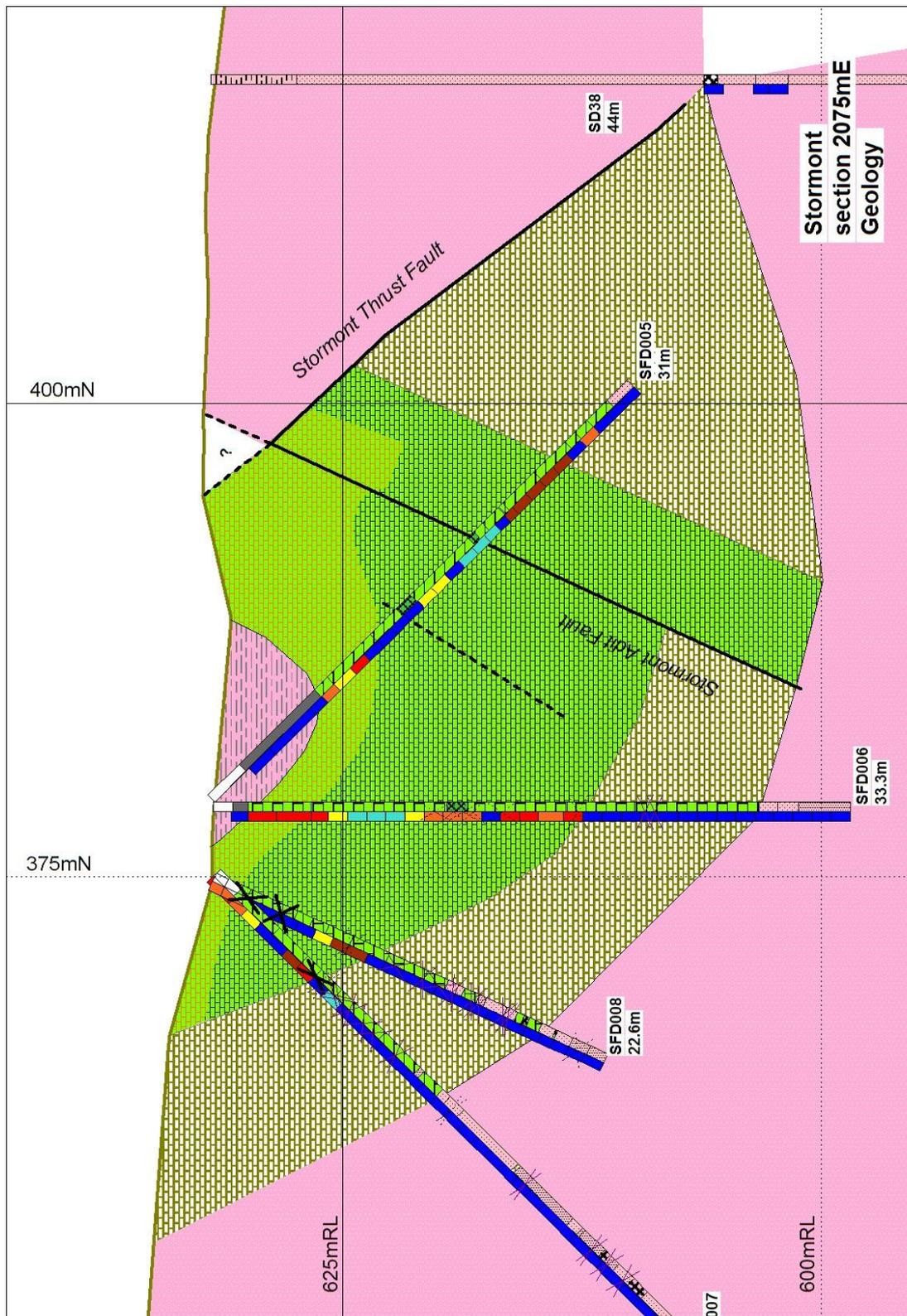
Figure 3.11: Stormont section 2075mE+/-6.25m – geology and gold grades
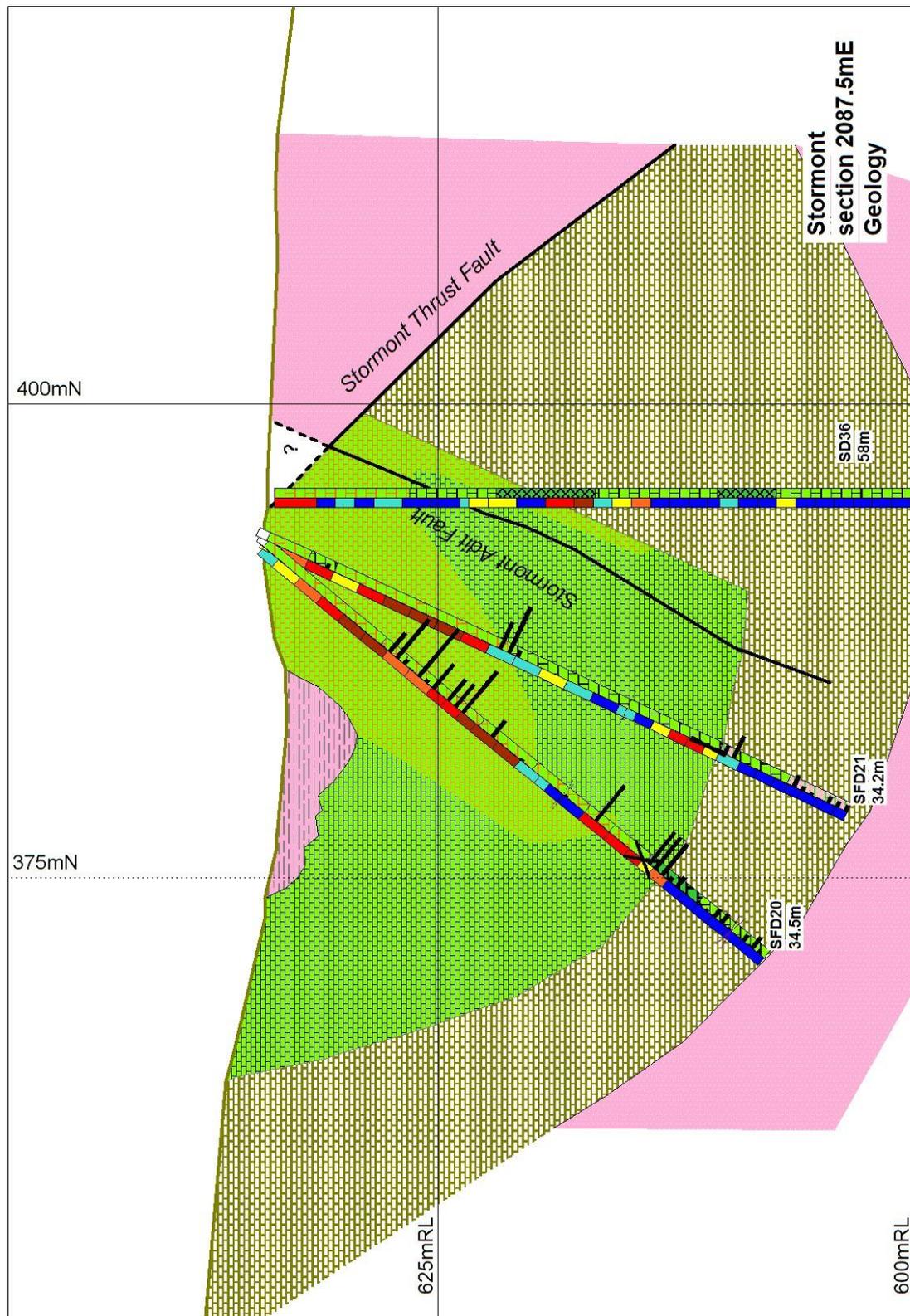
Figure 3.12: Stormont section 2087.5mE+/-6.25m – geology, magnetic susceptibility (SFD20 & 21) and gold grades.
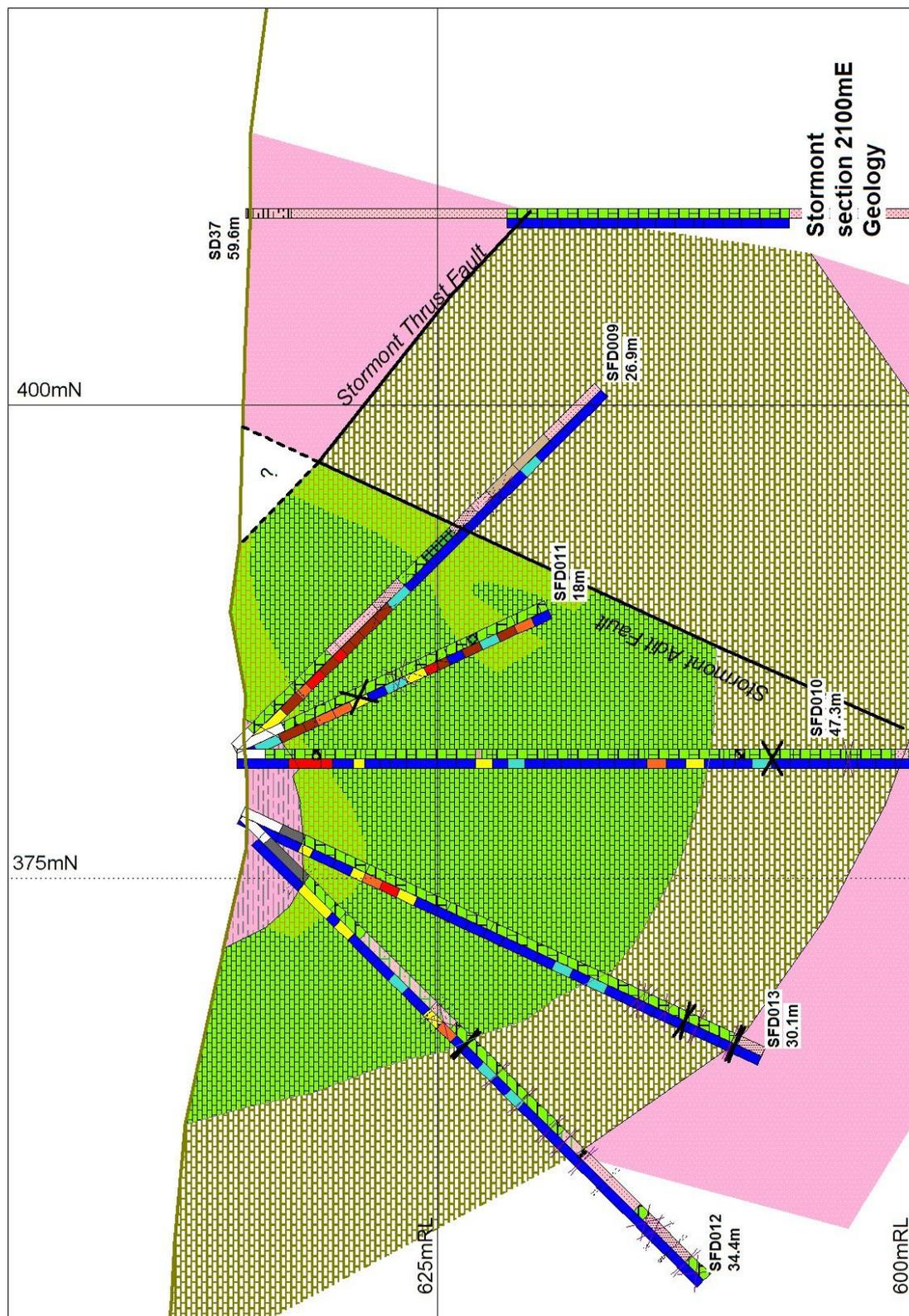
Figure 3.13: Stormont section 2100mE+/-6.25m – geology and gold grades
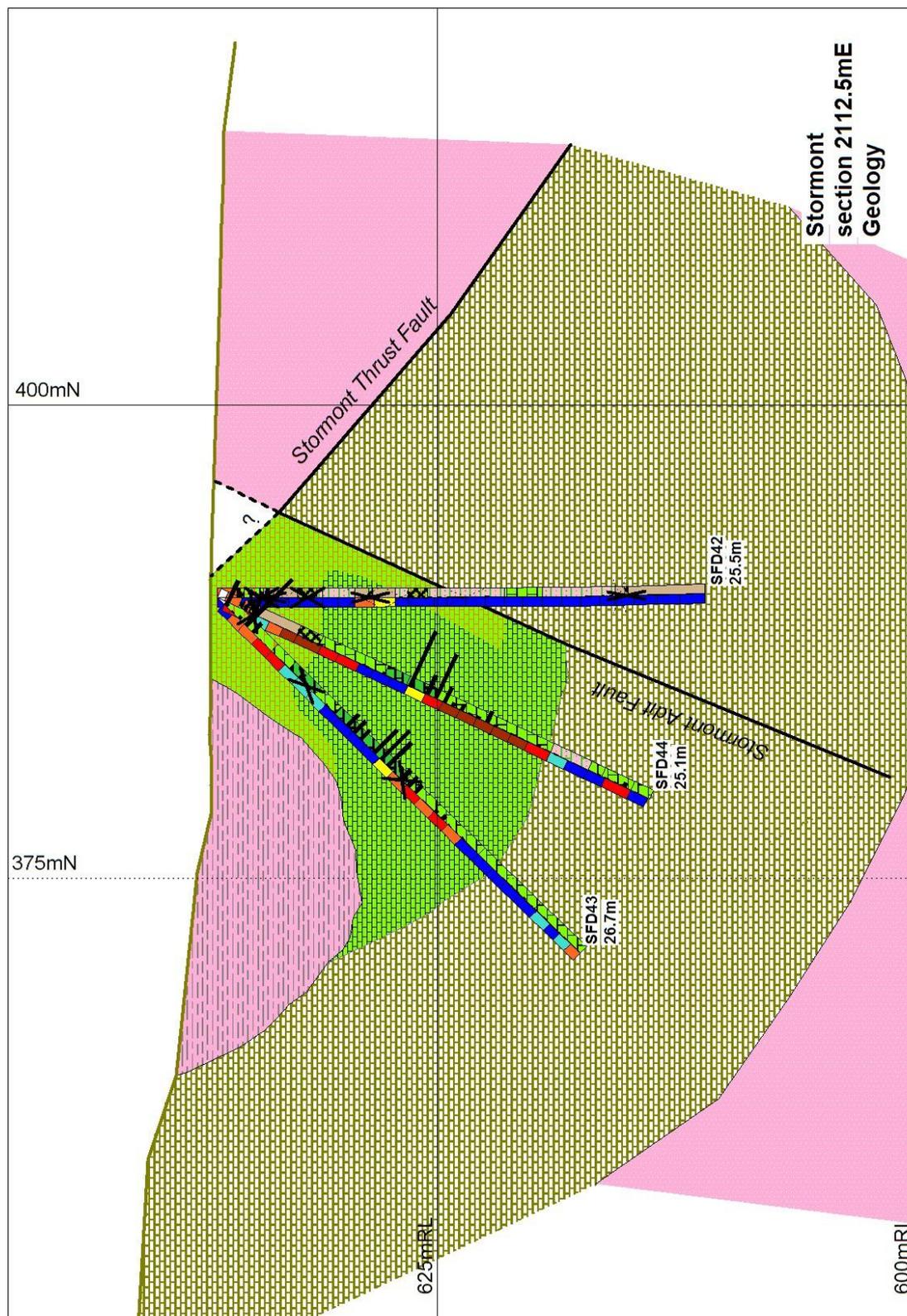
Figure 3.14: Stormont section 2112.5mE+/-6.25m – geology, magnetic susceptibility (SFD42-44) and gold grades.
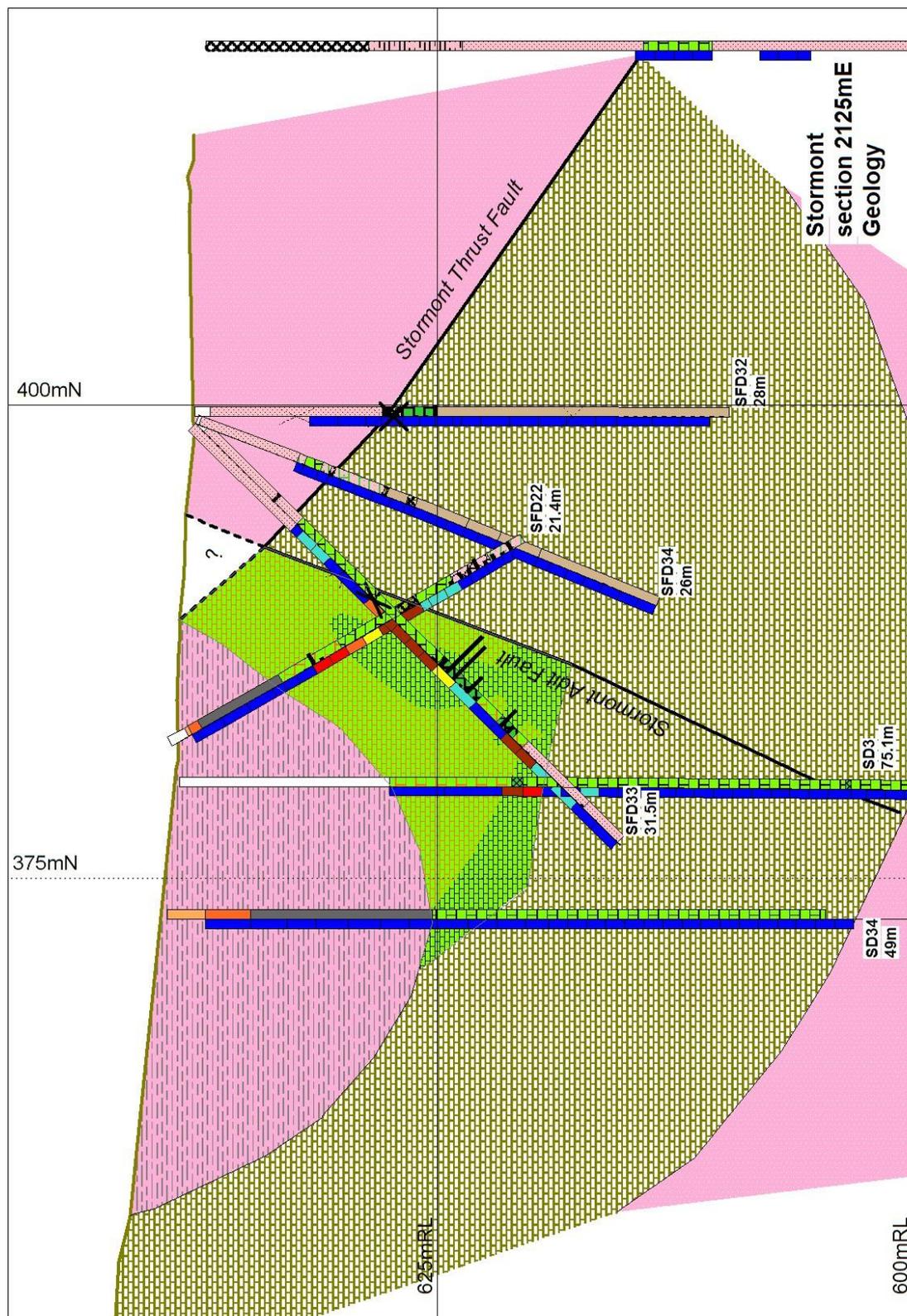
Figure 3.15: Stormont section 2125mE+/-6.25m – geology, magnetic susceptibility (SFD22 & 32-34) and gold grades.
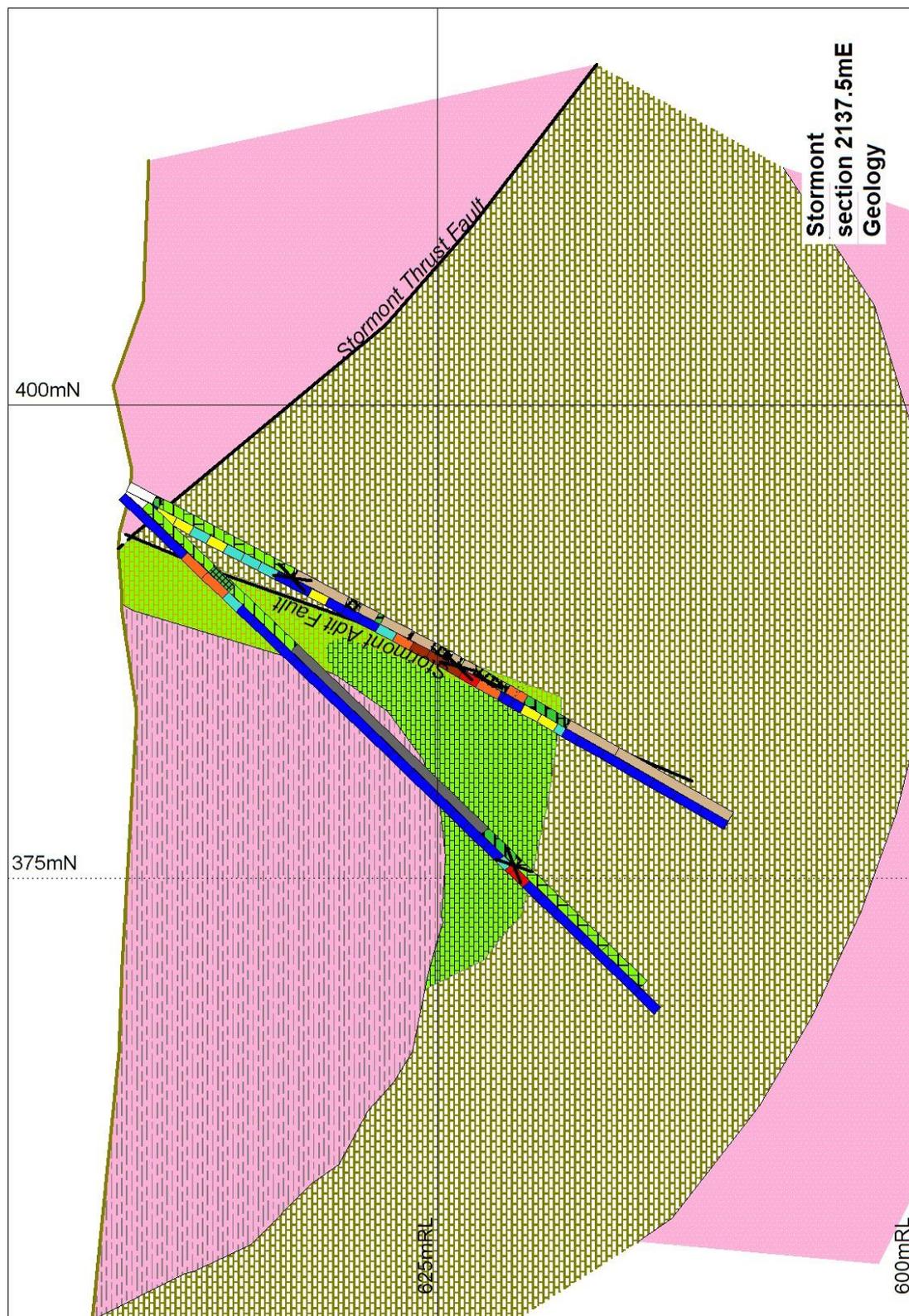
Figure 3.16: Stormont section 2137.5mE+/-6.25m – geology and gold grades.
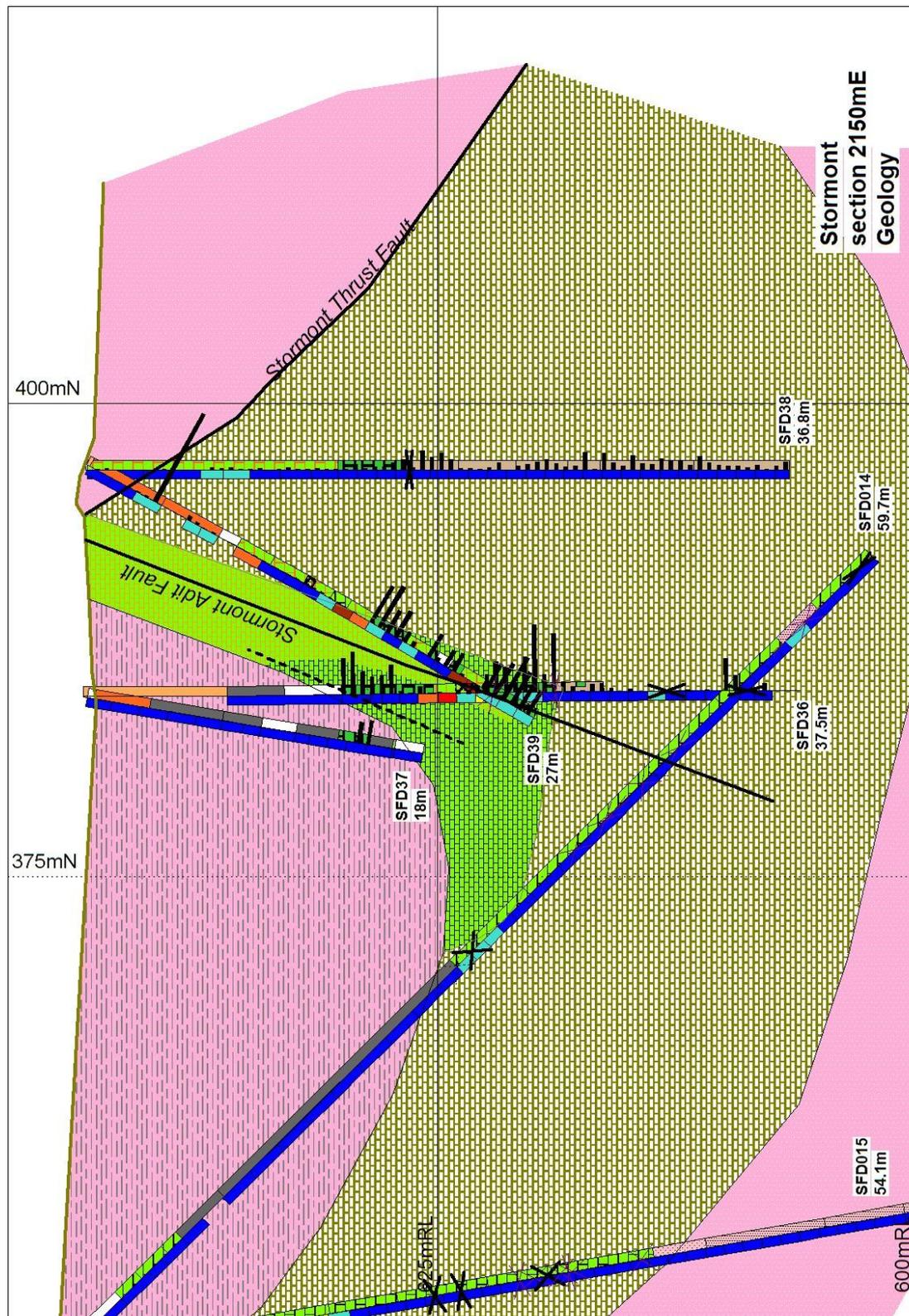
Figure 3.17: Stormont section 2150mE+/-6.25m – geology, magnetic susceptibility (SFD36-39) and gold grades.

3.3.2 Stratigraphy

The Stormont deposit lies on and near surface, outcropping for the most part, the exception being in the southern part of the deposit where a thin layer of Tertiary basalt (and possible basal Tertiary clay?) unconformably overlies mineralised skarn.

The central part of the orebody is covered by a unit of stratigraphically overlying black mudstone which is intersected in the core of the syncline southeast of 2075mE (though it must pinch out at 2050mE). In most intersections the unit appears as a black decomposed mud with occasional euhedral pyrite grains, however, there are also irregular shaped lighter grey shale and rare patches described as skarn. In SFD37 a short section of magnetite skarn may be included near the unit's base though in this latter case other alternative fault related explanations exist.

In many instances mineralisation is found in skarn immediately underlying the base of this unit even in holes otherwise poorly mineralised. It appears that the mudstone has acted as an aquiclude during mineralisation as well as itself being generally unfavourable for skarn formation.

The contact between the mudstone and the underlying skarn parallels the synclinal fold and is likely conformable. The exception to this is the area on the northeastern limb at its southern end where the Stormont Adit Fault appears to verge into this contact and truncate the shale on the folds eastern limb.

It is unclear whether to assign this shale unit to the Transition Beds or overlying Gordon Limestone from a stratigraphic perspective but for practicality herein it is considered to be the basal unit of the Gordon Limestone.

Conformably underlying the mudstone are the now skarned Transition Beds, a unit of calcareous sandstones and siltstones of ~35m thickness. It is this unit in which gold+bismuth mineralised skarn is found.

In the 2011/2012 drilling programme almost all holes intersected this sequence within the mineralised and altered envelope and while the skarn assemblages show clear stratiform zonation as detailed below there is little which can be said about the skarned rocks sedimentologically and texturally as they are completely replaced for the most part. There are no obvious coarser grained beds as seen in rocks occupying a similar/same stratigraphic position at Narrawa Creek. Irregular lenticular podlike with commonly a wavy "paisley" shaped domainal, discontinuous "banding" in calc-silicate+magnetite+/-actinolite+/-epidote skarn may be strata-controlled without directly reflecting bedding.

More weakly skarned sandstones beneath the skarned zone are commonly hornfelsed, massive and non-descript.

The base of the skarned sequence is commonly defined by an interbedded shale in sandstone unit which lies in the upper part of the massive quartz sandstone dominant Moina Sandstone, a unit of ~400m thickness. The shale is interbedded with the sandstone on a centimetre to decimetre scale and shows some evidence for soft sediment deformation though again texturally overprinting calc-silicate alteration obscures contacts.

3.3.3 Skarn Alteration/Mineralisation

Skarns in general can consist of a wide range of calc-silicate minerals with both prograde and retrograde alteration minerals overprinting precursor lithologies. The following calc-silicate and oxide minerals are present variably in the Stormont deposit: grandite (a garnet intermediate in the grossular-andradite series), hedenbergite (a clinopyroxene), actinolite, epidote, magnetite, quartz, calcite, chlorite, fluorite. Metal minerals present are native bismuth and bismuth sulphides

(bismuthinite, protojoseite), gold, minor maldonite, pyrite, pyrrhotite, sphalerite, galena and chalcopyrite).

Although chaotic at the small scale at least some the skarn mineral assemblages at Stormont display a recognisable broadly stratiform zonation which is mirrored by the location of economic gold and bismuth mineralisation.

Lindsay Newnham (1993), looking at a broader spaced holes on broader spaced sections, simply differentiated the skarn sequence into hangingwall "mineralised" and footwall "unmineralised" zones. Whilst gold+bismuth mineralisation has been intersected in the footwall part of this skarned zone it is generally rare and spotty (aside from adjacent to the Stormont Adit Fault).

Almost all of the resource modelled herein in hosted in the hangingwall "mineralised" zone with the exception being the arguably economic mineralisation around the Stormont Adit Fault where it extends into the footwall stratigraphic zone.

With further infill drilling it is apparent that (1) there is some development of an internal stratbound/stratiform zonation ("onion rings") in the hangingwall "mineralised" skarn with Upper High Grade and Lower High Grade zones separated by a Low Grade zone as shown on sections 2037.5mE to 2112.5mE in figures 3.26 to 3.32 respectively, and (2) that the hangingwall/footwall contact effectively steps up stratigraphically towards the southeast with gold+bismuth mineralisation in the lowermost "onion ring" i.e. Lower High Grade zone weakening in grade to the southeast. This is further explained in section 3.3.5 on mineralised domains. It is important to note that the stratiform nature is not perfect indicating some transgression of mineralisation across beds.

However, the broad concept of a hangingwall "mineralised" and footwall "unmineralised" distinction is valid in the more northern sections but becomes more confused in southern sections due to the dropping off of the Lower High Grade zone and the vergence of the Stormont Adit Fault and the black clay unit.

The hangingwall, mineralised skarn consists of prograde pyroxene (hedenbergite)+garnet (grandite) with retrograde actinolite and lesser retrograde epidote, magnetite, calcite and quartz. It is a massive green to light green rock with irregular domains cm to dm scale of dominantly pale red garnet. See figure 3.3 for an example of outcropping mineralised skarn.

Towards the base of the hangingwall skarn magnetite becomes more common. In parts the magnetite becomes massive and/or wrigglitic.

Gold and bismuth grades persist into the upper part of the magnetite rich zone but die out towards the lower part of the zone.

The footwall, unmineralised skarn is characterised by a lighter colour due to an assemblage of lighter coloured garnet, calcite, epidote and actinolite+/-pyroxene. This rock has been logged by other workers as "calc-silicate". It grades down sequence into dark green quartzite or grey chloritic quartzites with intermittent lighter coloured calc-silicate zones.

In the upper part of the footwall skarn it is common to have numerous veins at ~10/m, 1-20mm thick with internal fabric/zonation parallel to vein walls and consisting of variably, quartz, calcite, feldspar(?), muscovite, magnetite, bismuthinite. These veins have been described by previous workers as "greisen" veins (Halley in Castro, 1990).

The zonation is apparently stratiform and stratabound with banding and contacts irregular but consistent with conformity to S0 in the syncline.

Zonation within the skarn is chaotic with discrete domains of distinct, often almost monomineralic, assemblages over cm to dcm scale. A common domainal pattern is a lensoidal almost "paisley"

shape with a range of assemblages showing this pattern but commonly actinolite with garnet and also magnetite with actinolite.

Recognition of many of the geological phases requires thin section petrology in many instances.

There have been five petrological studies of varying detail and focus i.e. Fander in Roberts (1987), Halley in Castro (1990), Taylor (1990), Bottrill (2009) and Cockerton (2011). An industry petrologist Fander described a single provided section. An industry exploration geologist of some competency Halley was trying to cover all bases in order to learn as much about the skarn to aid further exploration. Bottrill inspected four samples for Frontier's Rob Reid from mineralised skarn. Taylor's Honours thesis was a generalised geological study of three skarns (also Ti Tree Ck and Fletchers Adit) whilst Cockerton's was focused on application of a particular model for the high grading of gold by bismuth scavenging..

Dr Scott Halley (in Castro, 1990) carried out transmitted light petrology on 21 thin sections from skarn samples taken from SD1, 3, 5 & 6. He did not distinguish between hangingwall "mineralised" and footwall "unmineralised" zones. Halley describes at least two phases of mineralisation with an earlier higher temperature prograde assemblage of garnet+pyroxene+calcite overprinted by a later lower temperature retrogressive assemblage of actinolite+epidote+magnetite+/-fluorite.

> "The Stormont deposit shows a typical skarn paragenesis. It has a primary skarn assemblage of garnet+pyroxene, with variable amounts of interstitial calcite. This has been overprinted by a retrograde assemblage of hydrous minerals, namely actinolite+epidote along with magnetite and minor fluorite. In turn, this stage has been overprinted by late stage veining which contains minor amounts of sulphide.

> The primary skarn contains clots of coarse-grained reddish-brown garnet within massive fine-grained olive-green diopside. Short intervals of skarn may be mono-mineralic. In places the skarn exhibits a distinct banding, with bands of garnet contained within massive diopside. This banding may reflect relict banding although it is not clear whether it is controlled by variations in original composition or permeability within the limestone. Primary skarns commonly show a zonation outwards from the granite contact or fluid feeder, from garnet to pyroxene to marble. However, no such zonation is evident at Stormont.

> During the retrograde overprint, diopside was the least stable and most easily altered mineral, being replaced by actinolite with minor calcite. During the early stages of retrograde alteration, garnet + actinolite appears to have been a stable assemblage. The retrograde skarn generally occurs as a massive replacement of the primary skarn by actinolite, epidote and calcite. The retrograde skarn is best developed, although not exclusively, at the base of the skarn unit. In many places, the entire thickness of primary skarn is overprinted.

> Magnetite shows a very patchy distribution through the retrograde skarn, with contents locally up to 50%. It occurs from spotty disseminations to thick bands. Much of the magnetite occurs in intricately banded wrigglite. Two types of wrigglite occur, a relatively early formed magnetite+garnet wrigglite, and a later magnetite+actinolite wrigglite. Occasionally, fluorite was observed in the magnetite+actinolite wrigglite, but generally it is too fine-grained to detect. Known examples of wrigglite skarns have more than 10% F e.g. Moina, Mt. Bischoff, Mt. Garnet (Qld.), and Lost River (Alaska), and the Stormont wrigglite most probably is also fluorine-rich. Without thin-section work, it is impossible to be sure of its mineralogy, but it may well also contain minerals such as Fe-Mg micas and vesuvianite.   The actinolite+magnetite wrigglite is cut by later bands of actinolite or epidote.

> Magnetite rich rocks, particularly those with abundant veinlets, commonly show overprinting of actinolite by a later assemblage of quartz+magnetite with chlorite or with green mica.

These rocks are difficult to distinguish macroscopically from the actinolite assemblage as both are dark green and fine-grained.

Abundant, late-stage, thin "greisen" veins cross cut the skarn, particularly the retrograde skarn. These veins contain fluorite and quartz, with conspicuous selvedges of coarse-grained muscovite, and have haloes of magnetite in the adjacent wallrock. They also contain minor amounts of pyrite, pyrrhotite, chalcopyrite, sphalerite and bismuthinite. Late fractures, without veins, also contain alteration envelopes of magnetite. Epidote+calcite+fluorite veins also occur in places.

Assay results indicate a very good correlation between bismuth and gold. Bismuthinite has three main occurrences. Assays indicate Bi levels of 400 to 1000ppm Bi in the wrigglites, although it is usually too fine-grained to detect visually. Visible bismuthinite commonly occurs in the late-stage greisen veins.   The third and relatively limited occurrence, is in garnet+pyroxene skarn with incipient alteration of pyroxene to actinolite. This is the type of mineralisation that occurs in the Stormont Bismuth Mine, where relatively good gold grades are associated with coarse-grained bismuthinite."

Taylor concurred with most of Halley's work seeing clinopyroxene (he describes as salitic) and garnet (and minor vesuvianite?) as the early prograde phase, with actinolite, epidote, magnetite, calcite, quartz and fluorite the early retrograde alteration phase followed by a later retrograde assemblage of chlorite, fluorite, magnetite, calcite, quartz, bismuth minerals (bismuth, bismuthinite) and gold.

Bottrill (2009) used XRD on four samples and polished section petrology on one sample. Samples were from the mineralised zone in holes SFD004 (9.9m), SFD005 (24.8m – with petrology), SFD006 (17.5m) and SFD009 (8.5m). Bottrill describes the rocks to be "calcic skarns. The primary skarns had andradite-diopside assemblages, and have been variously retrogressed to hastingsite amphiboles." XRD shows the presence of carbonates and quartz.

Cockerton (2011) says "the host assemblage consists of actinolite, quartz, calcite, grandite (a calcic garnet), epidote, and a slightly Fe rich member of the hedenbergite-diopside solid solution. Grandite is an intermediate composition in the andradite-grossular garnet solid-solution series". Cockerton's description continues below where reference is made to the location of gold and bismuth in these assemblages.

3.3.4   Gold deportment

Fander (1987) and Cockerton (2011) polished section petrology and associated descriptions are the best work available on gold deportment.

Frontier Resources Ltd supported Monash University honours student Amy Cockerton, from Monash University, to complete a study on the Stormont deposit as a potential case example of the Liquid Bismuth Collector Model (LBCM), a model for the concentration of gold in bismuth saturated hydrothermal solutions.   Amy studied samples from DDH's SFD004, 005 and 006 and gives the most detailed description of the mineralogy of the hangingwall "mineralised" skarn.

"Mineralisation is associated with a variety of silicate, oxide and carbonate assemblages, each of which contains bismuth minerals. The highly variable nature of the skarn has resulted in patchy domains including those dominated by (1) zoned grandite, (2) actinolite+/-magnetite, and (3) calcite+quartz+actinolite+garnet+/-epidote+/-hedenbergite assemblages. The domains range in size from 1 to 2 cm to >20cm long in the drill core samples."

"The ore mineral assemblage includes native bismuth, native gold (with up to 20% Ag), bismuthinite (with up to 8 wt% Pb), galena, an unnamed phase … (Bi4TeS2 with up to 4 wt%

Pb) and minor maldonite (Au2Bi). Bismuthinite is the dominant bismuth mineral followed closely by bismuth."

"Ore minerals are highly concentrated in the garnet-rich domains of the skarn, with lesser volumes in the actinolite-magnetite and the calcite ± quartz ± actinolite ± grandite ± epidote ± hedenbergite assemblages."

(1) Garnet-rich domains (90% garnet) contain abundant bismuth minerals and gold in the interstitial spaces between garnet grains as small (10-80um) accumulations associated with actinolite, quartz and calcite. Garnets show widespread oscillatory zonation with more Al rich cores and Fe rich rims, typical of skarn-type hydrothermal garnet and forms part of the prograde skarn assemblage.

(2) Actinolite+magnetite domains have bismuth minerals and gold in interstices between acicular actinolite (Fe rich, Mg poor) crystals. Gold is visually less abundant in this phase.

(3) Large polymineralic bismuth-rich accumulations are present among calcite+quartz+actinolite+garnet+/-epidote+/-hedenbergite areas of the skarn. The skarn could be considered a combination of the other two associations with the addition of calcite, quartz, epidote, and hedenbergite. However, the characteristics of the grandite crystals are subtly different being more euhedral porphyroblasts within a very fine grained quartz groundmass with calcite+/-epidote+/-fine-grained quartz+/-actinolite replacing the garnet. In some places up to 70% of the original garnet crystal has been replaced by this late stage retrogressive metasomatism. Polymineralic ore mineral accumulations are usually surrounded by quartz, calcite and actinolite.

"Gold occurs in metallic accumulations accompanying native bismuth, bismuthinite, unknown mineral (Bi4TeS2), and galena. The gold is present mostly as silver-rich native gold (with up to 20 wt % Ag) with minor maldonite (Au2Bi). Gold is also found in areas surrounding larger ore mineral accumulations as microscopic specks in microfractures, but is significantly more abundant in the larger polymetallic accumulations.

Bismuthinite dominates the volume of ore minerals sampled, followed closely by native bismuth. Galena is present, but Pb is also incorporated, in trace amounts, within native bismuth, bismuthinite, and unknown mineral (Bi4TeS2)."

Lower formation temperatures (110 – 200) recorded in fluid inclusions support the quartz+calcite assemblage being a late stage formed during retrogressive phase.

Reflected light photographs of polished thin sections show 8 gold grains in the range 5 – 50um with 4 of these 10-20um."

Photomicrographs of gold from Cockerton are reproduced below with her captions.

"Gold occurs in metallic accumulations accompanying native bismuth, bismuthinite, protojoseite (Bi4TeS2) and galena and is present mostly as silver-rich native gold (up to 20% Ag) with some maldonite (Au2Bi) also observed (Fig. 9). Gold is found in areas surrounding larger ore mineral accumulations as microscopic specks, in micro-fractures (Fig. 10A and 10B), but is significantly more abundant in larger accumulations (Fig. 10C and 10D)." Cockerton, (2011)
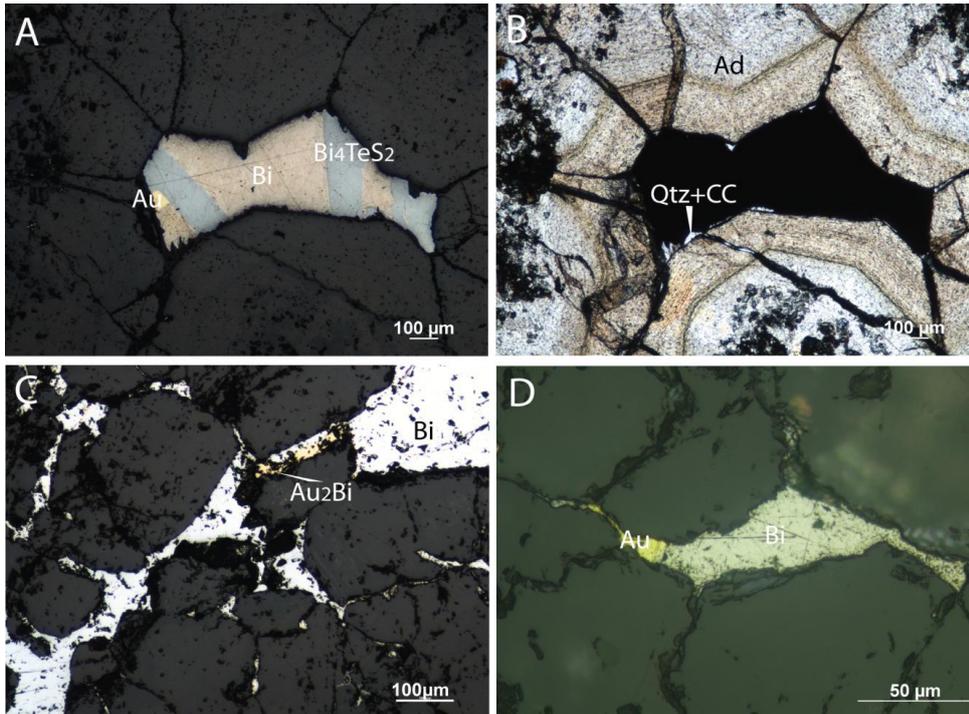
Figure 3.18: "Reflected light photographs of ore minerals between gaps and cracks in garnet. A) Native bismuth, gold and protojoseite in the space between the euhedral, hexagonal form of crystallising andradite. (B) Same as (A) but in plane polarised light, the oscillatory zoning and subhedral shape of the garnets is easily observed, Qtz – quartz, CC - calcite. (C) & (D) Examples of bismuth and gold fill micro-fractures in between andradite grains." (Figure 7 from Cockerton, 2011)
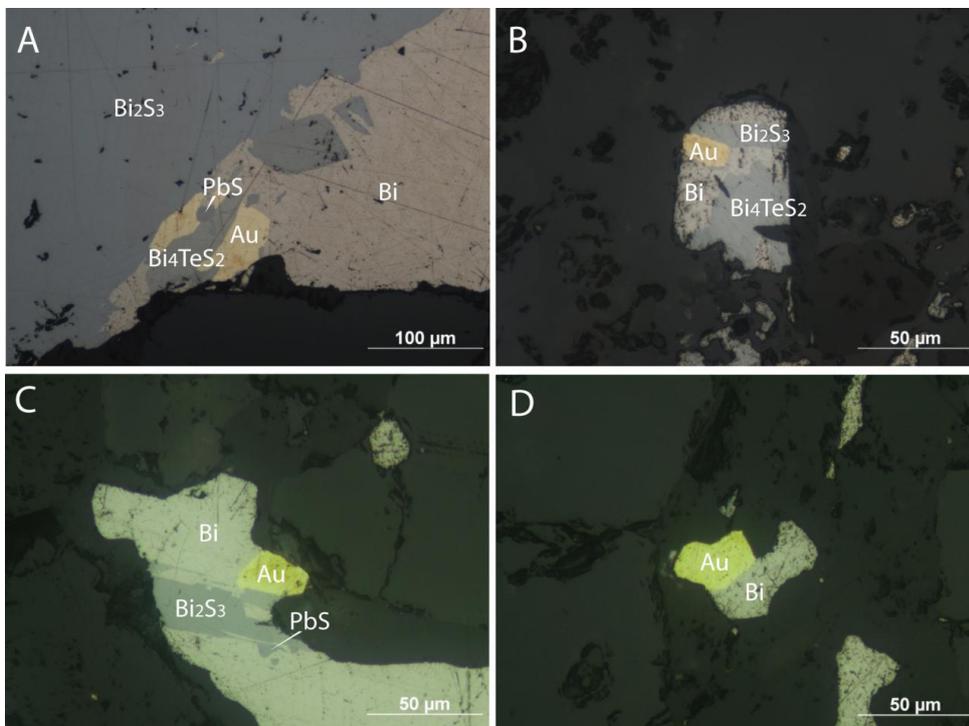
Figure 3.19: "The close textural relationship between native gold and native bismuth. Bismuthinite, galena and protojoseite (Bi4TeS2) may also be present. Photographs are of reflected light under an optical microscope." (Fig. 9 from Cockerton, 2011)
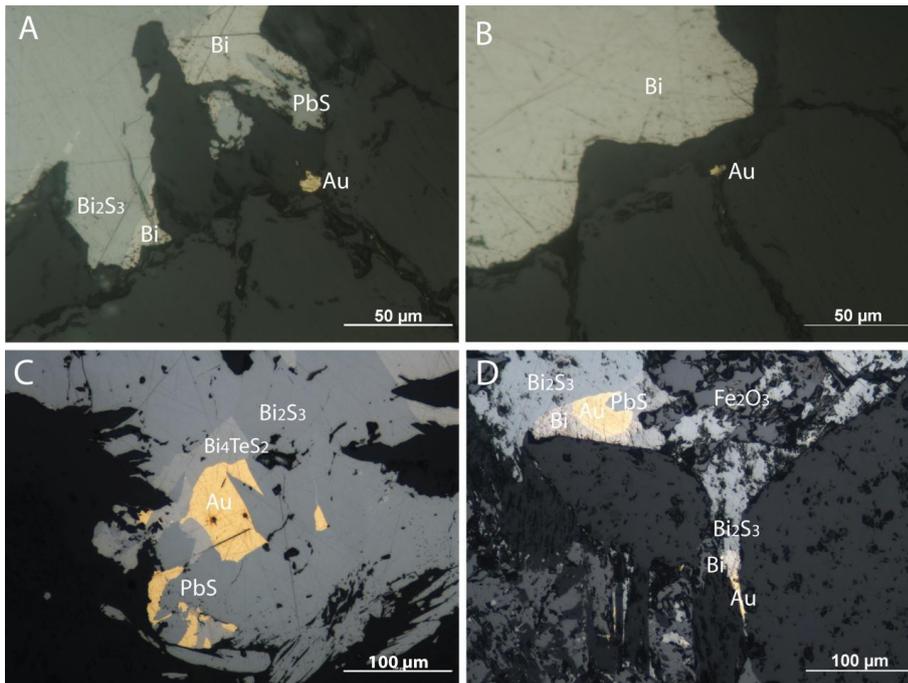
Figure 3.20: "Reflected light photographs of small specks of gold and large ore accumulations. A) and B) gold specks are a distance apart from the major bismuth accumulations in microcracks or fractures and C) and D) gold is located in larger bismuth-dominated metallic accumulations" (Fig. 10 in Cockerton, 2011).
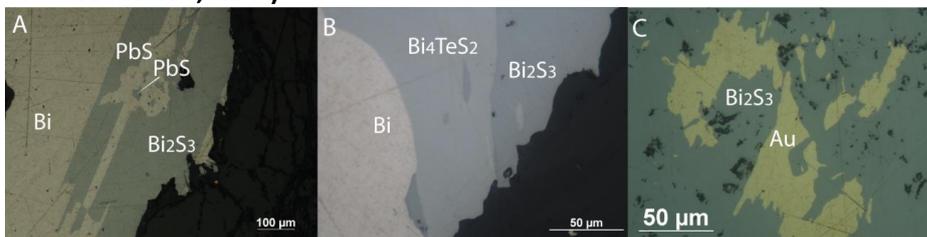
Figure 3.21: "Reflected light photographs of exsolution textures. A) Exsolution lamellae between Bi, PbS and Bi2S3 as well as exsolution globules of PbS, B) A mix between exsolution lamellae and globules between Bi, protojoseite (Bi4TeS2) and Bi2S3, C) Rare gold exsolution eutectoids. (Fig. 11 in Cockerton, 2011).
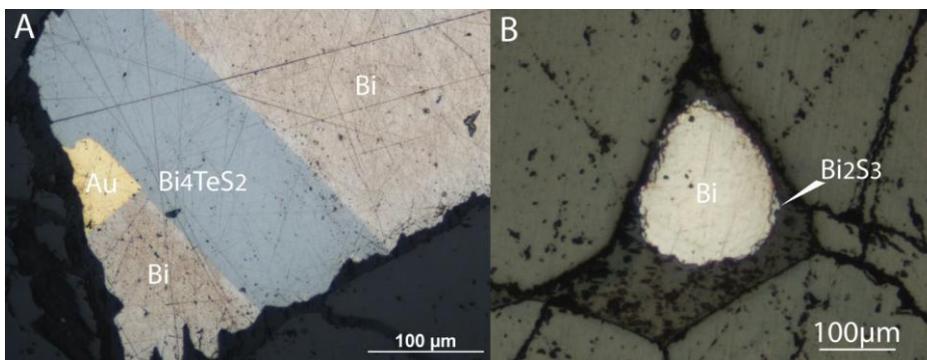
Figure 3.22: "Reflected light photographs examples of ore mineral contacts. A) Sharp contacts between ore minerals and both distinct to wavy and irregular contacts with the silicate

assemblage, B) native bismuth with a rim of bismuthinite, forming a rare rounded accretion of ore." (Fig. 12 in Cockerton, 2011).

Fander in Roberts (1987) describes polished section petrology on two samples of skarn from the hangingwall "mineralised" zone with close affinities of which one, sample T4888, contained gold and bismuth minerals which he described as follows:

> "This rock may be classified as a <u>garnet-actinolite rock</u> or <u>skarn</u>. It consists essentially of medium-grained (mean 750μ) complexly growth-zoned and sector-twinned pale yellow grossular-andradite with semi-pervasive included fine-grained actinolite. Sporadic relatively massive lenses and crude bands of actinolite are present. Accessory poikilitic quartz occurs within the actinolite aggregates and intergranular to garnet. Minor discontinuous quartz veinlets exhibit selvedges of garnet. Isolated flakes of dark green biotite occur in the relatively massive actinolite aggregates. These are partly altered to microcrystalline cloudy calcite and chlorite and are partly weathered, with associated Fe-stainings.

> One actinolite aggregate includes a 2x4mm ovoid aggregate, and subordinate actinolite-interstitial fine-grained disseminations of, bismuthinite. The coarse aggregate is granular-textured, with disseminated bismuthinite-intergranular patches of bismuth ranging to 160μ diameter. Both bismuthinite and bismuth exhibit very thinly dispersed included blebs of gold ranging to 25μ diameter (ovoid bleb in bismuth), but typically <10μ. Bismuth including gold is largely untwinned and these composites <u>may</u> represent degraded maldonite"

Taylor (1990) studied one polished thin section from the Stormont deposit.

> "Sample N° 73937 [322] is an example of the high grade leached Au-Bi ore at Stormont. This sample consists of sub to euhedral epidote (=30 modal %), poikilitic quartz (=40%), goethite and limonite (=28%), and small grains of bismuthinite and native gold (=12%). The native gold is not intergrown with bismuthinite, but occurs as rounded, discrete anhedral grains which are up to 0.1 mm in size. The gold is associated with bismuthinite (rather than native bismuth) and with the larger areas of quartz in this rock type.

> Electron microprobe analysis of five gold grains (from Stormont) … indicate that these grains have a very consistent fineness, with the average fineness (defined as 1000Au/(Au+Ag)) being 822.1.

Bottrill (2009) considered one polished thin section which consisted of garnet (0.5-1mm) ~20%, diopside (0.01-0.5mm) ~35%, amphibole (0.05-2mm) ~20%, calcite (<0.5mm) ~25%, magnetite (<0.5mm) ~2% with 2% quartz in veins and 2% sulphides disseminated and in veins, most in a 6mm vein of bismuthinite>?lillianite (lead bismuth sulphide)+bismuth+chalcopyrite+gold (numerous small rounded grains <60 microns). Most chalcopyrite and gold occur interstitial to garnet outside of the bismuthinite but some grains are included in bismuthinite."

3.3.5 Domains

The main, first order grade domain is well defined by grade in the upper part of the skarned Transition Beds, largely stratiform and stratabound, with the pre- or syn- mineralisation Stormont Adit running along the northeastern side.

It is this first order domain which has been modelled and the resource contained within it estimated.

The base of this domain as modelled has a curved base as defined by gold and bismuth grade. These grade cutoffs appear to lie at a similar stratigraphic position between adjacent sections as measured down from the base of the overlying black shale and equally up from the top of massive sandstones

(except around section 2062.5mE where there is a hole in the resource). This curved base parallels bedding as determined by occasional bedding orientations in drill core.

The northeastern margin of this first order domain is less well defined but is apparently controlled by the Stormont Adit Fault. Mineralisation occurs consistently down this structure into the "footwall" unmineralised skarn. However, in contrast to the hangingwall skarn on the southwest side of the fault where mineralisation occurs along the favourable strata some distance (to 30m) away from the fault, on the notheastern side of the fault mineralisation extends generally only a short distance away from the fault, even though the rocks are from the same hangingwall part of the Transition Beds.

The greatest distance mineralisation occurs away from the fault on this northeastern side is on sections 2062.5mE, 2075mE and 2087.5mE where intersections in holes SFD35, SFD005 and SD36 (respectively) extend the mineralised envelope up to 10m away from the fault. The controls on this northeastern bound of this zone are unclear with close inspection not locating any structure along this margin. Mineralisation also extends into the skarn to the northeast of the Stormont Adit Fault for up to 5m on section 2150mE.

Within this first order domain a number of sections reveal the development of arguably four recognisable discrete grade domains. These are shown on figures 3.23 to 3.35. Three of these are stratigraphic with Upper and Lower High Grade domains separated by the Low Grade domain. The fourth Fault Domain zone is structural and runs along the Stormont Adit Fault extending some metres to 10m into the hangingwall and footwall of the fault. This latter zone is commonly oxidised due to groundwater.

The stratigraphic domains are most clearly defined on sections 2087.5mE (holes SFD20 & 21) and 2075mE (holes SFD005 upper part, SFD006, 007 & 008). To the northwest on sections 2062.5mE and 2050mE the distinction is somewhat less clear but still discernible. On sections 2037.5mE and 2025mE the upper high grade zone has been removed by erosion with the lower high grade zone the only stratigraphic zone present.

On section 2100mE the lower high grade zone is narrower and weaker and by 2112.5mE has weakened further (albeit SFD43 stopping in mineralisation). On sections 2125mE, 2137.5mE and 2150mE the picture is less clear but mineralisation away from the Stormont Adit Fault is from the upper high grade domain with the lower grade domain no longer present.

On these south-westernmost sections (2125mE to 2150mE) most mineralisation is in the structurally defined domain.

The structurally controlled domain along the Stormont Adit Fault is best defined on sections 2037.5mE, 2050mE, 2075mE and 2087.5mE and on sections 2125mE, 2137.5mE and 2150mE. Here the skarn is commonly, though not always, strongly oxidised to clays including limonitic clays and ironstone.

Highly significantly the wedge of material between the projections of the Stormont Adit Fault and Stormont Thrust Fault along the deposits northeastern margin has been left unattributed. It is likely that this material is Moina Sandstone in the hangingwall to the Stormont Thrust Fault which has been offset by the Stormont Adit fault but this interpretation remains equivocal.

Figure 3.23: Stormont section 2000mE+/-6.25m – gold and bismuth distribution and domains.

Figure 3.24: Stormont section 2012.5mE+/-6.25m – gold and bismuth distribution and domains.
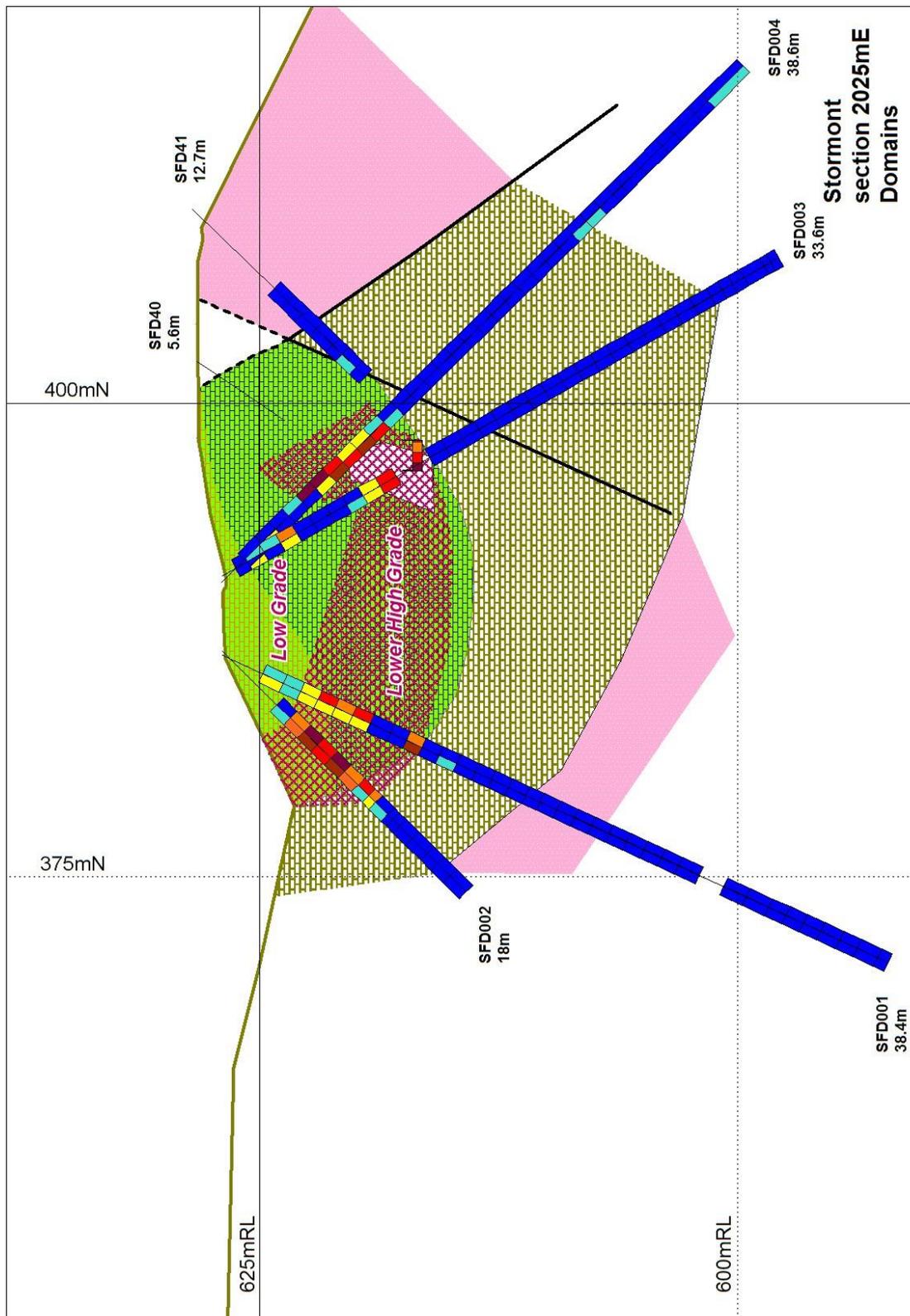
Figure 3.25: Stormont section 2025mE+/-6.25m – gold and bismuth distribution and domains.
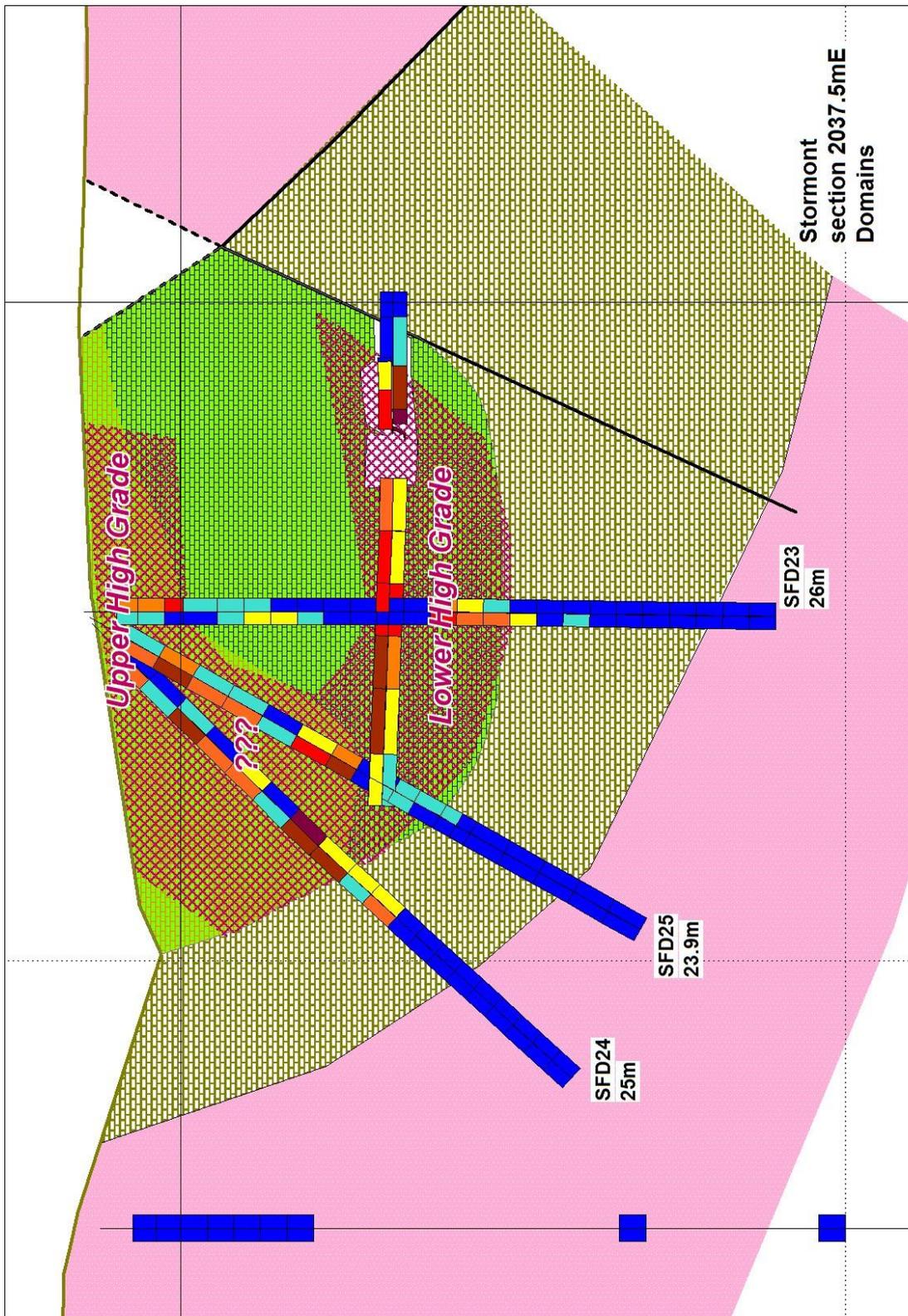
Figure 3.26: Stormont section 2037.5mE+/-6.25m – gold and bismuth distribution and domains.
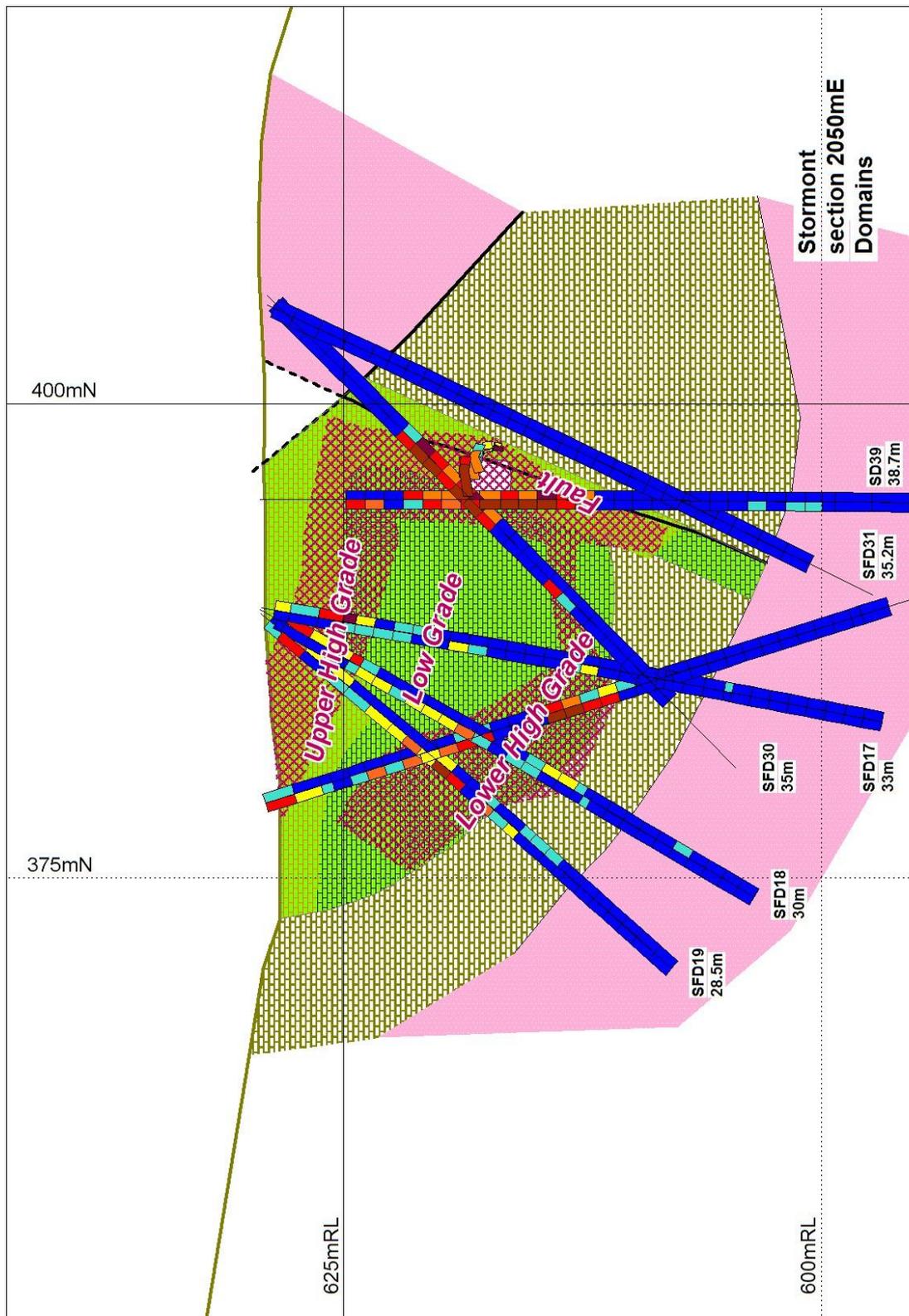
Figure 3.27: Stormont section 2050mE+/-6.25m – gold and bismuth distribution and domains.
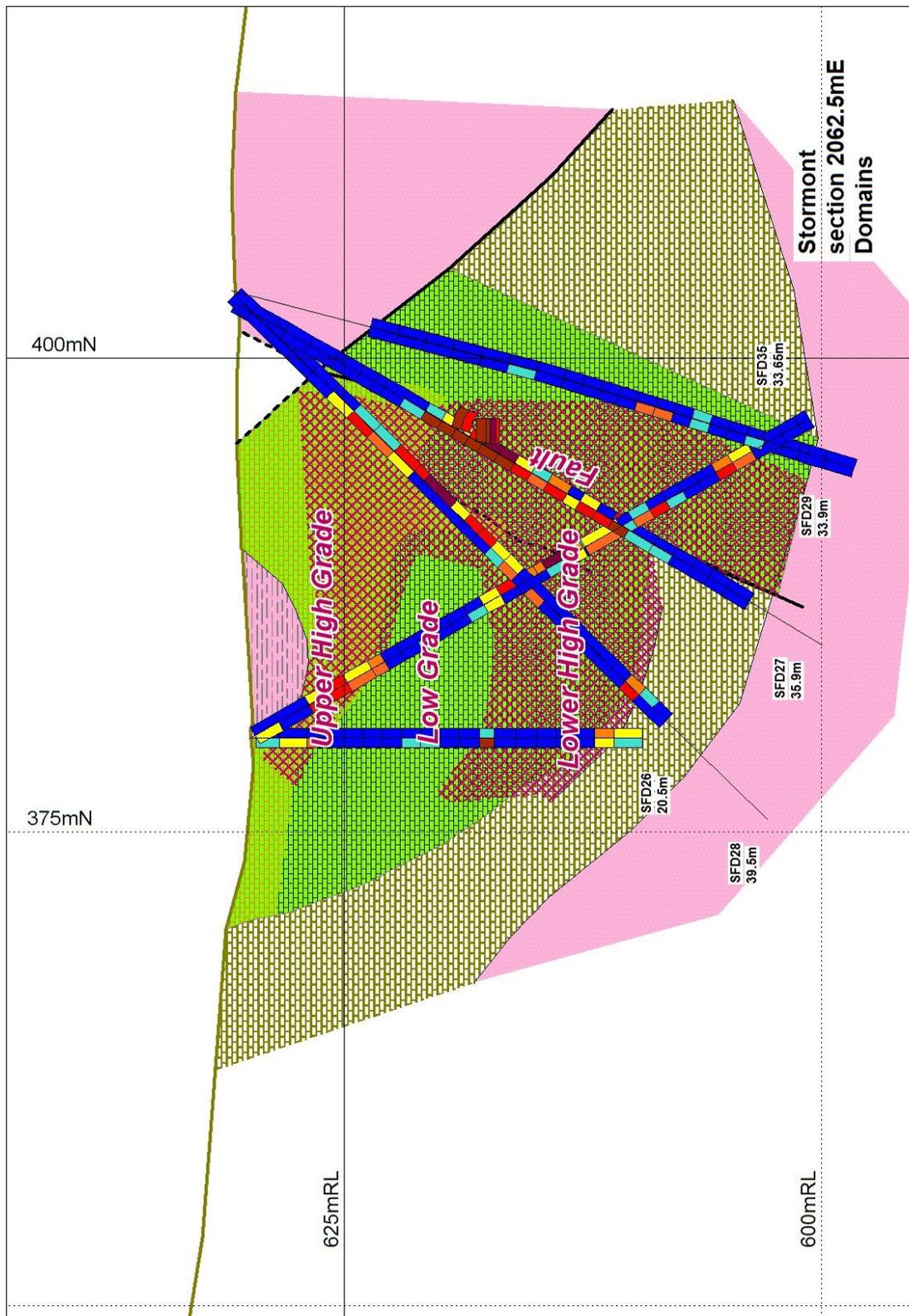
Figure 3.28: **Stormont section 2062.5mE+/-6.25m – gold and bismuth distribution and domains.**
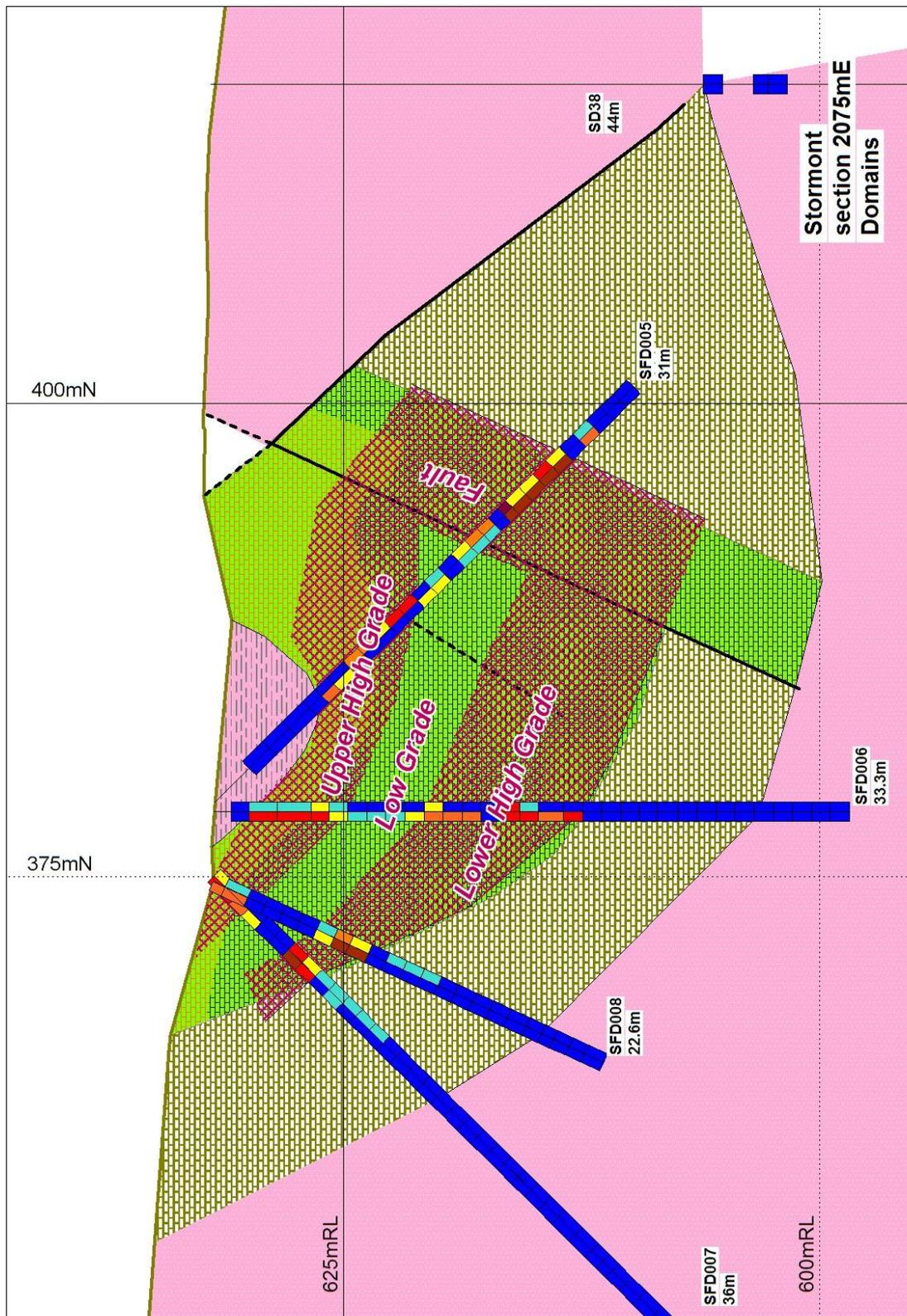
Figure 3.29: Stormont section 2075mE+/-6.25m – gold and bismuth distribution and domains.
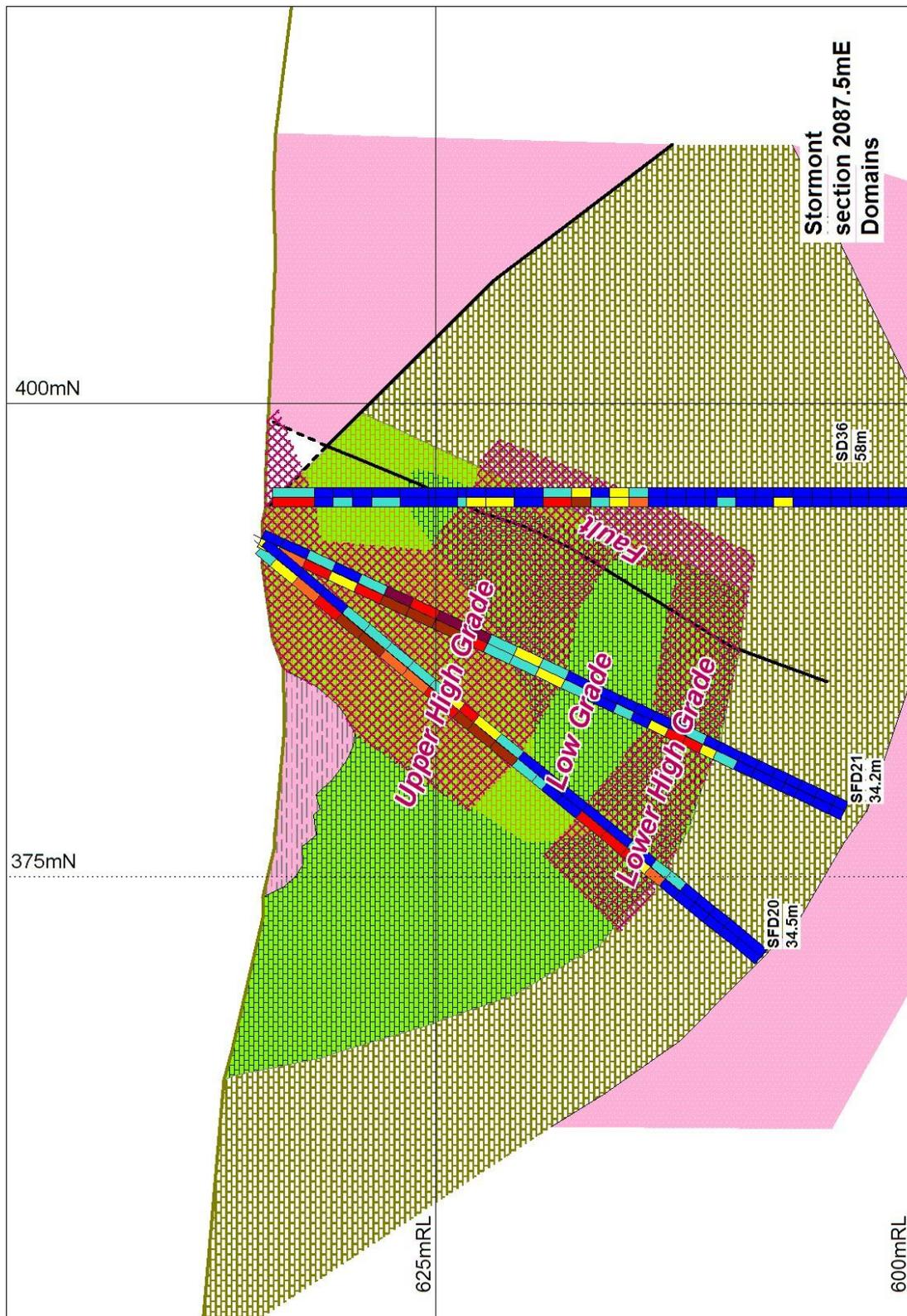
Figure 3.30: Stormont section 2087.5mE+/-6.25m – gold and bismuth distribution and domains.
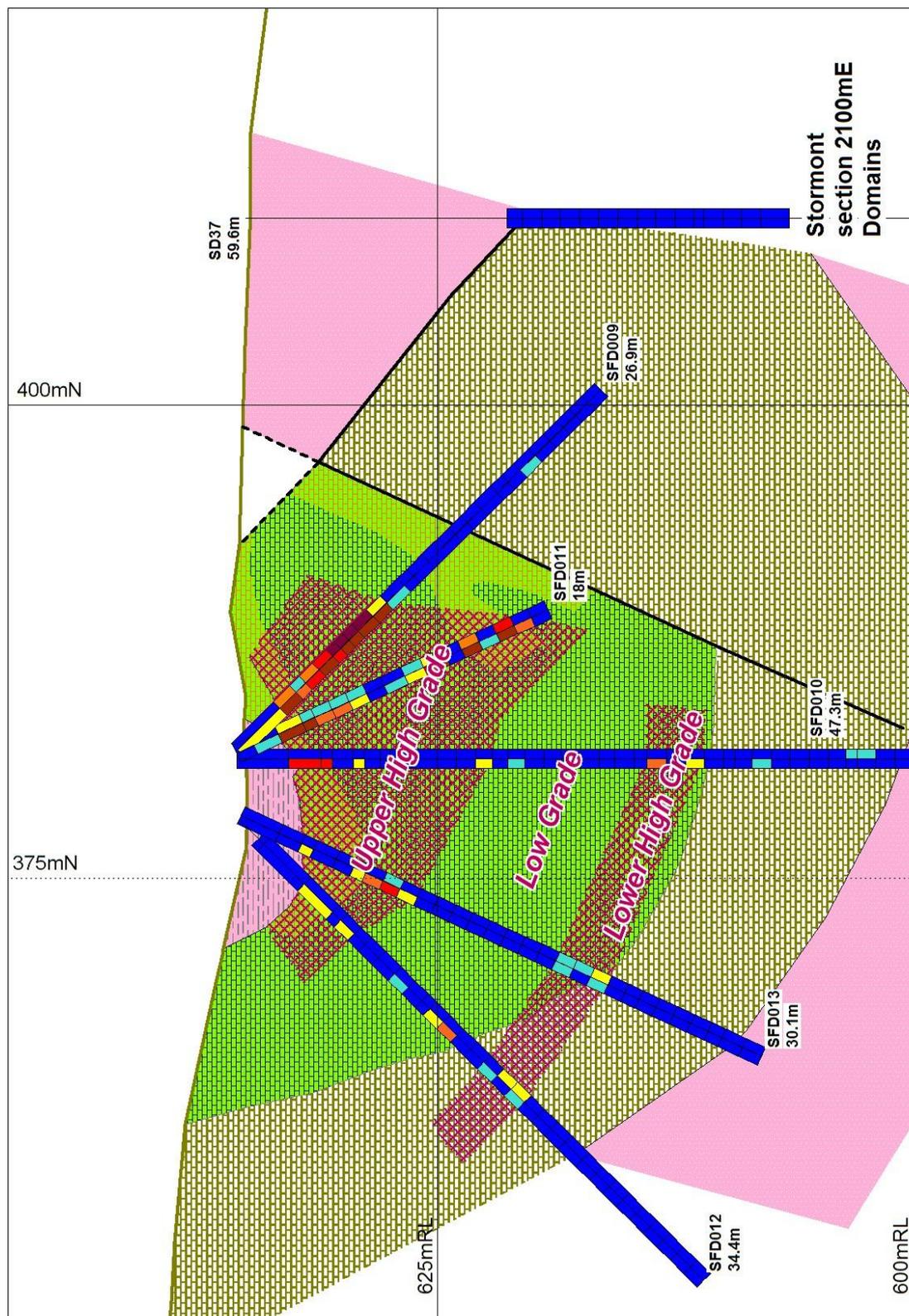
Figure 3.31: Stormont section 2100mE+/-6.25m – gold and bismuth distribution and domains.
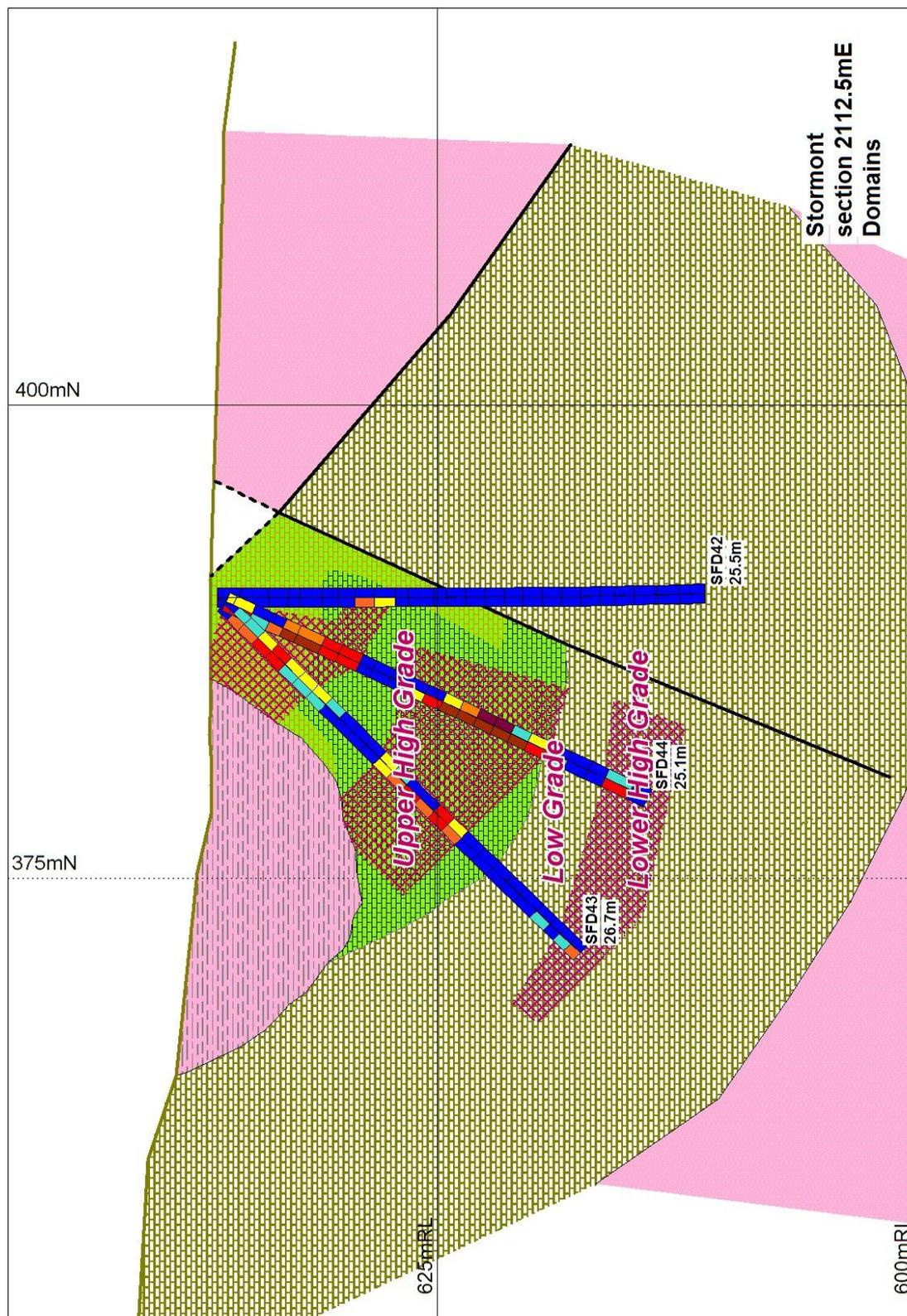
Figure 3.32: Stormont section 2112.5mE+/-6.25m – gold and bismuth distribution and domains.
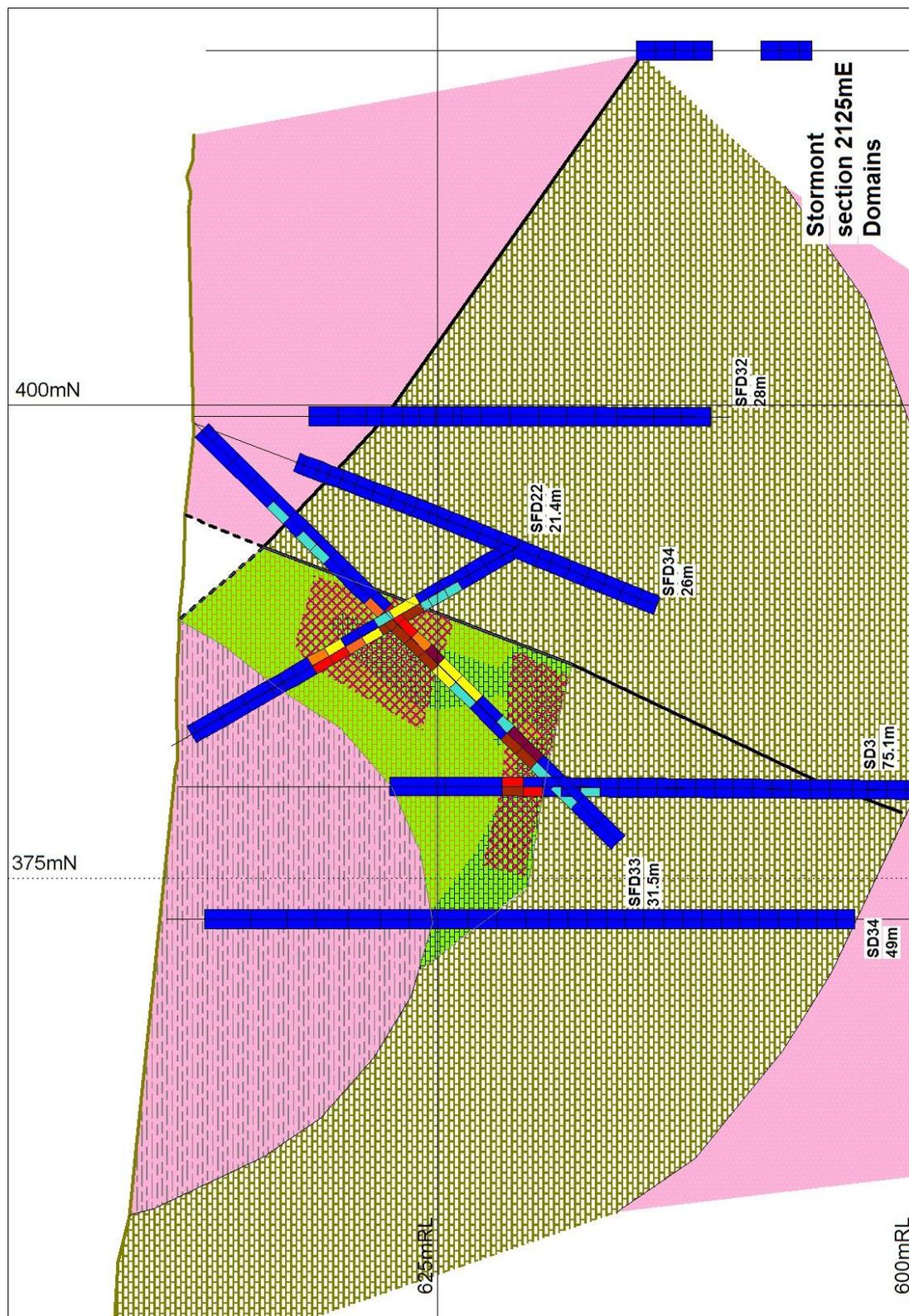
Figure 3.33: Stormont section 2125mE+/-6.25m – gold and bismuth distribution and domains.
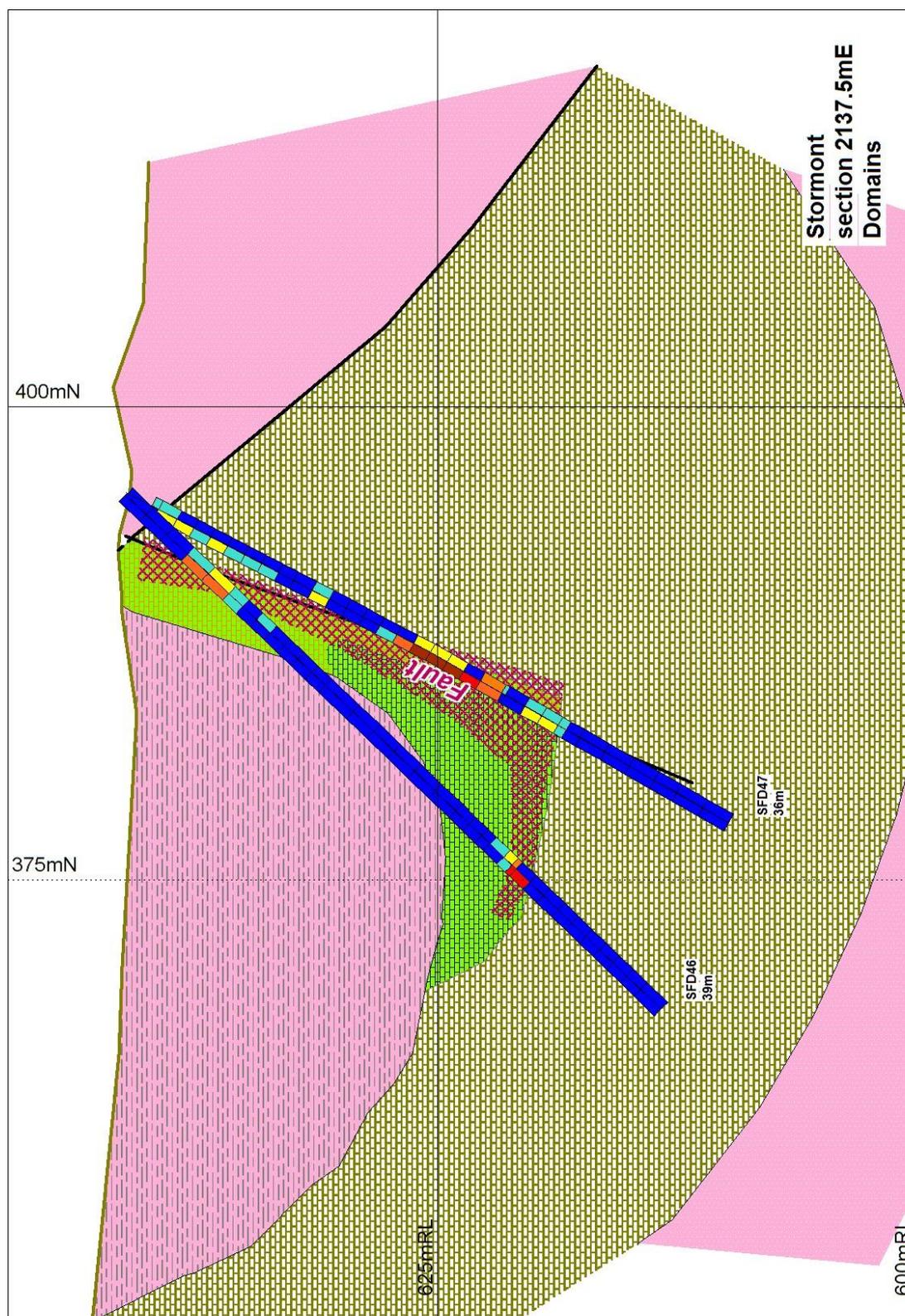
Figure 3.34: Stormont section 2137.5mE+/-6.25m – gold and bismuth distribution and domains.
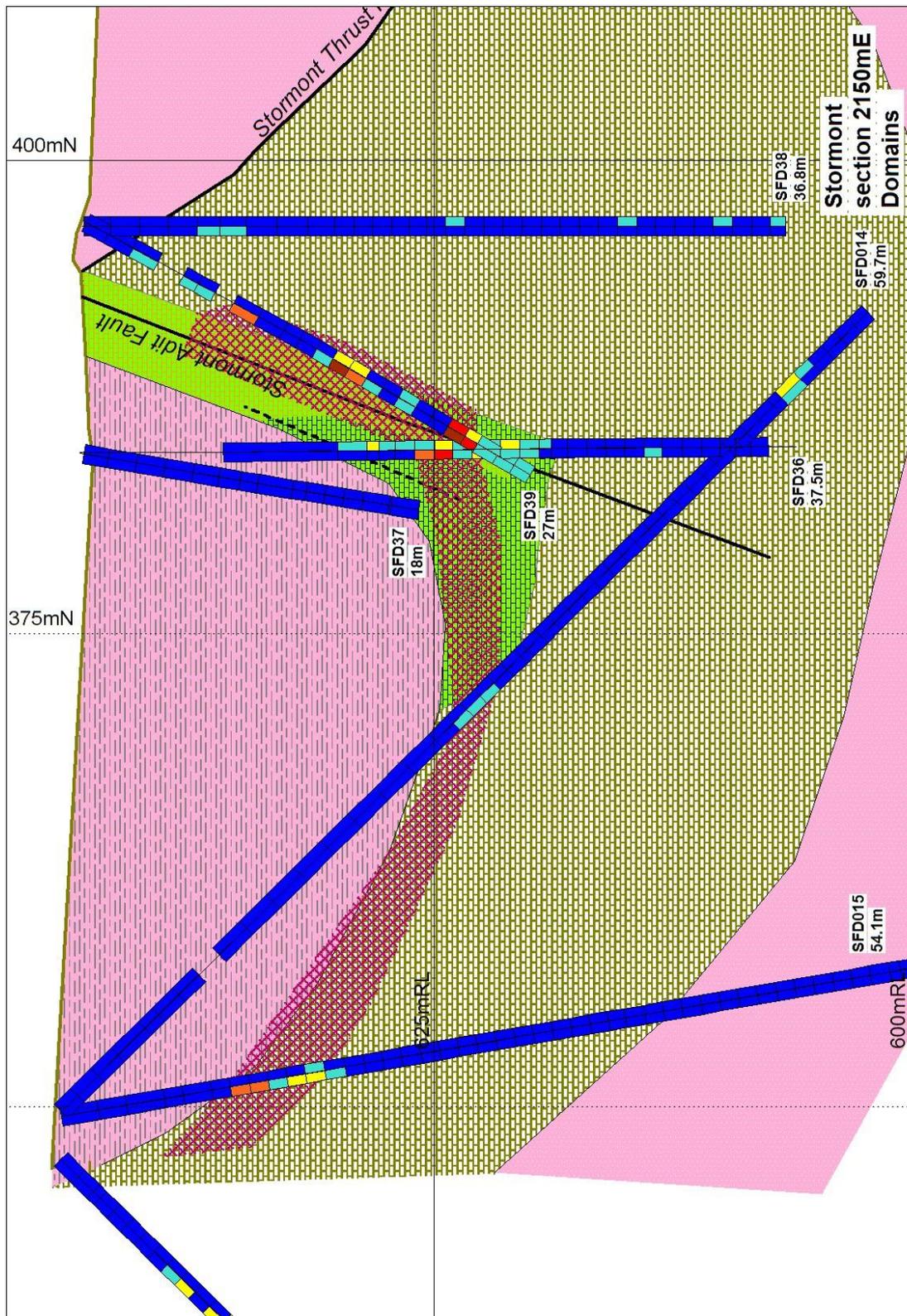
Figure 3.35: Stormont section 2150mE+/-6.25m – gold and bismuth distribution and domains.

3.3.6   Weathering/Oxidation

The near surface upper part of the skarn and that associated with faulting (especially the Stormont Adit Fault) is commonly strongly oxidised with limonitic clays and ironstone "liezer gange" rings. Otherwise the skarn is fresh and green with the transition between strongly oxidised and fresh taking place commonly quite quickly over the order of tens of cm's.

The interpreted boundary between oxidised and fresh skarn is shown on section in figures 3.5 to 3.17.

Drillhole oxidised intervals are coded *ox* in the *oxidised* field in the *oxidised* table in the *Stormont9.mdb* database included in appendix D.

Surface oxidation persists to between 3-8m below surface north of section 2062.5mE (i.e. sections 2000mE to 2050mE in figures 3.5 to 3.9 respectively).

From section 2062.5mE (figure 3.10) this thickness of oxidised skarn continues beneath the shale unit south east to section 2100mE (figure 3.13). Southeast of section 2112.5mE to section 2150mE (figures 3.14 to 3.17) the skarn beneath the shale is fresh with oxidation focussed on the Stormont Adit Fault zone and the north-eastern limb of the syncline.

Oxidation along the Stormont Adit Fault is variable. Certainly the fault in the vicinity of the adit is strongly oxidised.

On section 2062.5mE (figure 3.10) oxidiation does not persist for any great extent down SFD27 even though the hole intersects the fault at a very acute angle and stays proximal to the fault for most of the holes length.

On section 2075mE (figure 3.11) the fault is represented by slightly puggy but surprisingly unoxidised material.

Southeast of section 2087.5mE (figure 3.12) oxidation along the fault zone is more consistent and becomes more extensive southeast of 2125mE where the zone between the black clay and the fault is oxidised for the most part.

An anomalous zone of strong oxidation persists to depth in SFD20 on section 2087.5mE (figure 3.12) suggestive of a separate discrete fault control.

The oxidised zone is quite discrete but has not been 3D modelled in Surpac. Sectionally the very approximate (interpreted sectionally) area of oxidised versus fresh for each section is summarised in table 3.1.   The weighted average area of oxidised material is 29.5% whilst north of (and including) section 2112.5mE the weighted average area oxidised is closer to 26%.

Table 3.1: Estimation oxidised material per section				
Section	Oxidised area m2	Fresh area m2	Total area m2	% oxidised
2025	46	197	243	19
2037.5	110	203	313	35
2050	147	256	403	36
2062.5	164	437	601	27
2075	136	457	593	23
2087.5	194	400	594	33
2100	93	511	604	15
2112.5	67	173	240	28
2125	120	67	187	64
2137.5	53	93	146	36
2150	75	90	165	45
				29.5 % weighted average

No 3D modelling or domaining into oxidised and unoxidised material was done in this resource estimation. Unweighted and uncut separate means of oxidised and fresh drillcore from SFD17 to SFD46 are 5.69g'/t Au and 0.2% Bi for oxidised samples and 5.19g/t Au and 0.25% Bi for fresh samples indicating a bias towards oxidised material. Polished section petrological samples do not appear to have included oxidised material and it is unclear if there is any secondary enrichment, however, it is considered to be more likely that oxidation is often associated with fracturing and faulting, favourable primary mineralisation sites.

3.3.7   Structural Controls on Mineralisation

Introduction

The structural controls on mineralisation have been variably interpreted by previous workers. Whilst there has been no disputation of the presence of the syncline the presence and/or role of the two main faults i.e the Stormont Adit Fault and Stormont Thrust Fault, and a possible minor cross-fault, has seen a number of interpretations.

The Stormont (Adit) Fault was mapped by GFEL (Roberts, 1987; Fleming, 1988; Castro, 1990) and described but the thrust is not mentioned (there would have been little evidence for its presence). After drilling a number of vertical holes Newnham (1993) postulated a steeply northeast dipping thrust as marking the eastern edge to mineralisation as depicted in his figure 6. After drilling a further 13 holes Newnham (1996) states that "this interpretation of the Stormont Skarn differs from previous interpretations in two principal respects: (a) Recognition of a thrust fault terminating the skarn to the east and pushing Moina Sandstone over the top of the skarn. (b) The Stormont Fault, previously interpreted as a normal fault trending along the synclinal axis of the Stormont Skarn does not exist. There is probably extensive fracturing and brecciation along the stressed synclinal axis but there is little evidence of a major normal fault." Newnham (1997) reaffirms this interpretation referring to the thrust as the Stormont Fault.

The geological interpretation supplied by Frontier's Robert Reid in 2009 showed the thrust fault as the only fault of significance. Further investigation by the author saw the 2009 resource report (1) emphasise the principal stratigraphic control on the distribution of gold+bismuth mineralisation noting the persistence of high grades along both limbs away from the synclinal hinge zone; (2) speculate on the significance of the fault(s) mapped in the old adit; and (3) discuss the inconsistently expressed (in drillhole intersections) Stormont Thrust Fault interpreting it as a post-mineralising offsetting fault.

The drilling of a further 31 drillholes and surveying of the old workings has seen a significant reinterpretation of the location and significance of both the Stormont Adit Fault and Stormont Thrust Fault. In particular the significance of the former is increased markedly whilst that of the latter diminished.

However, the interpretation still remains problematic with;

- the Stormont Adit Fault expressed strongly on some sections whilst difficult to pin down on others

- the Stormont Adit Thrust is difficult to model in 3D and its dip is inconsistent across sections

- the relative timing relationships between the Stormont Adit Fault and Stormont Thrust Fault are ambiguous

Drillholes SFD40 and SFD41 were drilled on section 2025mE (just above southwest face of the open cut) in an attempt to resolve the relative timing relationships between the two structures.

SFD41, collared northeast of the expected trend of both faults intersected a rubbly fault from 9.1m to 10.3m which separated sandstone uphole from skarn downhole with 0.8m selvedge of calc-silicate alteration in the sandstone immediately adjacent to the fault.

SFD41 was collared 8m closer to the expected trace of the two faults. It intersected calc-silicate skarn throughout but with faults characterised by ferruginous surfaces, from 1.4m to 1.6m at 45° to core axis and from 3.7m to 3.8m at 35° to core axis.

The easiest interpretation is that the fault intersected in SFD41 from 9.1m to 10.3m is the Stormont Adit Fault which has offset the earlier Stormont Thrust Fault.

Stormont Adit Fault and sympathetic structures

Drilling has confirmed the presence and significance of the Stormont Adit Fault, a strike slip fault which runs down the backs of the old adit at its southeastern end beyond the dogleg. The fault is also apparently intersected at the ends of the northeast cross-cut and in the two small adits into the northeast wall of the old open cut. It strikes 143° and dips 65° to 70° to the southwest.

Despite the significance of the fault to mineralisation there are still some uncertainties.

In the first instance it was considered during the drilling programme that the fault was a single structure. Subsequent modelling requires the fault to change its strike around just southeast of the end of the adit. Faults intersected on either side of the trace of the fault appear to be faults sub-parallel to the main Stormont Adit Fault.

Accommodating these subsidiary faults and the flexure in strike may be better achieved with the Stormont Adit Fault actually present as two curviplanar fault surfaces, components of a strike-slip duplex with jogging between the two, or alternatively as a series a fault elements. Regardless of the precise geometry a zone of major faulting extends southeast from the end of the adit.

On section 2050mE, SD1, a vertical hole immediately west of the drive beyond the dogleg intersects a major fault zone between 12.6m and 19.5m indicating the Stormont Adit Fault to have some width. Similarly the fault must pass through SFD30 on section 2050mE. Here the fault is much more discrete bringing sandstone against calc-silicate skarn.

Southeast of the adit on section 2062.5mE the fault is intersected in skarn between 9.3m and 11.3m in SFD27 whilst at 5.8m in SFD28, nearer surface, the fault is discrete again juxtaposing sandstone against skarn.

On section 2075mE the only option for the fault in SFD005 is from 19.2m to 19.65m but this requires a subtle swing in strike towards the south, away from the trend of other fault intersections.

SD36 on section 2087.5mE intersects faulted skarn between 23.2m and 26.3m within skarn. This position is somewhat offset from the along strike projection of the fault but there remains the possibility that SD36's location is out by a metre or so.

The alternative possibility that the fault swings its strike as suggested by the faults position in SFD005 can be supported by faulting around 24m in SFD20 though the fault would curve significantly. It is around this position that the jogging would occur if this interpretation is favoured.

On section 2100mE SFD009 intersects a major fault between 14.0m and 16.1m where the Stormont Adit Fault was expected. If the fault retains a similar dip to that on 2050mE then the fault is also intersected in SFD10 from 36.0m to 37.3m.

SFD42 on section 2112.5m is intersected by a number of faults, however, it is the fault intersected between 13.5m and 13.8m, described as sooty at 35-40 which best fits the Stormont Fault. The other structures are consistent with the steep southwest dip of the Stormont Adit Fault and are considered to be sympathetic structures.

On section 2125mE the fault is represented by highly ferruginous material between 13.5m and 15.0m. In SFD33 the fault passes though similar material between 5.8m and 8.8m. It is also the fault intersected in SD3 from 34.9m to 35.2m.

On 2137.5mE SFD47 intersects a series of faults at low angles to core axis. SFD46 intersects faulted skarn between 6.0m and 7.5m. The skarn downhole of this faulted zone is also rubbly.

Modelling of sandstone-skarn contacts in 3D suggests the Stormont Adit Fault has not significantly offset the basal Moina Sandstone. The orientations of this contact either side of the fault are consistent with it being continuous around the core of a syncline.

The Stormont Adit Fault has been a major route for groundwater over much of its length with oxidation extending to 15-20m below the surface around the fault. However, there are also intersections of the fault where there is no evidence of groundwater e.g. in SFD005.

A number of other smaller faults and shears are intersected in drilling away from the trace of the Stormont Adit Fault. Where measureable angles to core axis are consistent with a steep southwest dip and these structures are considered to be sub-parallel and sympathetic to the Stormont Adit Fault.

Stormont Thrust Fault

Previous interpretations of the geology have stressed the role of a thrust fault named the Stormont Thrust. These interpretations see the thrust fault as playing a significant role in introducing mineralising fluids into the reactive beds of the upper Transition Beds. They also see the thrust fault outcropping along the north-eastern edge of the resource.

These early interpretations suggest some uncertainty regarding the position of the thrust, a point noted in modelling the fault and deposit for the 2009 Inferred Resource calculations; i.e.

"The other structure of importance to the geometry of the resource is the Stormont Thrust. This structure is a little enigmatic in that it is apparently well expressed (according to the drill logs) in a number of drillholes (two of which lie sufficiently close for a dip of 52º to be modelled) and is necessary to explain the presence of Denison Group sediments at shallow depths to the immediate northeast of the skarn body, yet it is poorly expressed (again according to the drill logs) in other drillholes. It also apparently swings or is offset in a number of locations."

Frontier's previous resource estimation shows a significant portion of the higher grade part of the resource lying in the immediate footwall to the thrust. This is in part due to the survey errors (detailed elsewhere) with a larger area between the thrust and drilling and the placement of the higher grade adit samples nearer the thrust.

The 2011/12 drilling has shown the Stormont Thrust Fault to be a less significant structure with the Stormont Adit Fault, a 60º-80º southwest dipping strike-slip(?) fault or fault duplex (which runs down the adit beyond the dogleg) the main control on mineralisation.

Almost all 2011/12 drillholes were drilled towards the southwest. This was in part logistical, in part in order to help define the north-eastern margin of the deposit. This meant that holes were commonly at low angles/sub-parallel to the Stormont Adit Fault.

On section 2050mE both SFD30 and 31 were collared from the same position northeast of the projected trace of both faults. Both holes made very similar intersections in the upper part of the hole. SFD30 passed through a faulted contact from 8.0m to 8.8m separating sandstone uphole from skarn downhole. In SFD31 the faulted contact is at 7.0m to 7.3m, again separating sandstone uphole from skarn downhole suggesting both faults may be the same.

The location of the adit and the mapped and surveyed Adit Fault immediately nearby compels the fault in SFD30 to be the Adit Fault. If this is the case then the fault at 7.0m in SFD31 should be the

Thrust Fault. If this is so then the Thrust Fault should also have been intersected in SFD30 uphole from 8.0m. There is no fault in this position. From 1.7m to 1.9m is a zone of puggy broken core which if correlated with the SFD31 fault would see the structure as a parallel fault to the Adit Fault i.e. inconsistent with the thrust.

The alternative is that the thrust was dipping at less than 15° to the northeast and truncated by the Adit Fault.

On section 2062.5mE holes SFD27, 28 and 29 were collared from the same position northeast of the expected trace of both faults.

The picture in this hole is similar to that on section 2050mE.

Once again the proximity of the adit and the Adit Fault compels some interpretations. The fault in SFD27 from 9.3m to 11.3m separates sandstone uphole (though with a skarn selvedge of 0.9m) from skarn downhole. Orientation of this fault at 30° to core axis is also consistent with the Adit Fault. The similarly oriented puggy shear at 7.8m is most likely a subsidiary shear.

Similarly the fault in SFD28 at 5.8m separating sandstone uphole from skarn downhole must be the Adit Fault.

In SFD29 a very ferruginous fault zone between 7.9 and 8.8m separates sandstone uphole from variably weakly skarned sandstone downhole. For this fault to be the thrust fault the fault must dip at a low angle (<15°) to the northeast and have been truncated by the Adit Fault in a very similar situation to section 2050mE.

Vertical hole SD38 has been interpreted previously as having intersected the thrust between 25.8m and 26.5m within sandstone.

On section 2100mE vertical hole SD37 is interpreted as having intersected the thrust on the contact between overlying sandstone and underlying skarn at 13.7m.

On section 2125mE vertical hole SD35 is interpreted as having intersected the thrust between overlying sandstone and a relatively thin skarn intersection.

Holes SFD32, 33 and 34 were collared northeast of the projected trend of the two faults from the same position. SFD32, a vertical hole intersected a fault from 9.95m to 10.8m, separating sandstone uphole from calc-silicate skarn downhole. Significantly a 10cm selvedge of magnetite skarn overprints the sandstone adjacent to the fault.

SFD34 intersected a fault zone between 7.5m and 10.0m separating sandstone uphole from skarn downhole. Given the proximity and similarity in appearance it is difficult not to correlate this fault with that intersected in SFD32. If such is the case the fault must dip between -20° and -50° to the northeast.

SFD33 intersects a fault between 5.8m and 7.5m with sandstone uphole and skarn downhole.

Thus the current best interpretation of the Stormont Thrust Fault is that it dips at ~15° to the northeast and is truncated by the Stormont Adit Fault. This interpretation is somewhat unsatisfactory and it is equally possible that alternative explanations are correct.

4.0 Data Sources

A significant part of the data used in modelling the Stormont deposit was generated by Frontier in its 2008 and 2011 programmes, the exception being drillholes SD1, SD34, SD36 and SD39 and channel samples GFSTC1 to GFSTC13 which were generated by previous explorers.

This sample assay data used in this resource estimate comes from diamond core drilling on nominally 12.5m spaced sections and channel sampling along the walls of the open cut and underground workings.

Survey data comes from surveying by Len McKenzie (accredited surveyor).

Bulk density data utilised in this estimate has come solely from Frontier's 2008 drilling programme with a total of 70 ore grade samples submitted for bulk density analysis by the water immersion method.

Geological interpretations come largely from recent work building on previous work.

4.1 Drilling

4.1.1 Drilling programmes

A summary of the drillholes in the central zone and those utilised in the resource estimate is given in table 4.1. Details of the relevant drilling programmes have been summarised in section 2.1.2. Locations of drillholes are shown in plan view in figure 3.4 and in section view in figures 3.5-17, 3.23-3.35 and 10.3-10.28). SD1 is the deepest hole at 145.0m. All other holes are less than 75.1m deep.

Nearly all of the earlier drilling programmes (pre-Frontier) drilled vertical holes with the exceptions being SD39, SD41 and SD42 which were angled towards 74°, 56° and 86° (AMG) respectively at -70°. Frontier's 2008 drillholes were all angled holes oriented along their 045°-225° (AMG) grid as fans of angled holes commonly drilled from a central drill pad.

Frontier's 2011 drilling programme was completed with 872.1m drilled in 31 drillholes, SFD17 to SFD47. Drilling was done on nominal 12.5m sections midway between the existing 25m spaced drill sections. Some infill drilling was also done on these 25m sections.

Drilling was nominally towards the north-east (045° true = 031° magnetic) or south-west (225° true = 211° magnetic) or vertical though some holes were drilled at angles slightly at variant with these orientations in order to accommodate old workings or because of minor errors in set-up only realised once drilling.

Almost all holes were drilled by Frontier's own custom built RB38 rig, the exception being SFD's 26, 35, 40, 41 and 45 which were drilled with the Poltock man-portable rig.

RB38 holes were all drilled HQ2. Of the Poltock rig holes, SFD35, 40, 41 and 45 were drilled TT56 throughout with SFD26 in TT56 to 7.35m and finished in TT46.

Table 4.1: Summary drillholes - Stormont Au+Bi resource							
Total holes in central zone							
Company	Year	No. holes	Total length	Ave. length	Core size	Hole ID's	No. samples
RGC	1988	3	290.4	96.8	HQ/NQ	SD1, 3 & 6	88
RGC	1990	6	282.3	47.1	HQ/NQ	SD7 to 12	150
Goldstream/Titan	1995/96	13	740.9	57	HQ	SD30 to SD42	326
Goldstream/Titan	1996	3	136	45.3	HQ	SD43 to SD45	52
Jervois	2000	3	131.9	44	NTW	ST01 to ST03	74
Frontier	2008	16	543.9	34	HQ/NQ	SFD001 to SFD016	525
Frontier	2011	31	872.1	28.1	HQ/TT56/TT46	SFD17 to SFD47	
Total		75	2997.5				1215

Total holes used in resource estimate							
Company	Year	No. holes	Total length	Ave. length	Core size	Hole ID's	No. samples
RGC	1988	2	220.1	110.1	HQ/NQ	SD1 and SD3	17
Goldstream/Titan	1995/96	3	174.6	58.2	HQ	SD34,36 and SD39	26
Frontier	2008	13	402.1	30.9	HQ/NQ	SFD001 to SFD013	183
Frontier	2011	25	722.45	28.9	HQ/TT56/TT46	SFD17 to 30, 33, 35, 36,39 to SFD47	364
Total		**43**	**1519.25**	**35.3**			**590**

Most of the orebody essentially outcrops on the surface though most holes intersected 1m to 2m of (unsampled) soil/colluvium at the collar. Hole SD1 which collared in outcropping skarn had complete core loss from 0.0m to 4.5m which potentially lies within the highest grade part of the resource. Sections with core loss in sections of skarn were modelled as such but with no sample data.

Hole SD3 has complete core loss from 0.0m to 11.0m at which point the hole passes into lower grade mineralised skarn. Due to the proximity of SD34 in which core loss was minimal it is most likely that this core loss took place in the black clay unit.

Core recoveries in the 2008 and 2011 programmes were all good with only SFD36 experiencing any significant core-loss and it was essentially repeated in SFD37.

Other holes have had partial core loss though mineralised sections. These have been considered on equal merit with fully recovered sections with no weighting.

4.1.2 Collar Surveying

Drillhole collar survey accuracy was recognised as one of the most significant deficiencies of the Stormont database in the 2009 estimate. Drillhole collars had previously been surveyed by a variety of means ranging from conventional, conventional from differential GPS control, and direct GPS.

As part of the 2011 work programme the old workings and all locatable relevant drillholes were surveyed by Len McKenzie, a certified surveyor of Burnie, on two instances and his son Adam, a 4th year student, on one instance.

On the first instance Len established control using differential GPS. He also surveyed many of the existing holes using differential GPS. New drillhole collars were largely classically surveyed off this GPS control. Positional accuracy was +/-20mm in the horizontal plane, 60mm in the vertical.

This surveying immediately revealed a discrepancy in RL's of 10m from previously supplied data. This, in conjunction with the revelation that the old adit was 8m out from its expected position caused a significant rethink in terms of the geological controls on mineralisation as well as the impact on the resource.

Almost all collars were surveyed by Len, the exceptions being early holes SD3, SD34, SD46 and SD39 holes. Len also surveyed the azimuths of the Frontier holes SFD1 to SFD47.

Hole collars are listed in the *collar* table in the *Stormont9.mdb* database in appendix D. All collars are in AGD66 zone 55 projection.

Len's datafile is also included in appendix D in file *Stormont_MGA94_Mckenzie_svypts_alldata.xls* in a folder titles *Surveying*. Be aware that these co-ordinates are in MGA94 zone 55 projection.

4.1.3 Downhole surveying

Apart from holes SD1 to 5 there was no downhole surveying of drillholes in the earlier drilling programmes. These holes all remained essentially vertical with no holes deviating to a dip of less than -89.0°. Frontier did not survey any of its 2008 holes, many of which were angled.

Given the short nature of the holes and the scale of the deposit this was considered reasonable for an inferred resource.

With Frontier's 2008 hole collars cemented and the cost associated with re-entering old holes to survey it was never going to be reasonable to require resurveying of old holes. It was intended to improve the overall quality of hole surveying by downhole surveying the 2011 holes.

In the 2011 programme many holes were angled. Downhole surveys at nominally 15m, 30m and/or end of hole were taken with an Eastman single-shot. Unfortunately many of these surveys showed magnetic interference and are of no use for azimuth though dip readings are unaffected.

In a number of instances downhole surveying has not been achieved and the hole azimuth is that at collar. Given the length of the holes (<40m), their being predominantly HQ, and the scale of the deposit it is again felt that the potential positional error due to lack of downhole survey will not significantly affect the resource. However, if using these holes for grade control or geotechnical purposes it is necessary to be aware of this potential error.

Downhole surveys are in the *survey* table in the *Stormont9.mdb* database.

4.1.4 Logging

Core logging has been carried out by a number of geologists. These geologists are almost all known to the author and are technically sound. There is a degree of consistency between core logs in part because of the cross-referencing of geological interpretations with earlier logging/interpretation as well as the close spacing and thus largely contiguous geology intercepted in the drillholes.

The 2011 geological work was carried out by the author with some assistance by graduate geologist Chris Thaus (B.Sc.). This work largely involved logging all new drillholes and managing the drilling on an ongoing basis. Interpretative geological sections were created and shown as figures 3.4 to 3.17 3D wireframed models were generated from this 2D interpretative work.

The geology of the deposit is a little difficult to define at the small scale given the variability inherent in skarn type deposits.   However, as potentially economic mineralisation is found almost invariably within the massive skarn Au+/-Bi grades largely define the extent of mineralisation.

Core logs aren't included with this report, however, summary geology is coded in the *Stormont9.mdb* database in appendix D in fields *lith_code2012* and *strat_code2012* in the geology table.

4.2 Channel sampling

4.2.1 Channel sampling programmes

The walls of the old open cut and the internal walls of the adit and cross-cuts provide excellent exposure of the mineralised skarn and have been channel sampled in three separate programmes. Details of the relevant channel sampling programmes have been summarised in section 2.1.2. Locations of channels are shown in plan view in figure 4.1 with gold results and bismuth results in figures 4.2 and 4.3 respectively..

GFEL samples were taken horizontally over nominally 2m contiguous intervals using a pneumatic chisel. Frontier's 2008 sampling was done on nominally 2m contiguous intervals using a diamond saw to cut out a wedge of rock.

In 2011 Frontier carried out a further 41.3 metres of channel sampling along the previously unsampled northeastern wall of the open cut. Sampling was again done using a diamond saw.

| Table 4.2: Summary channels - Stormont Au+Bi resource							
Total channel samples in central zone							
Company	Year	Total length	Min. length	Max. length	Modal length	nominal ID's	No. samples
GFEL	1987	129.1m	1.0m	3.0m	2.0m	GFSTC01 to 15	67
Frontier	2008	21.8m	0.5m	2.0m	variable	FRSTC01 to 04	16
Frontier	2011	41.3m	0.7m	2.0m	2.0m	FRSTC05 to 11	25
Total		**192.2m**					**108**
Total channel samples used in resource estimate							
Company	Year	Total length	Min. length	Max. length	Modal length	nominal ID's	No. samples
GFEL	1987	102.1m	2.0m	3.0m	2.0m	GFSTC01 to 15	53
Frontier	2008	17.8m	0.5m	2.0m	variable	FRSTC01 to 04	14
Frontier	2011	33.6m	0.7m	2.0m	2.0m	FRSTC06 to 11	21
Total		**153.5m**					**88**
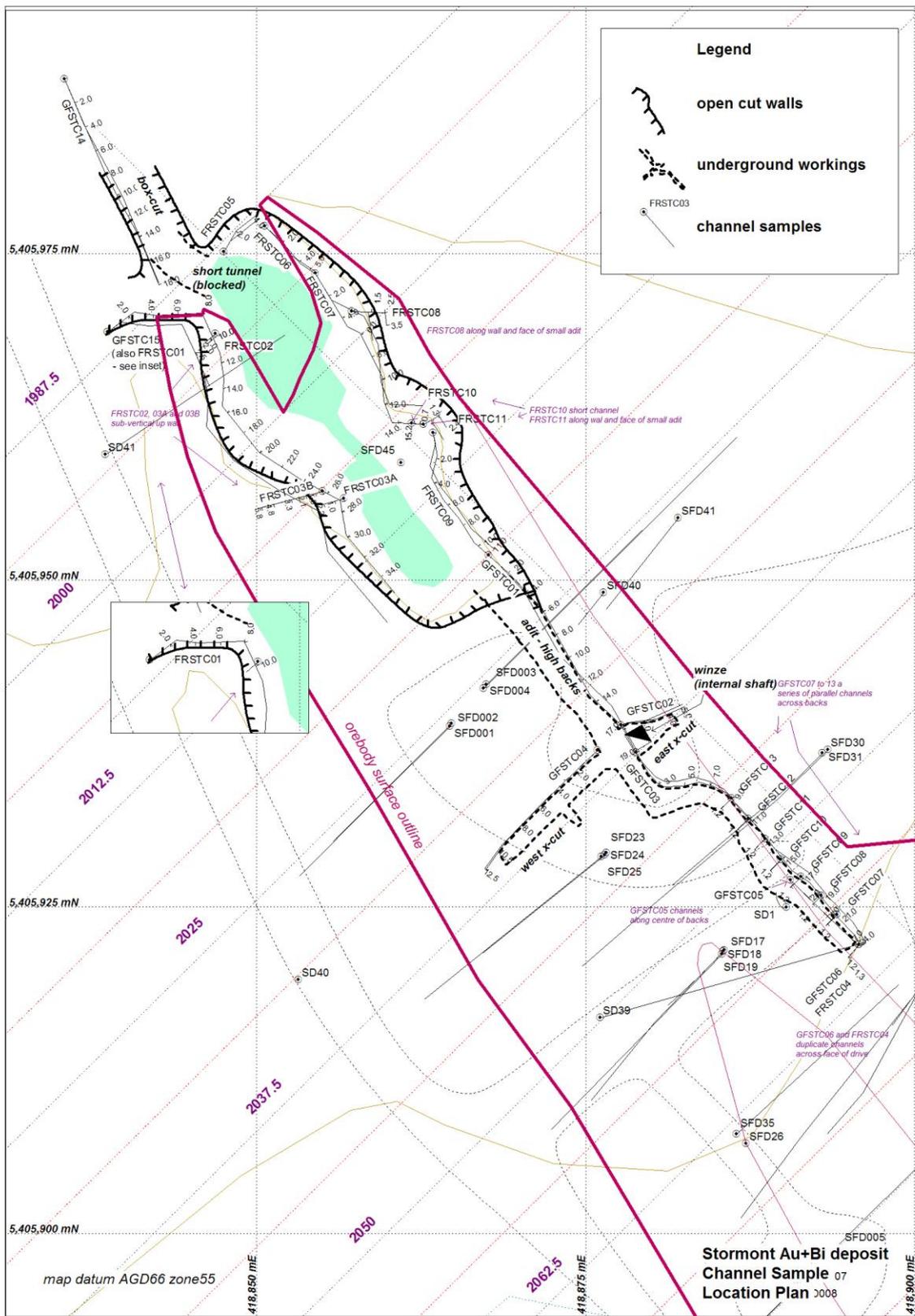
Figure 4.1: Channel sample locations – all programmes.
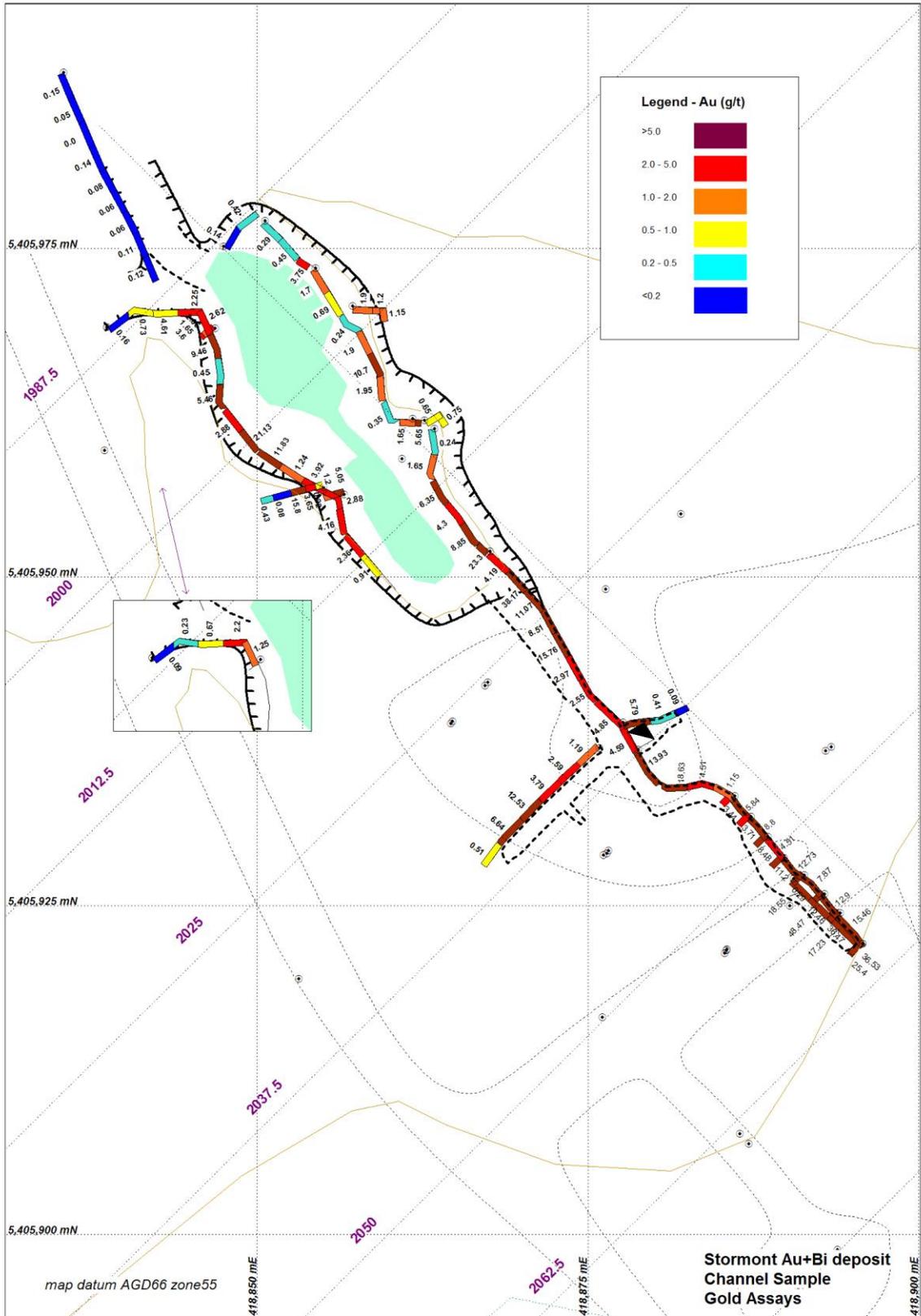
Figure 4.2: Channel sampling all programmes - gold assays.
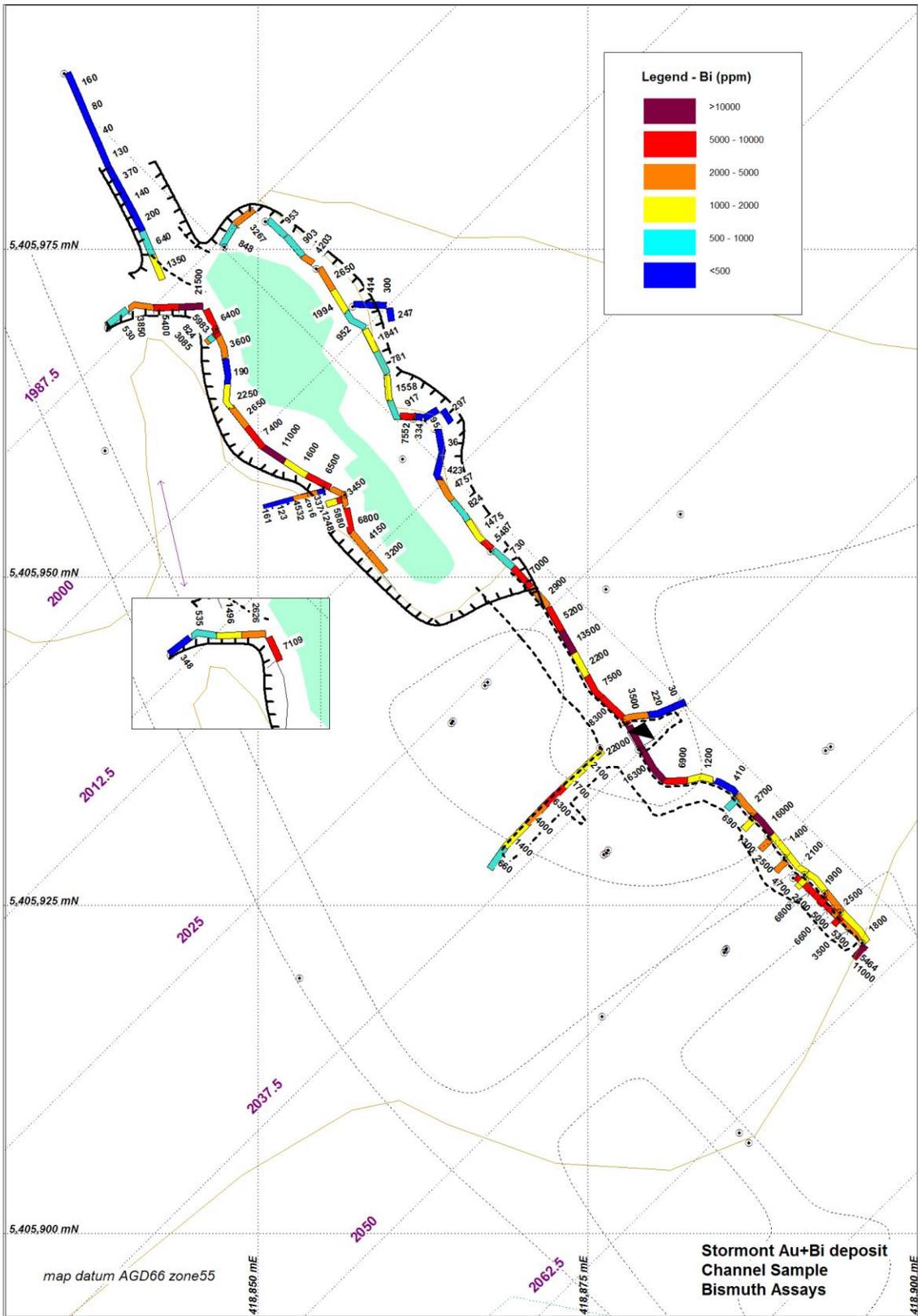
Figure 4.3: Channel sampling all programmes - bismuth assays.

4.2.2 Surveying

In the 2009 Inferred Resource calculation first round Frontier channel sample positions in the old open cut were surveyed by GPS whilst those of GFEL were estimated from old plans.

Channel samples in the old workings for both GFEL and Frontier channels were measured by tape from known features within the workings (i.e. from corner of cross-cut with main drive) and have been positioned accordingly so as to be correct with respect to the old workings. Some Frontier channel samples in the old open cut had hand-held GPS collars or were tape-and-compass surveyed from GPS points.

In the 2009 estimation the location and direction of these channels was determined by overlaying onto registered mine plans and locating them. This required some fudging.

2011 Frontier channel samples were surveyed (for the most part, bush shielded a few points) by conventional jigger with datum at the spike in the traffic island. Some (four) survey tags from first round Frontier sampling were also surveyed at the time allowing these to be better fixed in space.

The detailed, conventional surveying of the open cut and underground workings allowed both GFEL and first round Frontier channels to be better fixed in 3D space. In a number of instances the length of wall reportedly channel sampled falls a little less than the ascribed sample lengths where their position could be confirmed by features.

GFSTC01 was adjusted to commence on the open cut wall such that finished on the crosscut corner. GFSTC02 along the northeast crosscut is not 5.0m in length and so sample lengths were reduced by 0.2m.

4.3 Sampling

4.3.1 Drill samples

In all drilling programmes diamond drill core was split and sampled half core. In most instance core was cut by diamond saw though in more highly weathered sections core was split by hand (by mortice or sampled from loose material). Sample intervals are demonstrably based on the logged geology in apparently all instances.

4.3.2 Channel samples

Channel sample length was chosen by nominal sample length modified by physical changes in the surface being sampled (i.e. corners of drives, changes in the wall of the open cut). There is no description of the volume of material sampled in individual samples. GFEL's channel sampling programme was carried out using a pneumatic chisel. Frontier's sampling was carried out using a diamond saw.

4.3.3 Sample preparation and analyses

The resource has been estimated from samples from seven sampling programmes (4 drilling and 3 channel), however, results from the other three (all drilling programmes) have been used to constrain the resource.

Details of sample preparation are not given for the various programmes, however, since samples were all assayed by accredited laboratories with fire assay the method for gold analysis it is reasonable to assume that sample preparation was to industry standard.

Table 4.3 Assay method and detection limits		Au		Bi		Ag	
Sampling programme	Laboratory	Method	Detection limit (ppm)	Method	Detection limit (ppm)	Method	Detection limit (ppm)
GFEL channels	Analabs, Burnie	Fire assay	0.005	AAS	10	AAS	1
RGC SD1 to SD6	Analabs, Burnie	Fire assay	0.008	AAS	10	AAS	0.5
RGC SD7 to SD12*	Analabs, Burnie	Fire assay	0.008	AAS	10	AAS	0.5
Goldstream/Titan SD30 to SD42	Amdel, Adelaide	Fire assay	0.01	AAS	5	AAS	NA
Goldstream/Titan SD43 to SD45*	Amdel, Adelaide	Fire assay	0.01	AAS	5	AAS	NA
Jervois ST01 to ST04*	Analabs, Burnie	Fire assay	0.01	AAS	10	AAS	1
Frontier SFD01 to SFD16	Burnie Research Lab	Fire assay	0.01	AAS	10	AAS	1
Frontier channels FRSTC01 to 04	Burnie Research Lab	Fire assay	0.01	AAS	10	AAS	1
Frontier SFD17 to SFD47	Amdel, Adelaide	Fire assay	0.01	ICP	5	ICP	1
Frontier channels FRSTC05 to 011	Amdel, Adelaide	Fire assay	0.01	ICP	5	ICP	1

Over the five sampling programmes a range of elements have been assayed as well as Au, Bi and Ag. Due to the inconsistency of elements assayed only Au, Bi and Ag have been estimated in the block model though Ag was not assayed for in the Goldstream/Titan drillholes.

4.4 Quality control procedures

4.4.1 Introduction

As is common with exploration drilling for the early work there was only limited implementation of quality control procedures with most work that done by the assay laboratory as part of their own standard in-house QA/QC procedures. Further, that QA/QC carried out in the most recent programme indicated a systematic error in gold assays from Burnie Research Laboratories.

One of the foci of the 2011/12 work was to attempt to rectify this deficiency.

4.4.2 Reassaying Burnie Research Laboratories pulps

In the 2009 estimate it was recognised that there was a systematic error in the accuracy of the gold assays from Frontier's drilling and channel sampling. Standard G905-6 which is specified to be 5.96g/t Au (with standard deviation 0.02g/t Au) assayed on average 5.34g/t Au (with standard deviation 0.26g/t Au) from 26 individual assays in 7 batches.

This discrepancy is a major concern as given the predominance of Frontier samples in the database used in the estimation, if the Burnie Research Laboratories consistently undercalled the Frontier assays by the 10.5% indicated from the difference in Frontier's standards results this would see the grade of the resource increase by something of the order (only estimated roughly) 7% to 9%.

Fortunately the pulps from the relevant samples were available and were sent to Amdel for reanalysis.

The reassaying confirmed that BRL's analyses were incorrect with Amdel's grades in general higher by ~10% (the exception being very low levels which in a few instances were actually less than the BRL result). The discrepancy is illustrated in figure 4.4 which graphs BRL results (x axis) against Amdel reassays (y axis) with a tight linear regression line of the form

Amdel Au g/t = BRL Au g/t x 1.0583 + 0.0985   and with R^2 = 0.9893
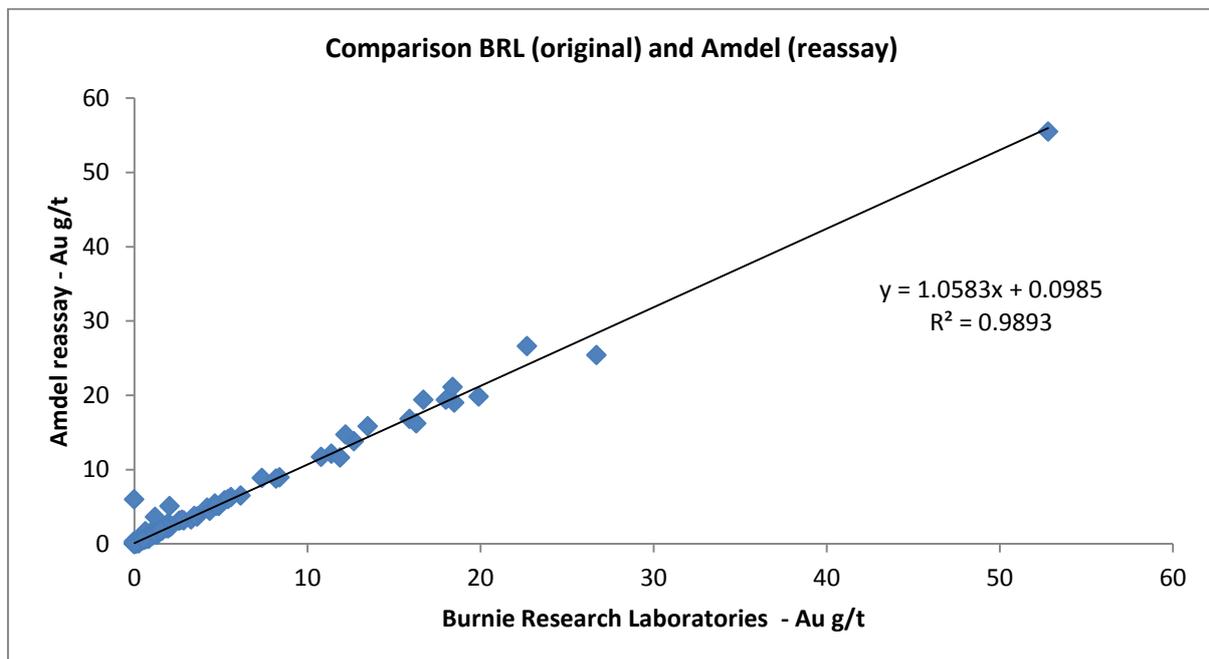
Figure 4.4: Comparison between 2008 Burnie Research Laboratories assays and AMDEL 2012 gold reassays.

Two standards were included a total of 23 times in the Amdel analysis, including the G905-6 standard pulp from the original BRL assaying and adding a further independent standard G907-7.

Standard G905-6 (Geostats) stated to be 5.96ppm with a standard deviation of 0.26ppm was assayed 15 times with a mean 5.95ppm with a standard deviation of 0.16ppm.

Standard G907-7 (Geostats) stated to be 1.54ppm with a standard deviation of 0.07ppm was assayed 8 times with a mean of 1.51ppm with a standard deviation of 0.04ppm.

This work has confirmed that the Burnie Research Laboratoy gold assays are likely incorrect and have been replaced in the database by the new Amdel assays.

4.4.3   Independent Standards

Laboratory repeats or earlier drilling/sampling programmes have been at the lower end of standard practice with most batches re-assayed at ~1/20 and with no focus on high grade samples. There has been no assaying of independent standards for bismuth.

Table 4.4 Quality control repeats and standards			
Sampling programme	Laboratory	Repeats	Standards reported
GFEL channels	Analabs, Burnie	No	no
RGC SD1 to SD6	Analabs, Burnie	No	no
RGC SD7 to SD12	Analabs, Burnie	No	no
Goldstream/Titan SD30 to SD42	Amdel, Adelaide	~1/20 and high grade zone	no
Goldstream/Titan SD43 to SD45	Amdel, Adelaide	~1/20	No
Jervois ST01 to ST04	Analabs, Burnie	~1/10	No
Frontier SFD01 to SFD16	Burnie Research Laboratories	~1/20	in-house and Frontier

Frontier 2008 channels	Burnie Research Laboratories	~1/20	in-house and Frontier
Frontier SFD17 to SFD47	Amdel, Adelaide	~1/20	in-house and Frontier*
Frontier 2011 channels	Amdel, Adelaide	~1/20	in-house and Frontier*

In the 2011 work gold standards were submitted with all batches every 25 samples. Standards used were Geostats G905-6 (14 times), G907-7 (11 times) and low grade Oreas141 (10 times), the latter acting more as a blank than a standard as it almost always assayed below detection limit.

G905-6 had a mean of 5.82ppm and standard deviation of 1.24ppm with 9 repeats averaging 5.90ppm and standard deviation of 0.38ppm.

G907-7 had a mean of 1.55ppm and standard deviation of 0.07ppm with 6 repeats averaging 1.63ppm and standard deviation of 0.09ppm.

The statistics support the high quality of the Amdel gold assays.

Initially it was hoped to use the in-house desktop for Bi analysis but by the end of the sampling programme it was apparent that the assays produced were of insufficient repeatability to use in an Indicated Resource estimation.

Amdel were asked to assay all pulps determined to have come from the mineralised zone (defined by a combination of gold and in-house XRF bismuth assays) for bismuth and silver using ICP. Unfortunately due to a misunderstanding no standards were included in the pulps chosen.

The only effective QA/QC for bismuth in the resource is the umpire check reassaying by Intertek.

4.4.4   Umpire reassaying

There had been no umpire re-assaying of residual samples by other laboratories in any of the sampling programmes. This was done with the samples from the 2011 programme.

The pulps from 44 samples from within the modelled orebody were sent on to Genalysis (Intertek) laboratories for Au, Bi and Ag reassay. 44 samples constitutes 12% of the 364 samples of the 2011 programme.

The mean Amdel gold grade of 2.65ppm whilst Intertek's mean is 2.59ppm. A plot of Intertek gold assays against original Amdel assays follows as figure 4.5.

The difference between the two is 2.3% and lies within acceptable bounds. Further work may be justified in better understanding the difference between the two assay sets.

Bismuth values differed somewhat between Amdel and Intertek with Intertek's almost invariably higher at significant values. Amdel's mean for the 44 samples is 1930ppm Bi whilst for Intertek it is 1842ppm, a difference of 4.8%. The difference is expressed in figures 4.5 and 4.6.

The difference is considered within reasonable bounds for check assaying though it would be wise to consider this in future mine planning. Future check assaying to clarify any differences may be justified but has not yet been undertaken.
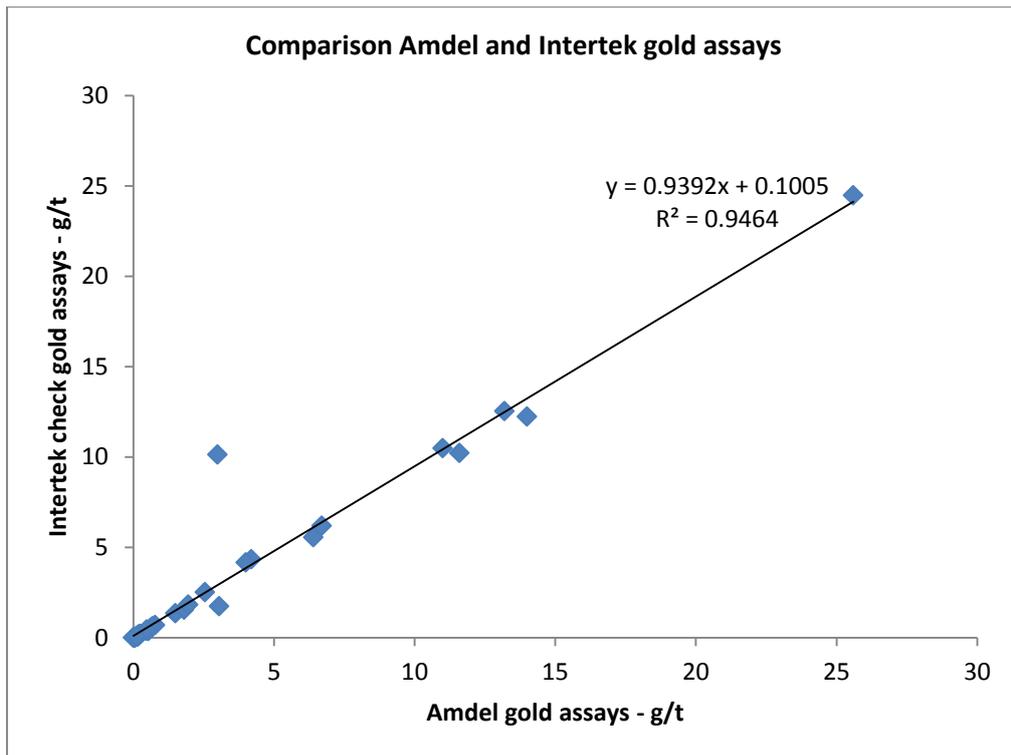
Figure 4.5: Comparison between Amdel original gold assays and Interteck check assays

Figure 4.6: Comparison between Amdel original bismuth assays and Intertek check assays
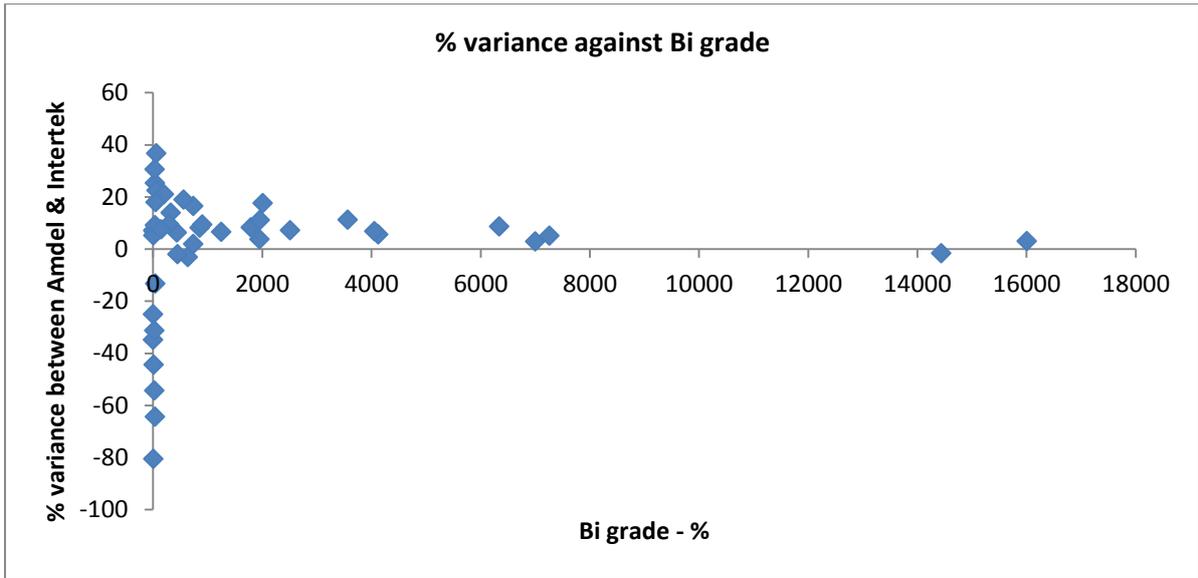
Figure 4.7: Variance between Amdel original bismuth assays and Interteck check assays against Bi grade

The relationship between Intertek's and Amdel's silver assays is less consistent with Interteks assays almost invariably markedly lower than Amdel's, in a number of instances half the original Amdel assay. This is clearly illustrated in figure 4.8. This discrepancy was only revealed late in the preparation of this estimate. Given the time required to resolve the discrepancy and the relatively small contribution of silver to the overall resource it was decided to note the difference and pursue the question should it be seen as significant. To this end the silver figure must be considered as Inferred at this point. This is also reasonable given the lack of silver assaying in drillholes SD1 and SD3.

Figure 4.8: Comparison between Amdel original silver assays and Interteck check assays

4.4.5   Field duplicates

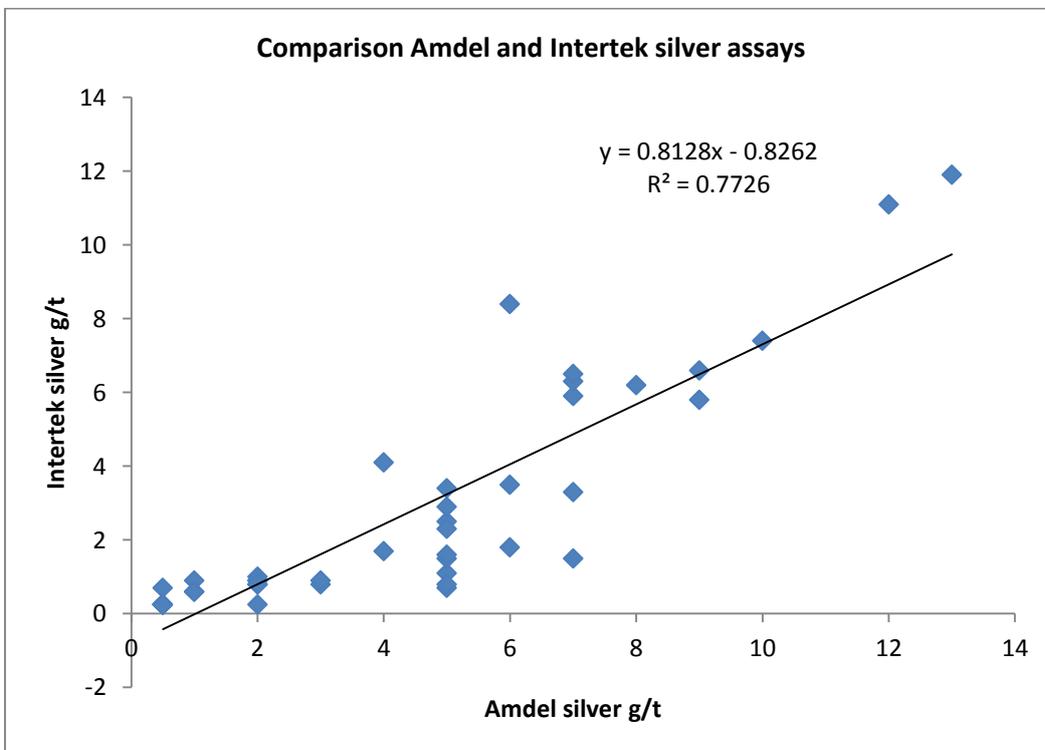There are two field duplicate sample data sets, one in drillcore, the other in channel samples.

Amdel reassayed the other half of the drillcore for 21 high grade samples from holes SD36 and SD39 for Goldstream/Titan with excellent repeatability. Raw data are presented in Table 4.5.

Table 4.5 Au repeat assays SD36 and SD39					
Hole ID	From	To	primary	repeat	2nd repeat
SD36	0	2.2	4.19	3.72	
SD36	5.2	6.7	0.45	0.05	
SD36	10.2	11.2	0.87	0.79	
SD36	11.2	12.7	0.59	0.58	0.64
SD36	12.7	14.2	0.12	0.1	
SD36	14.2	15.7	4.19	3.44	
SD36	15.7	16.7	15.3	14.5	
SD36	16.7	17.7	0.48	0.48	
SD36	17.7	18.7	0.72	0.76	
SD39	0	1.6	2.51	3.15	
SD39	1.6	3.1	0.77	0.76	
SD39	5.6	6.6	1.24	1.28	
SD39	7.6	8.6	1.57	1.75	
SD39	8.6	9.6	0.84	0.78	
SD39	9.6	10.6	1.27	1.17	
SD39	10.6	11.6	4.61	4.45	
SD39	11.6	12.6	3.11	2.84	
SD39	15.6	16.6	18.9	19.2	
SD39	16.6	17.6	14.6	13.9	13
SD39	17.6	18.6	3	2.67	
SD39	18.6	19.6	2.31	2.39	

In channel sampling Frontiers channel samples FRSTC01 replicates GFEL's channel GFSTC15 for part of its distance and FRSTC04 **approximately** replicates GFEL channel GFSTC06. Results are presented in table 4.6 and show a moderate correlation with 4.6 against 0.8 the main outlier. Sample locations for channel samples GFSTC15 and FRSTC01 are shown on figure 4.9. Channels GFSTC06 and FRSTC04 were each taken across the southernmost end of the adit at waist height.

Table 4.6 Au repeat samples - channels	
GFSTC15	FRSTC01
0.2g/t Au	0g/t Au
0.7g/t Au	0.2g/t Au
4.6g/t Au	0.8g/t Au
2.3g/t Au	1.8g/t Au
2.6g/t Au	1.1g/t Au
GFSTC06	FRSTC04
36.0g/t Au	26.7g/t Au
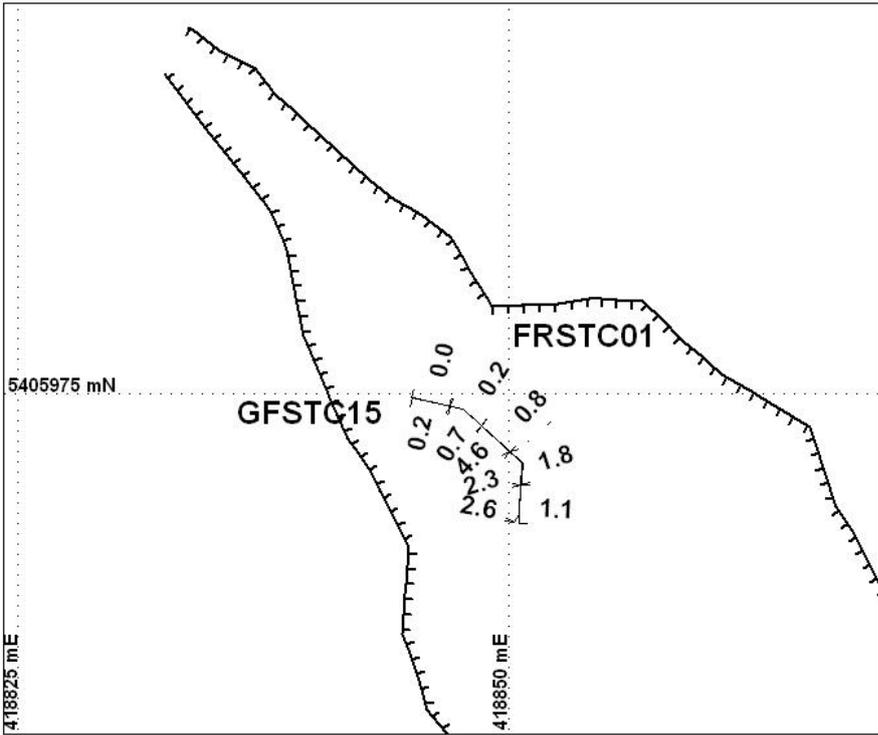
Figure 4.9: Location and gold assays (g/t Au) of recent Frontier FRSTC01 channel field duplicate samples and earlier Goldfields channel GFSTC15.

4.5   Bulk density

Frontier submitted 227 samples of drill core from the 2008 drilling programme for bulk density determination by the water immersion method. Of these 84 are from the high grade zone and have been used in this calculation.
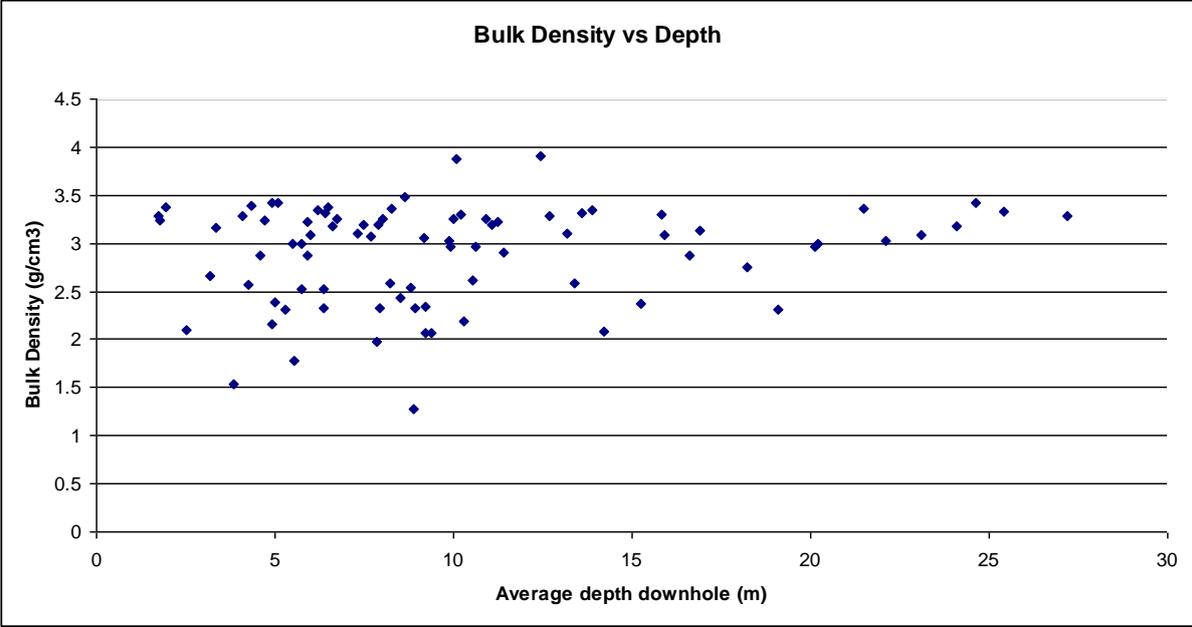
Figure 4.10:   Variation of bulk density with depth.

Logging SFD17 to SFD47 has shown the depth of complete oxidation to be relatively shallow i.e. generally <5m, although around the Stormont Adit Fault oxidation may persist to greater depths due

to groundwater movement along the fault. There has been no attempt to 3D model the strongly oxidised zones as a separate domain though this is achievable with the data available and recommended before mining of the deposit.

4.6   Surveying

As noted above as part of the 2011 work programme the old workings and all locatable relevant drillholes were surveyed by Len McKenzie, a certified surveyor of Burnie, one two instances and his son Adam, a 4th year student, on one instance.

Len surveyed a datum in the small clump of ferns and rock near the collars of SFD30 and 31 at MGA94 (zone55) 419011.04mE 5406119.4mN 629.77masl using differential GPS with a horizontal accuracy of +/-20mm and vertical accuracy of +/-60mm. From this datum Len surveyed all existing drillholes as well as creating a number of temporary and permanent reference points. This data was used to create the surface DTM.

On two separate occasions both Len and his son, a 4th year trainee surveyor, surveyed the old open cut and old workings. This was done by picking up both channel sample locations and salient points in the open cut at a roughly 5m x 5m density. The old adit and cross-cut was surveyed along the corners of both the floors and backs, both walls at about mid height and a centre line in the backs. These points were used to generate a 3DM of the old workings.

Len's datafile is also included in appendix D in file *Stormont_MGA94_Mckenzie_svypts_alldata.xls* in a folder titles *Surveying*. Be aware that these co-ordinates are in MGA94 zone 55 projection.

5.0   Data quality summary

For the 2009 Inferred Resource estimation the project database supplied by Frontier was in a series of .csv files. A thorough assessment of this database was made with only a few relatively minor errors recognised. These .csv files were imported into an MS ACCESS database *Stormont4.mdb.* This database was mapped into SURPAC and checked for internal inconsistencies using SURPAC's database verification function.

Newly acquired 2011 drillhole and channel sampling data was added to this database, renamed *Stormont9.mdb* and checked again using SURPAC's database verification function.

Whilst there are some minor shortcomings in the overall dataset i.e. lack of downhole surveying and minor difference in Bi grades between original and check assays the overall data quality is considered to be of sufficient quality to justify Indicated status. The principal underpinning of this level of confidence is small size of the deposit, drilling on 12.5m sections and the disseminated nature of both Au and Bi mineralisation indicated by a nugget effect of 25% (see section 8.2).

6.0   Geological interpretation and modelling

6.1   Methodology

3D modelling was carried out using both the 2D sectional approach and 3D on-the-fly approach using the same data set.

Interpretative linework was generated on 2D Discover/MapInfo sections showing geology, Au and Bi grade and some limited structural information. These sections were generated at 12.5m spacings as per Frontier's 045º-225º (AMG) grid (lines 1975E to 3000E) with +/-6..25m search envelopes. This 2D linework was exported via .dxf files format into 3D SURPAC where the linework was rotated and transformed to its correct position in AMG AGD66 space.   These 2D lines commonly carry an inherent inaccuracy due to the projection of drillholes up to +/-6.25m away onto these idealised 12.5m sections.

The same geological and grade data as displayed on the 2D generated sections was displayed in 3D using SURPAC's Display Drillholes function with the same contacts able to be snapped onto directly on-the-fly in true 3D space.

The combination of sectional linework (now in 3D space) and point data snapped directly onto drillholes was converted into a 3D triangulated surface .dtm using SURPAC's CREATE DTM function. Visual discrepancies in the resultant .dtm shape between the sectionally generated linework and point data were corrected by moving individual points on sectional linework up or down (i.e. in z direction) or less commonly sideways in the xy direction in order to generate a more geologically reasonable shape (all instances as a smoothed shape) but retaining the honouring of the point data snapped directly onto drillholes.

Geological shapes were completed by generating lines of intersection between cross-cutting geological features and incorporating these lines into the completed .dtm.   The high grade mineralised 3DM used for resource estimation was created by bringing together the .dtm's of the relevant bounding surfaces (i.e. surface, base of high grade mineralisation, Stormont Thrust etc. as detailed in section 3.3)*.*

The SURPAC 3D geological elements have been included in appendix D.   The orebody shape developed is named *Stormont_10_orebody* and is also included in appendix D.
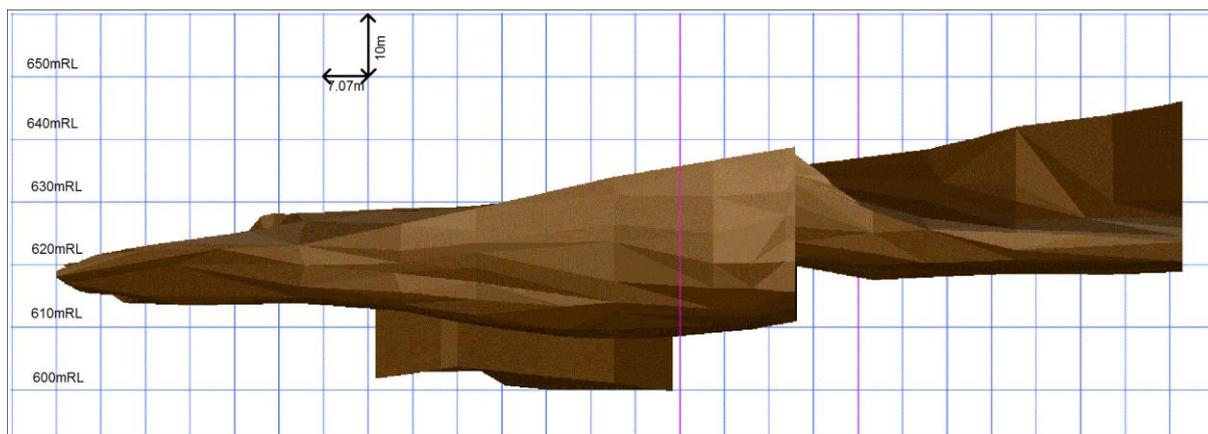

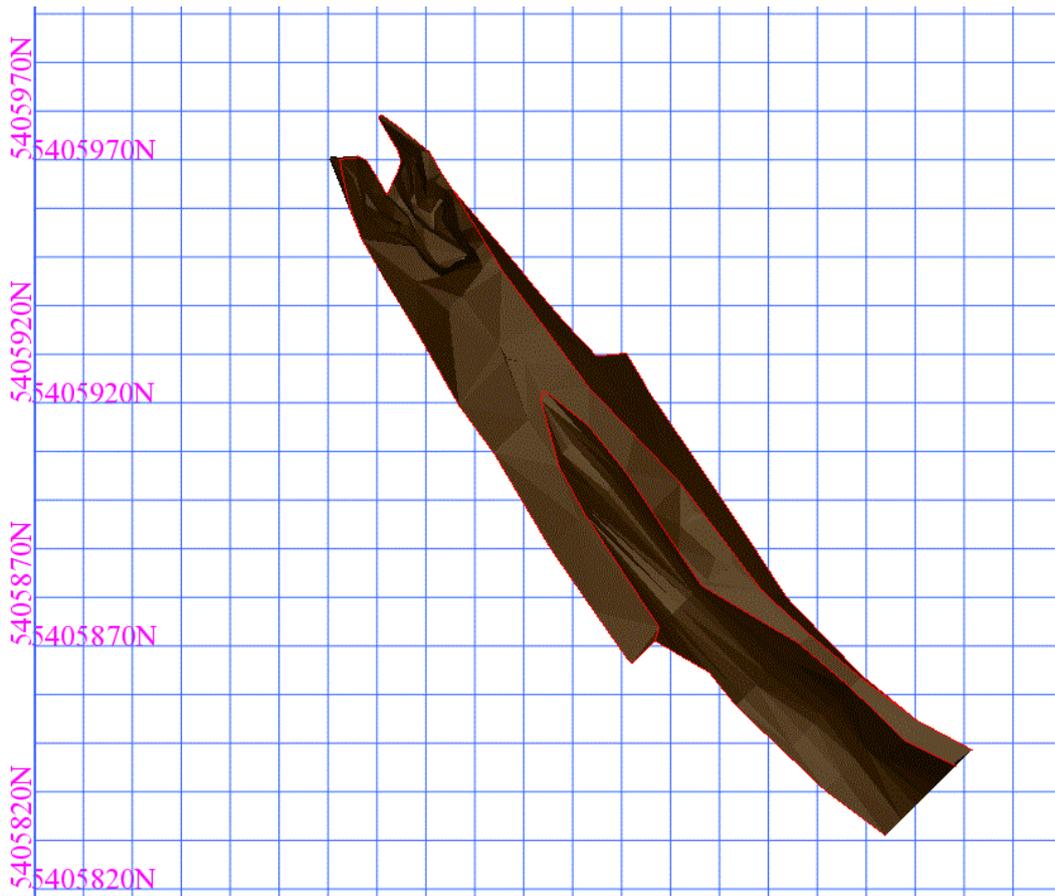**Figure 6.1: Orebody 3dm Stormont_10_orebody.dtm looking to the northeast.**

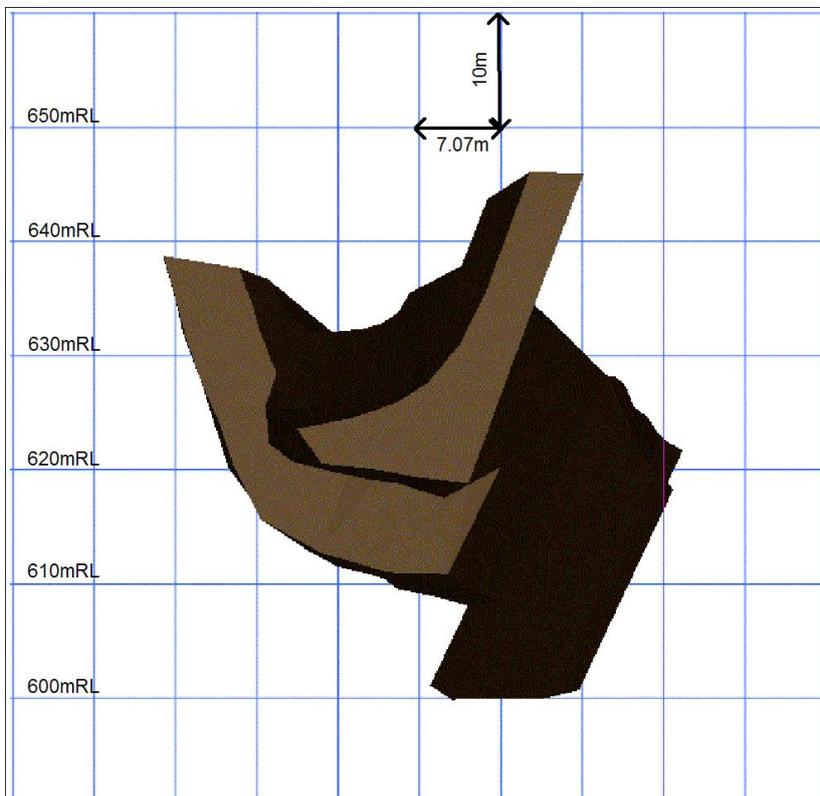**Figure 6.2: Orebody 3dm Stormont_10_orebody.dtm looking down.   Grid is AGD66 zone55.**

Figure 6.3: Orebody 3dm Stormont_10_orebody.dtm looking to the northwest

6.2 Surface DTM/Old Adit 3DM

The surface.dtm was generated from a combination of 3D points generated from Len McKenzies surveying of drillhole collars, permanent and temporary reference points and channel sample locations and salient points in the old open cut. The density of these points is adequate in all but the southwestern margin of the deposit where there are only a few points.

The points agree with 10m contours shown on the 1:25,000 map sheets and these contours were used to flesh out the surface DTM along the southwestern side.

A 3DM of the old adit was generated from the 3D points surveyed by Len's son Adam. Points were read every few metres along the corners of the floor and backs, along both walls at mid-height and along a centre line in the backs.

6.3 Mineralisation domain modelling

A single mineralised domain *Stormont_10_orebody* was modelled for the whole deposit.

Grade defined sub-domains are recognisable (see figures 3.23 to 3.35) and have been called Upper High Grade, Low Grade, Lower High Grade and Fault. Separate oxidised and fresh domains are also recognisable. In both instances it was considered that insufficient control was available to robustly define these domains and so no sub-domaining was attempted.

Visual inspection of 2D sectional data (see figures 3.4 to 3.17) and colour coded high grade sections in 3D shows that there is clearly a high grade Au zone in the northern part of the central zone lying in the stratigraphically upper part of the skarn immediately beneath the black clay around the keel of the syncline and extending up both limbs in the middle part.

This high grade zone "dugout canoe" shaped 3DM is constrained on its upper surface for the most part by the surface topography. Southwest of section 2050mE the middle of the DTM's upper margin is constrained by the black clay unit.

The bottom and southwestern side of the 3DM are grade constrained for the most part with a nominal cut-off of 1g/t Au. Bi has not been specifically used to constrain the mineralised zone but it follows gold anyway and no high grade Bi has been excluded in the modelling.

The apparent stratabound/stratiform distribution of mineralisation has been used to justify the curved near surface southwestern margin of the mineralised domain.

Southwest of section 2100mE the Lower High Grade domain weakens and the base of the Upper High Grade zone becomes the base of the modelled mineralised domain though mineralisation also becomes focussed on northeastern limb of the fold and is arguably now fault controlled.

The northeastern margin of the mineralised domain is less well defined. On sections 2000mE to 2050mE it appears that the Stormont Adit Fault is controlling the lateral extent of mineralisation. On sections 2062.5mE to 2100mE mineralisation extends up to 10m laterally into the rocks in the footwall to the Stormont Adit Fault with no obvious control on the northeastern margin of this zone. Whilst there is no evidence to support such an interpretation the northeastern margin of mineralised domain in this area has been modelled as a planar surface paralleling the Stormont Adit Fault.

6.4 Validation of geological interpretation and wireframe models

Validation of the geological interpretation and wireframe has been undertaken visually in 3D and on sections in figures 3.4 to 3.17.

7 STATISTICAL ANALYSIS

7.1 Introduction

Statistical analysis was undertaken based on composited datasets of the gold, silver and bismuth assays. The activities completed in this phase of the study were as follows:-

▪ Compositing of the drillhole data to lengths within the coded mineralisation interval.

▪ Compilation of descriptive statistics and histogram plots of the composite gold, silver and bismuth datasets.

▪ Outlier grade analysis and determination of upper cuts.

▪ Assessment of data clustering and calculation of de-clustered grade statistics.

7.2 Data Coding

The wireframe model of the mineralised high grade domain has been used to assign a code into the drillhole database to allow assessment of the variation in grade in the domain. The coding applied to the database is summarised in Table 7.1.

Table 7.1: Domain coding					
Domain		**Wireframe**		**Variable**	
Type	**Description**	**Name**	**Type**	**Name**	**Code**
High Grade Mineralisation	Inside high grade domain	*Stormont_10_orebody.dtm*	solid	Zone	1

The domain coding assigned to the drillholes was visually compared with the corresponding wireframe boundaries in cross section and plan views to ensure all coding was robust.

7.3 Compositing

The drillhole database coded within each interpreted domain was composited as a means of achieving a uniform sample support. It should be noted, however, that equalising sample length is not the only criteria for standardising sample support. Factors such as angle of intersection of the sampling to mineralisation, sample type and diameters, drilling conditions, recovery, sampling/sub-sampling practices and laboratory practices all affect the 'support' of a sample. Exploration/mining databases which contain multiple sample types and/or sources of data provide challenges in generating composite data with equalised sample support, and uniform support is frequently difficult to achieve.

A regular 2m run length (down hole) composite was chosen as 33% of samples were collected at intervals of greater than 1m and only 1% greater than 2m (Figure 7.1).

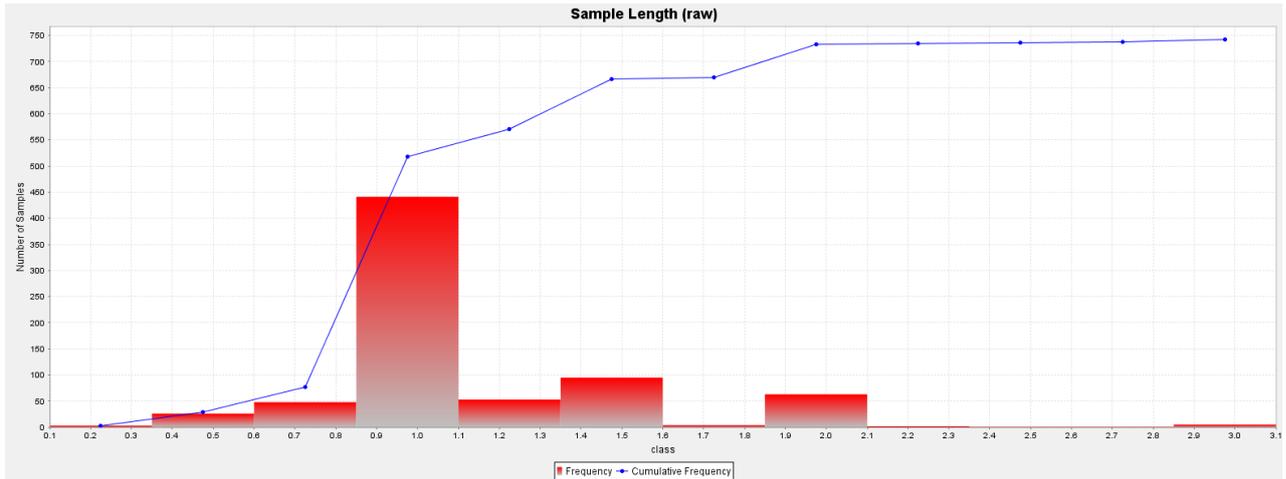The SURPAC 2m composite file is included in appendix D.

Figure 7.1: Sample length

7.4 Statistical Analysis of Composite Data

Detailed statistical analysis of the gold, silver and bismuth composite data was conducted for all composites..

Descriptive statistics for the composites are presented in Table 7.2. The summary charts of these datasets indicate that they all form positively skewed distributions. Individual box plots, histograms, log histogram plots and probability plots for each element are presented in Appendix B. The log histograms and probability plots for each element indicate that there may be more than one population of grade in the mineralised domain. However, the relatively low number of composites and irregular data spacing preclude any further domain subdivisions.

Table 7.2: Summary 2m Composite Statistics			
	Au (ppm)	**Ag (ppm)**	**Bi (ppm)**
Mineralised Domain			
Count	438	242	423
Minimum	0.005	1	4.24
Maximum	48.47	21.5	28,315
Mean	3.67	5.93	2,231
Median	1.07	5.54	824
Standard Deviation	6.76	4	3,529
Coefficient of Variation	1.84	0.67	1.58

7.5 Assessment of Upper Cuts

Assessment of the composite outliers was completed to determine the requirement for high grade cutting (high grade cuts) for each of the input datasets to be used for resource estimation. The approach taken to the assessment of the high grade composites and potential outliers is summarised as follows:-

▪ Detailed review of histograms and probability plots of reef composites, with significant breaks in populations used to interpret possible outliers.

- Investigation of clustering of the higher-grade data. High grade data that are clustered were considered to be real while high grade composites not clustered with other high grade data were considered to be possible outliers, requiring further consideration via cutting.

- The ranking of the composite data and the investigation of the influence of individual composites on the mean and standard deviation (mean versus standard-deviation plots).

Following the compositing of the sample data a series of high grade cuts or caps were determined as presented in Table 7.3. The upper cuts as applied results in a reduction in mean grades of between 1% and 7% for the three elements.

Table 7.3: Composite Outlier Analysis

Element	No. of Data	Raw Data				Cut Data				No. of Data Cut	Mean % Decrease
		Max	Mean	Std Dev	CV	Upper Cut	Mean	Std Dev	CV		
Au	438	48.47	3.67	6.76	1.84	25	3.4	5.45	1.6	11	7%
Ag	242	21.5	5.93	4	0.67	15	5.83	3.67	0.63	7	2%
Bi	423	28,315	2,232	3,529	1.58	12,000	2,079	2,821	1.36	7	7%

7.6   De-clustered Statistics

Cell de-clustering has been undertaken to assess the effects of the data clustering on the global mean grade. Clustering of high grade data is apparent from the sampling of the historical workings. Table 7.4 presents a comparison of the naïve and de-clustered mean grades for each element. It is evident that de-clustering results in considerably reduced mean grades for each element.

Table 7.4: Comparison of Naïve and De-clustered composite datasets

Element	Naïve Mean Grade	Cell size (m) Y x X x Z	De-clustered Mean Grade	% difference
Au	3.67	30m x 30m x 5m	2.57	30%
Ag	5.93	30m x 30m x 5m	5.41	9%
Bi	2,232	30m x 30m x 5m	1,527	32%

7.7   Correlation Analysis

Bivariate analysis was completed on the uncut data between gold, silver and bismuth data located within the modelled mineralised domain. Little linear correlation is noted between any of the data (Table 7.5). Visually there is quite a strong correlation between gold mineralised samples and bismuth mineralised samples (see figures 3.24 to 3.36).

Table 7.5: Correlation Matrix Correlation Coefficient

	Au	Ag
Ag	0.28	
Bi	0.42	0.54

7.8   Bulk Density Statistics Analysis

Frontier's 84 samples averaged 2.9 g/cm^3 with a maxima of 3.91, minima of 1.28 and standard deviation of 0.51. There is not a strong relationship between bulk density and depth. Bulk density has not been estimated into the block model but rather a single value of 2.9 g/cm^3 has been used.

8.0 VARIOGRAPHY

8.1 Introduction

Variography is used to describe the spatial correlation (co-variance) between data points within an interpreted zone for a nominated distance or lag. All data points within the zone are compared at nominated lag distances with the average squared difference of the two sample points obtained. The averaged squared difference of the data point's gamma (h), for each lag distance, is plotted on an X-Y graph. The variogram displays the lag distance (h) on the X-axis and the average squared differences (gamma value) for the nominated lag distance as the Y-axis. This calculated graph is called an experimental semi-variogram. It should be noted that in the text semi-variograms will be referred to as variograms.

Variography can be undertaken in many forms depending on the aims of the study. The variography for the Stormont Deposit has been completed based directly on the composite data values using a normalised spatial measure known as the pairwise relative variogram. However, in this document, the term "variogram" is used as a generic word to designate the function characterising the variability of variables versus the distance between two samples.

A series of mathematical models are fitted to the experimental variography which, when used in the Kriging algorithm, will recreate the spatial continuity observed in the modelled variography.

A standard approach was used to generate and model the variography for each envelope. The steps taken are summarised below:-

■ Generate and interpret a 3D gridded variance map to aid in the determination of the major, semi-major and minor axes of continuity.

■ Generate and model the downhole direction variogram, which allows the determination of the nugget effect (close spaced variability).

■ Calculate and model the major, semi major and minor axes of continuity.

The variography was calculated and modelled using the Isatis geostatistical software package.

8.2 Grade Variography

Detailed variography was completed for the 2m composites for Au, and Bi, coded within the interpreted mineralisation domain. There were insufficient data points to generate robust variograms for Ag.

The direction of maximum continuity for Au and Bi is horizontal and approximates the strike of the mineralised domain.

A visual representation of the direction of maximum continuity and overall ranges is displayed in appendix C.

The modelled variography for Au and Bi display very similar sills and ranges, therefore the variogram model for Au was adopted for all three elements. The variogram model displays a high level of short scale variability that is comprised of a moderate (15%) relative nugget. The variogram model is dominated by a short range structure that accounts for 65% of the total variance including nugget effect, with a range of 15m. The overall range is 70m. The semi-major and minor axes display equivalent short ranges for both structures (5m), and 25m and 12m respectively for the overall ranges.

The fitted variogram model is presented in Table 8.1, while the variogram plot is included in Appendix C.

Table 8.1: Summary Variogram Models												
Rotation (Surpac)			Nugget (C0)	Sill (C1)	Range (m)			Sill (C2)	Range (m)		
Z	X	Y			major	semi-major	minor		major	semi-major	minor
Au											
130	0	0	0.15	0.5	15	5	5	0.35	70	25	12

9.0   BLOCK MODELLING

9.1   Introduction

A three dimensional block model was constructed using Surpac mining software. The block model contains sufficient variables to record the results of Ordinary Kriging (OK) grade estimates and other required parameters.

The block model is named *Stormont_2012_03.mdl* and is included digitally in appendix D

9.2   Block Construction Parameters

The block model was constructed using appropriate three dimensional extents encompassing the modelled mineralised domain. Parent block dimensions were selected based on both the data spacing and mine planning considerations, and sub-block dimensions were chosen to enable accurate reproduction of the wireframe volumes of the mineralisation domain. The coordinate extents of the block model and the dimensions are summarised in Table 9.1.

Table 9.1: Block model dimensions *Stormont_2012_03.mdl*								
	Model Origin Coordinates	**Extent (m)**	**Rotation**			**Number of Blocks**	**Block Size (m)**	
			Azimuth	**dip**	**plunge**		**Parent**	**Sub-block**
East	418860	80				16	5	1.25
North	5406000	250	140	0	0	50	5	1.25
Elevation	600	50				10	5	1.25

The wireframed topographic surface and mineralisation domain have been coded to the block model.

Table 9.2 displays a listing of the variables in the Stormont block model. Wireframe coding incorporated into the model is summarised in Table 9.3.

Table 9.2: Block model variables	
Variable	**Description**
au	Estimated Au ppm
ag	Estimated Ag ppm
bi	Estimated Bi ppm
au_equiv	Calculated Au equivalent (Au + 0.01627Ag + 0.0002Bi)
dis	Distance to nearest sample used in Au estimation
avdis	Average distance to samples used in Au estimation
kvar	Kriging variance
matl	Material (1=mineralised, 2=non-mineralised, 3=air)
numsamp	Number of samples used in estimation
pass_au	Estimation pass number (Au)

Table 9.3: Block model coding				
Variable	**Code**	**Constraint**	**Wireframes**	**Description**
matl	1	Inside	*Stormont_10_orebody.dtm*	High grade mineralisation
matl	2	Outside	*Stormont_10_orebody.dtm*	Non-mineralised
matl	3	Above	new_stormont_topo_clean_3.dtm	Air

9.3 Validation

The block model has been extensively validated against the mineralisation wireframe. The model has been validated by viewing in multiple orientations using the 3-D viewing tools in Surpac. Based on the visual review the block model was considered a robust representation of the interpreted mineralisation.

10.0   Grade Estimation

10.1   Introduction

Resource estimation for the Stormont deposit was undertaken using Ordinary Kriging (OK) as the principal estimation methodology for gold, silver and bismuth.

10.2   Ordinary Kriging

The grade interpolation for this exercise is based on Ordinary Kriging (OK), one of the more common geostatistical methods for estimating the block grade. In this interpolation technique, contributing composite samples are identified using a search volume applied from the centre of each block. Weights are determined so as to minimise the error variance considering both the spatial location of the selected composites and the modelled variogram.   Variography describes the correlation between composite samples as a function of distance and direction.   The weighted composite sample grades are then combined to generate a block estimate and variance.

10.3   Search Neighbourhood

Search ellipse orientation and radii, as well as minimum and optimum number of samples were determined based on variogram orientation, variogram model anisotropy and ranges, horizon geometry and data distribution. Figures 10.1 and 10.2 displays the search ellipse in relation to the mineralised domain.
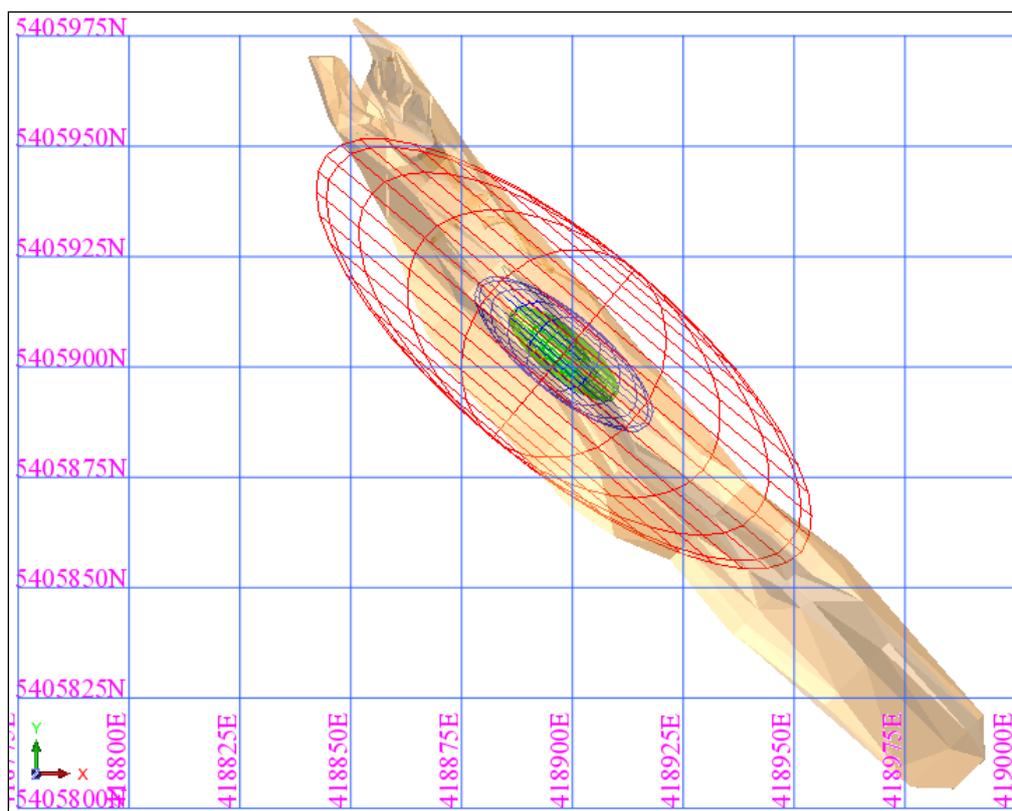

Figure 10.1: Search Ellipse Orientation – 1st pass (green), 2nd pass (blue), 3rd pass (red) – plan view
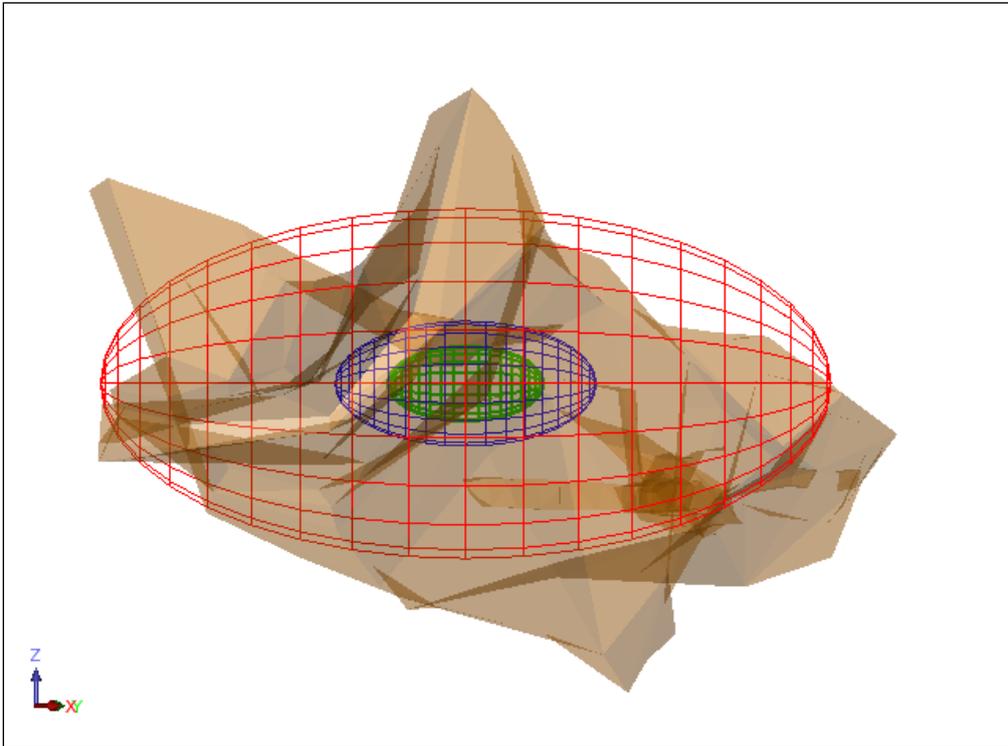
Figure 10.2: Search Ellipse Orientation – 1st pass (green), 2nd pass (blue), 3rd pass (red) – looking horizontally to 045° (true)

10.4   Grade estimation

Estimation used the variogram model parameters determined from grade variography, as discussed in Section 8.0.

OK estimates were completed using an optimised whole block discretisation of 4 points in the east-west dimension, 4 points in the north-south dimension, and 1 points in the vertical dimension for a total of 16 discretisation points per whole block estimate. Any sub-blocks within the 3-D limit of each whole block were assigned the whole block OK estimates.

A multiple search strategy was applied in obtaining the estimates. Table 10.1 provides the sample search parameters applied for each pass.

Domain control was used for both the input composite data and block selections.

The OK estimates were completed using Surpac mining software. In estimating the grade, the standard fields relating to the search neighbourhood used, number of composites selected, the distance to the nearest composite, the average distance of composites and the kriging variance were recorded. No change of support has been applied.

Table 10.1: Summary of Sample Search Parameters								
Estimation Pass	**Sample Search Orientation**			**Sample Search Distance (m)**			**Samples**		
	Major	**Semi-major**	**Minor**	**Major**	**Semi-major**	**Minor**	**Min**	**Max**	**Max per DH**
1	130	0	0	15	5	3	12	30	5
2	130	0	0	25	9	4	12	30	5

| 3 | 130 | 0 | 0 | 70 | 25 | 12 | 6 | 12 | 5 |

10.5   Block Model Files

The resultant grade estimates are held in the model file *Stormont_2012_03.mdl* included in appendix D.

10.6   Validation

The resulting estimates were extensively validated by visual and statistical comparison of block estimates against the source date for each estimated domain.

Downhole primary data is plotted against slices of the block model coloured by Au grade and Bi grade for 12.5m wide sections from 2000mE to 2150mE in figures 10.3 to 10.15 and 10.16 to 10.28 respectively.

Detailed visual estimation was also undertaken in other views (long section and plan) and in 3D using the graphics facilities in Surpac.

Further validation of the estimate was made by comparison with the mean grades over 10m thick northing slices and 5m thick elevation slices (Figures 10.29 and 10.30).

The analysis clearly demonstrates that the grade variability in composites is greater than that of grade estimates. The directional trends observed in composites are more or less reproduced within the block estimates. Acceptable levels of reproducibility are noted between the input composites data and the block estimates on the basis of visual review. On this basis and the other validation checks, it is considered that the OK whole block estimates are appropriate and robust.
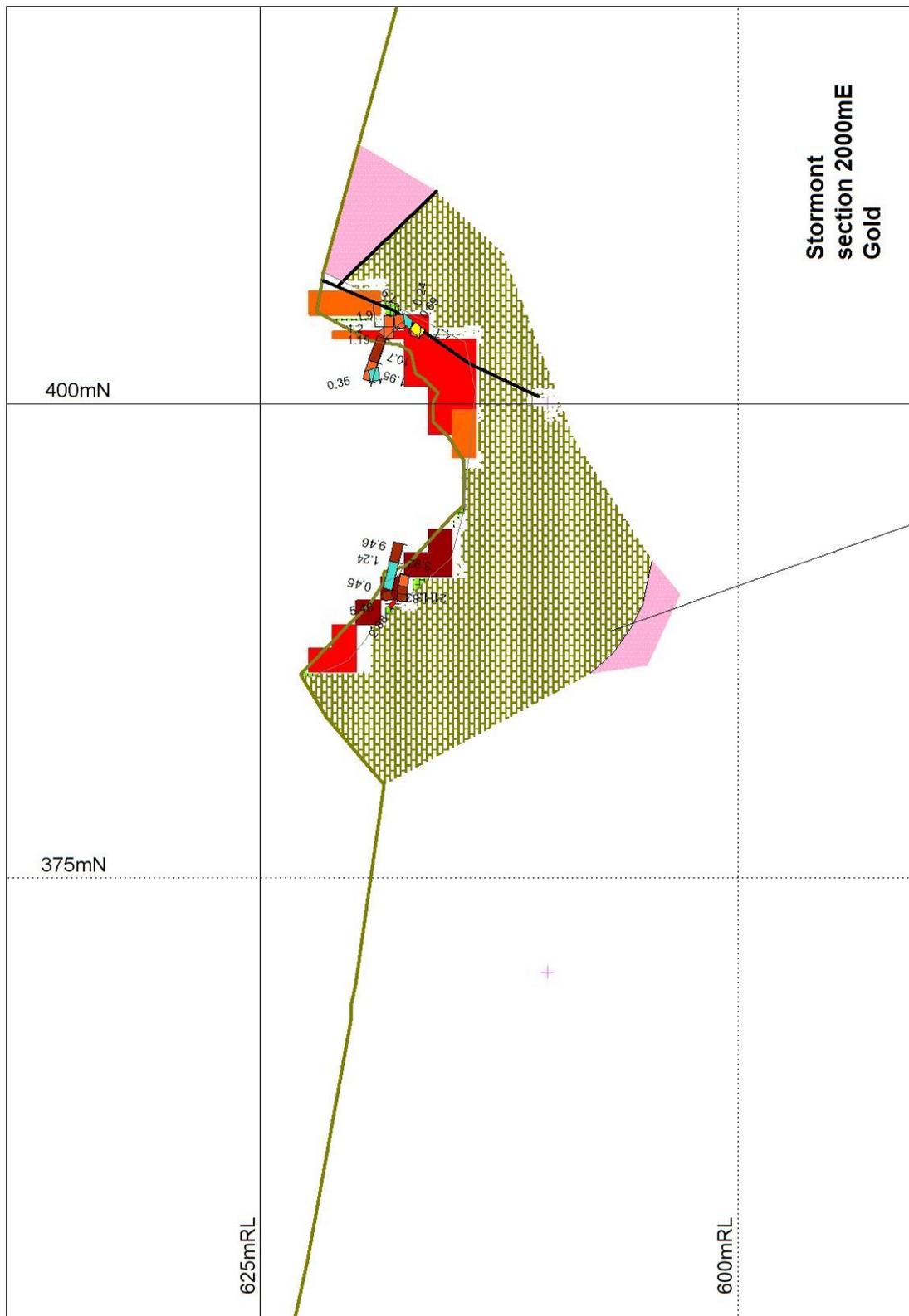
Figure 10.3: Section 2000mE +/-6.25m, downhole gold grades superimposed on (same) gold colour coded slice of block model.
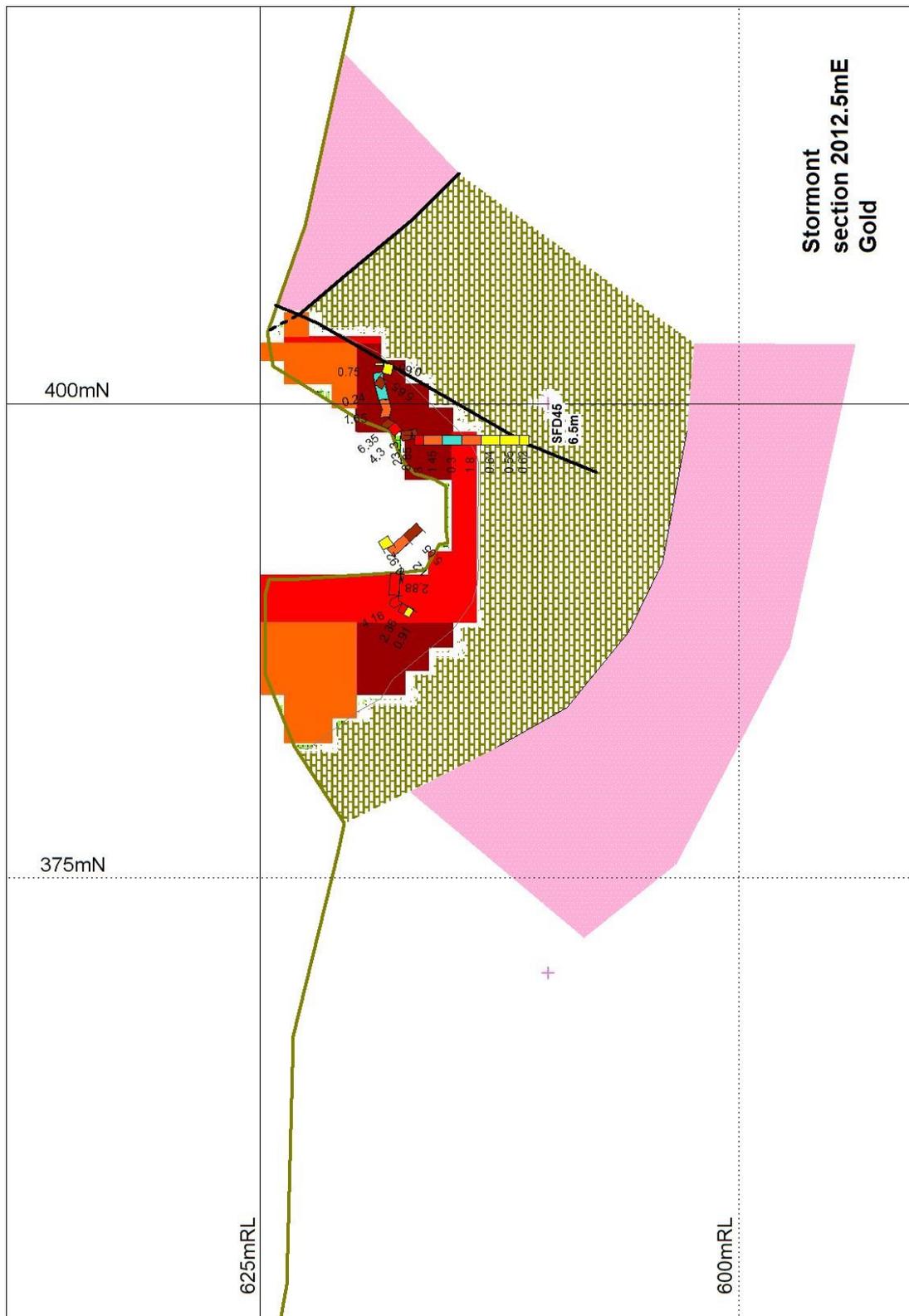
Figure 10.4: Section 2012.5mE +/-6.25m, downhole gold grades superimposed on (same) gold colour coded slice of block model.

Figure 10.5: Section 2025mE +/-6.25m, downhole gold grades superimposed on (same) gold colour coded slice of block model.
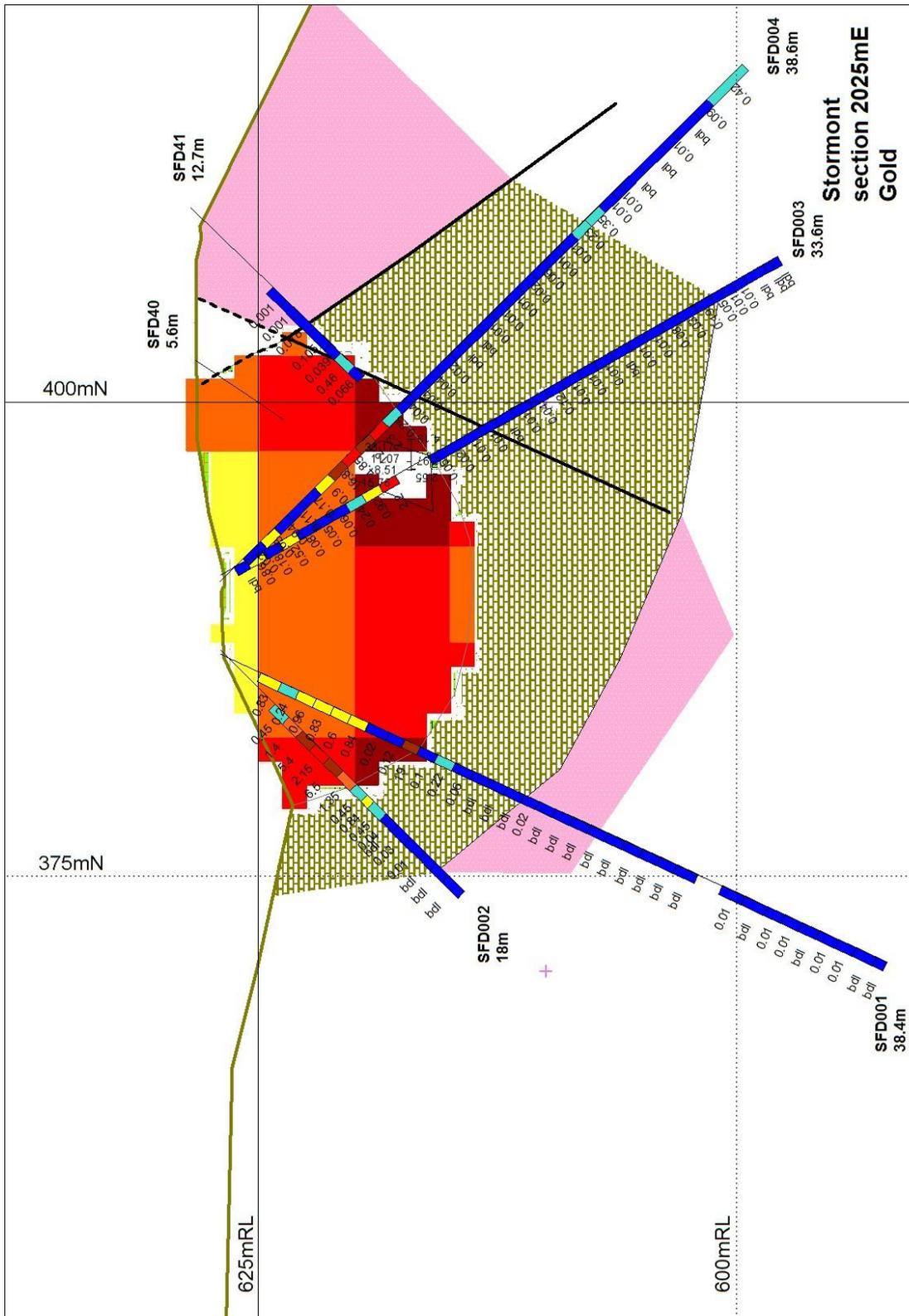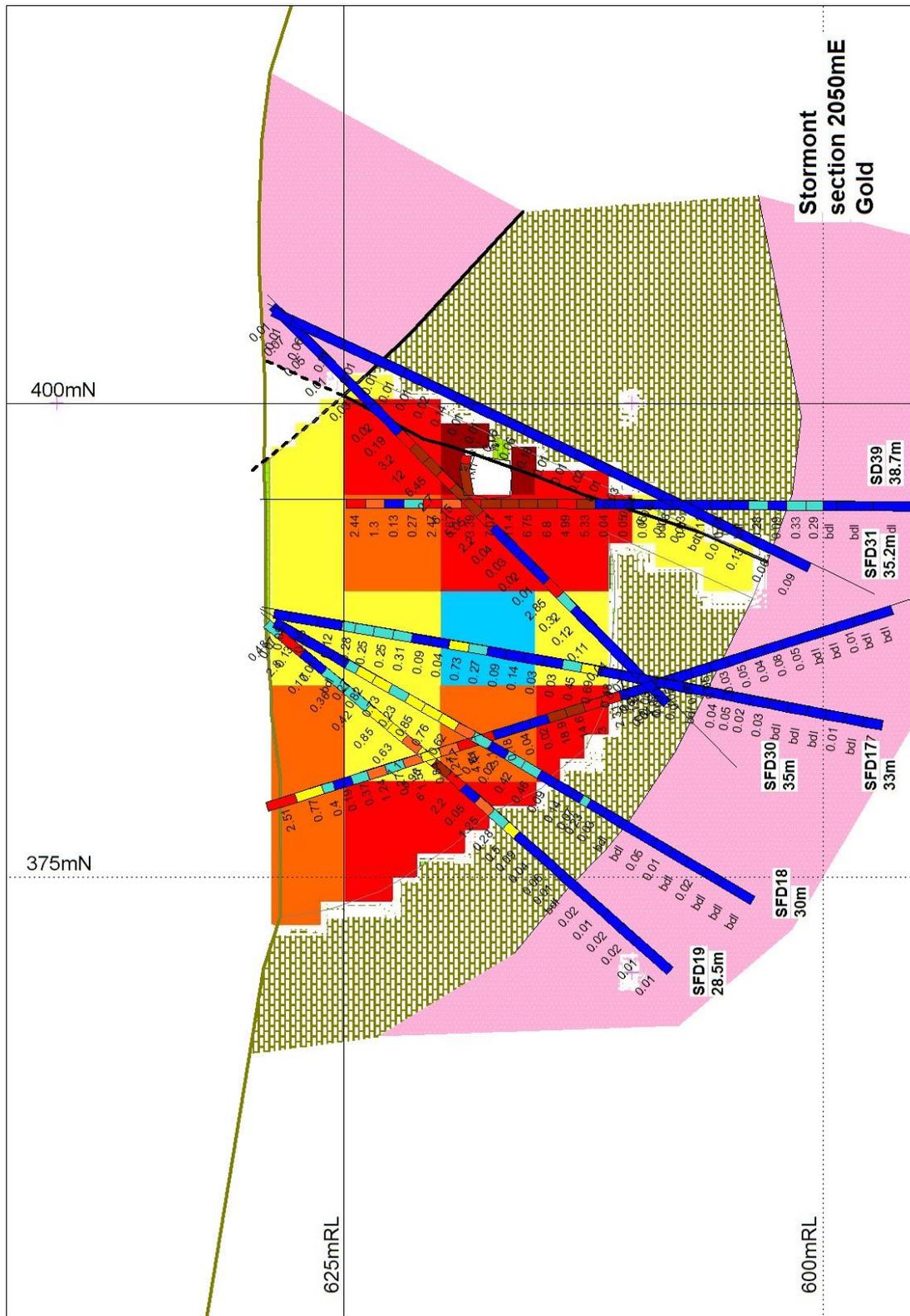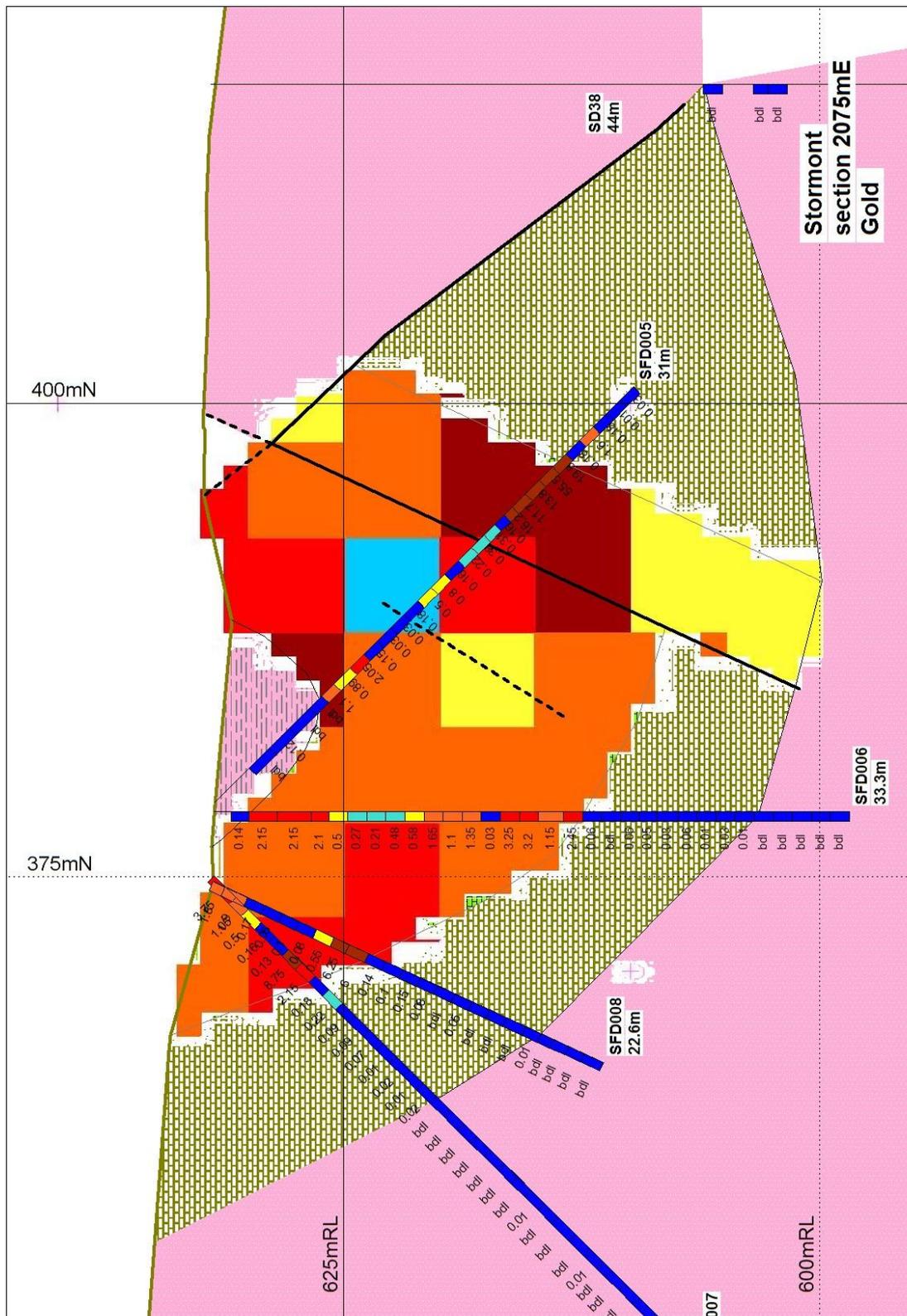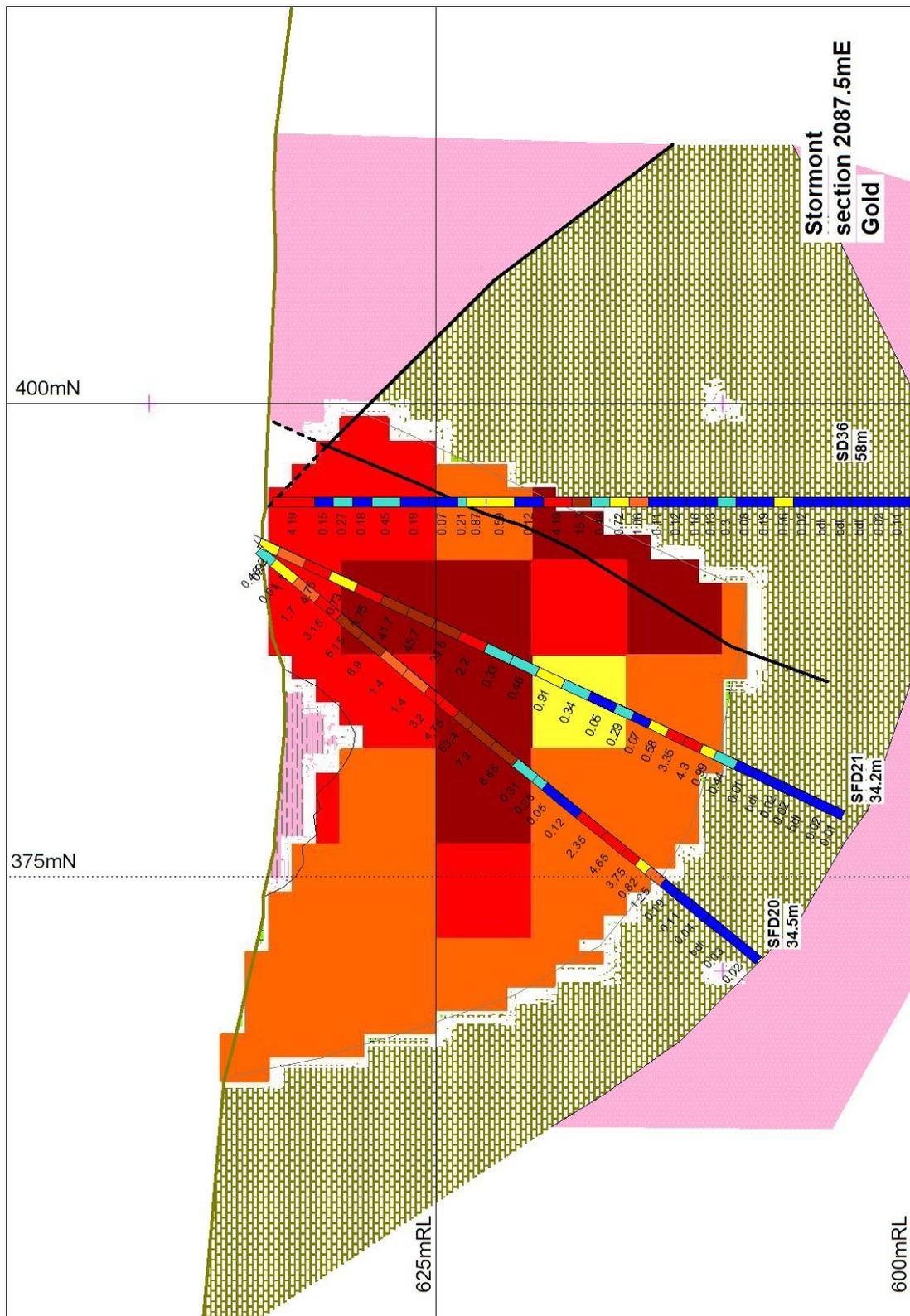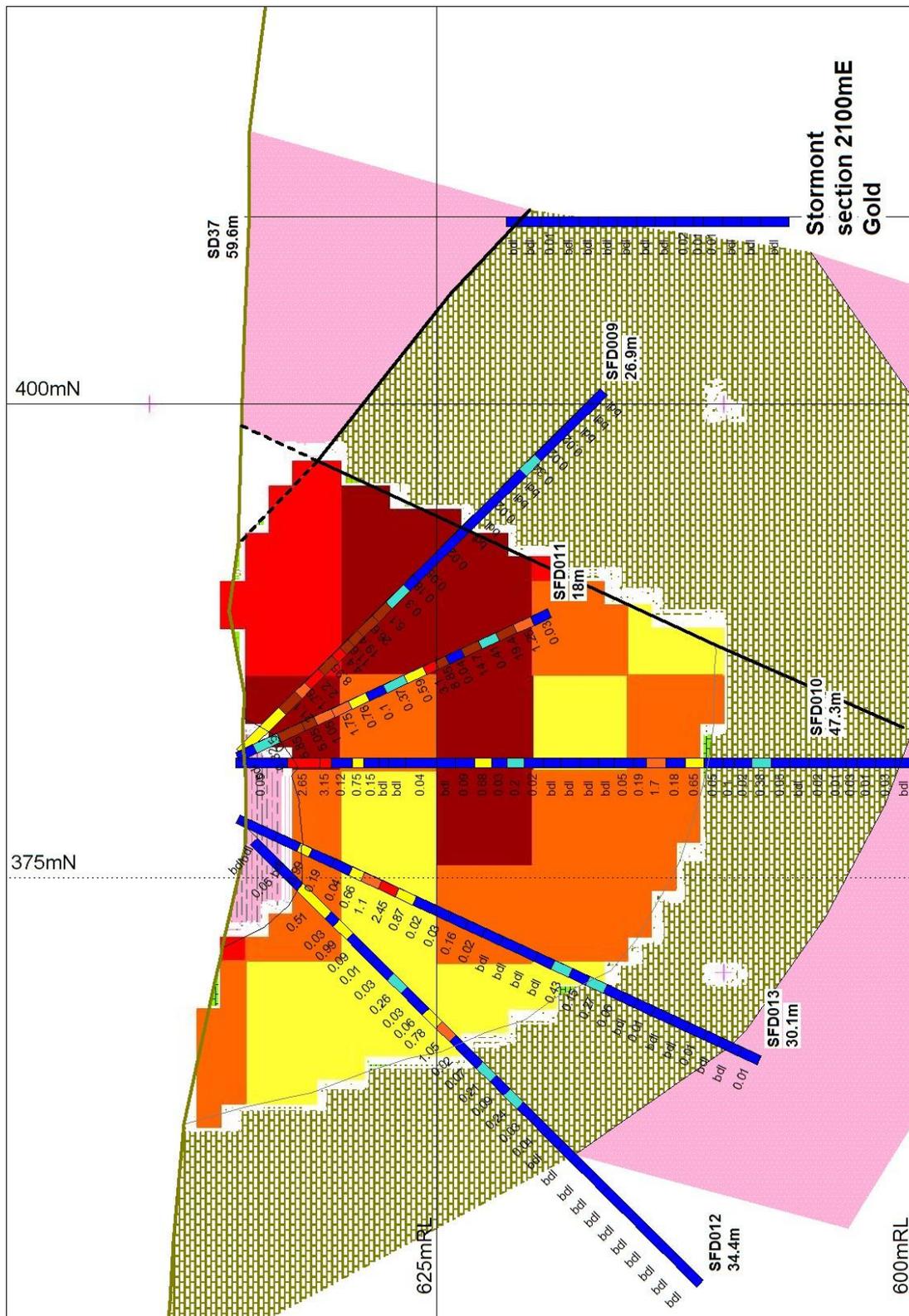
Figure 10.6: Section 2037.5mE +/-6.25m, downhole gold grades superimposed on (same) gold colour coded slice of block model.

Figure 10.7: Section 2050mE +/-6.25m, downhole gold grades superimposed on (same) gold colour coded slice of block model.
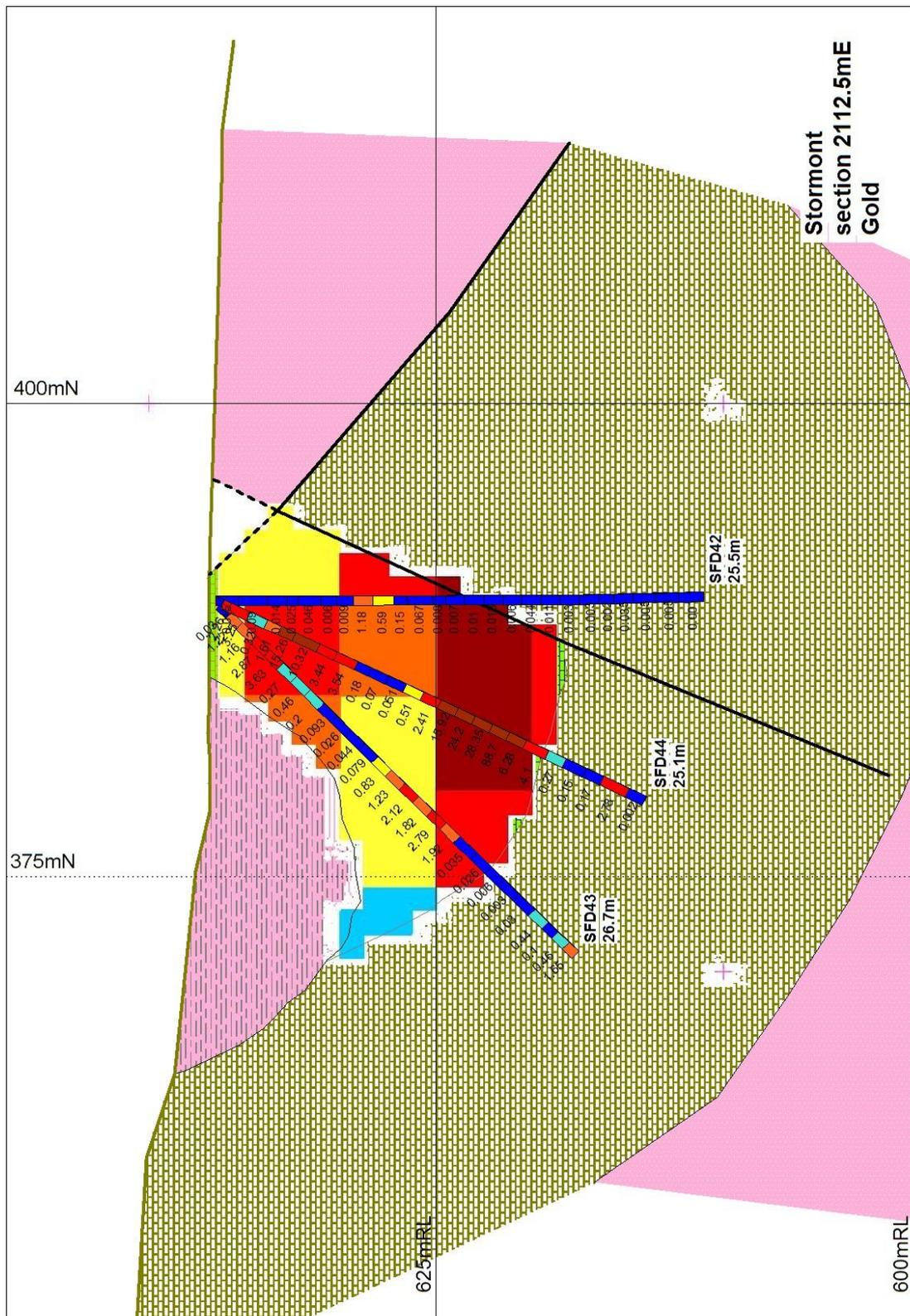
Figure 10.8: Section 2062.5mE +/-6.25m, downhole gold grades superimposed on (same) gold colour coded slice of block model.

Figure 10.9: Section 2075mE +/-6.25m, downhole gold grades superimposed on (same) gold colour coded slice of block model.
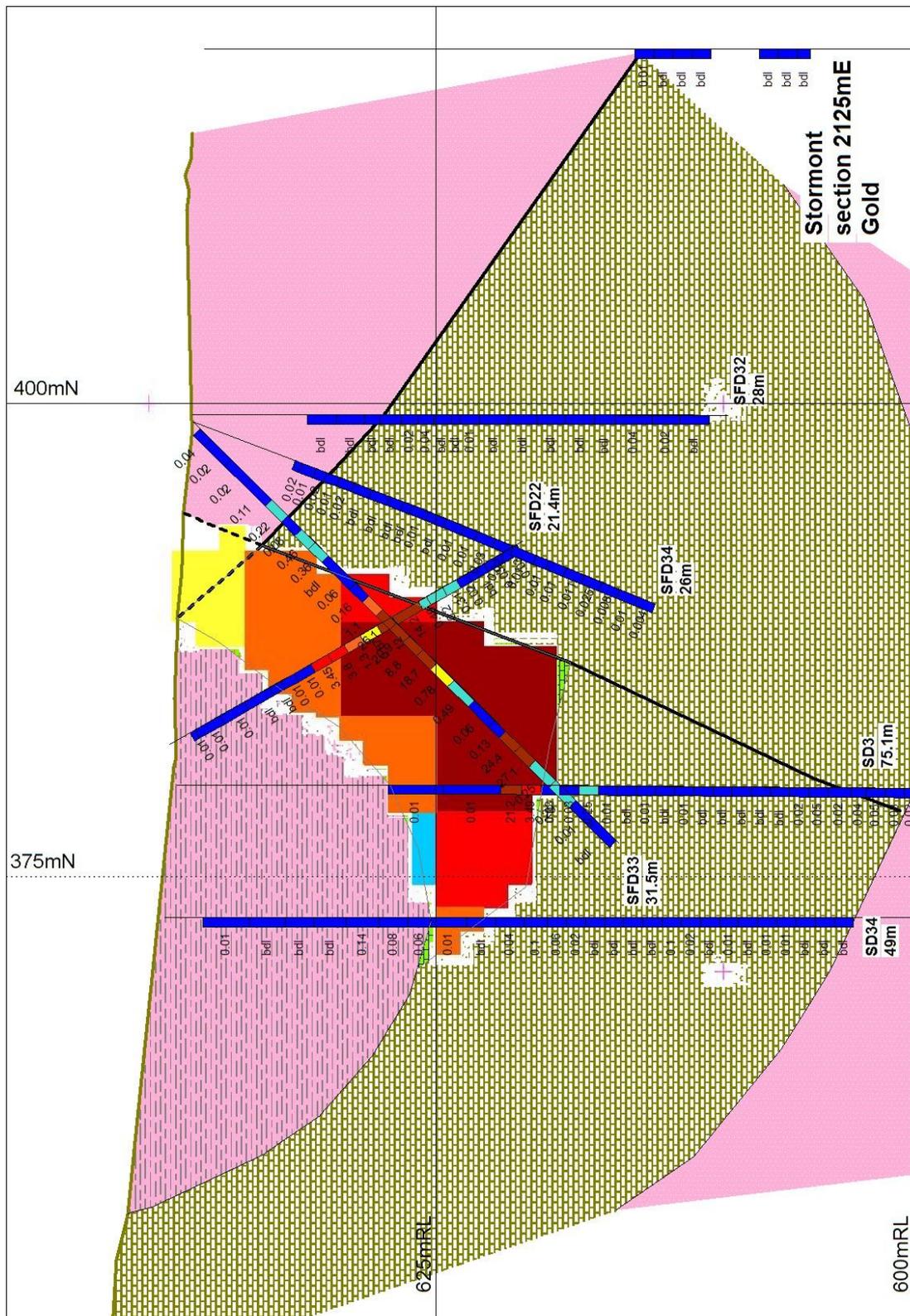
Figure 10.10: Section 2087.5mE +/-6.25m, downhole gold grades superimposed on (same) gold colour coded slice of block model.

Figure 10.11:   Section 2100mE +/-6.25m, downhole gold grades superimposed on (same) gold colour coded slice of block model.

Figure 10.12: Section 2112.5mE +/-6.25m, downhole gold grades superimposed on (same) gold colour coded slice of block model.

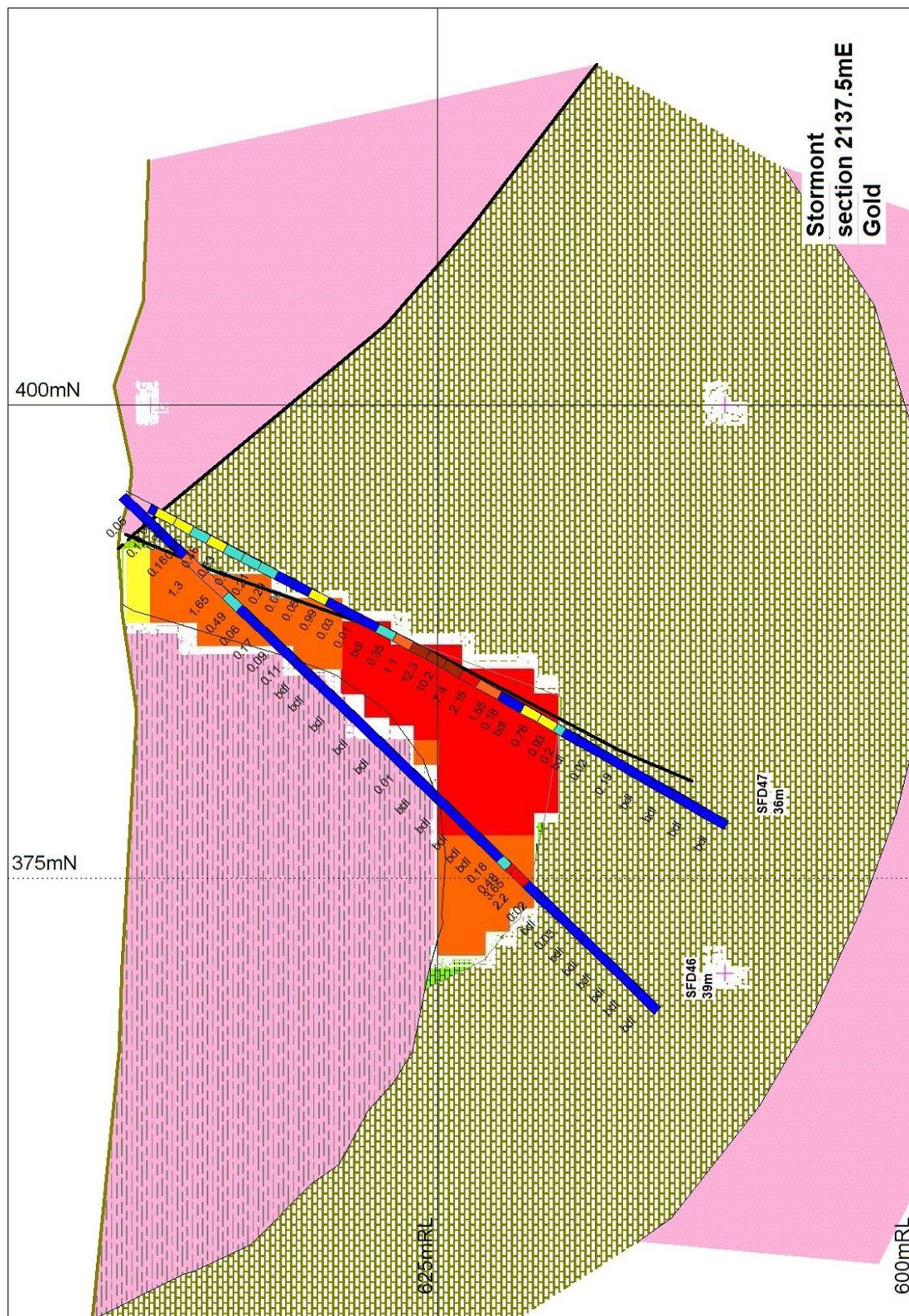**Figure 10.13: Section 2125mE +/-6.25m, downhole gold grades superimposed on (same) gold colour coded slice of block model.**

Figure 10.14: Section 2137.5mE +/-6.25m, downhole gold grades superimposed on (same) gold colour coded slice of block model.
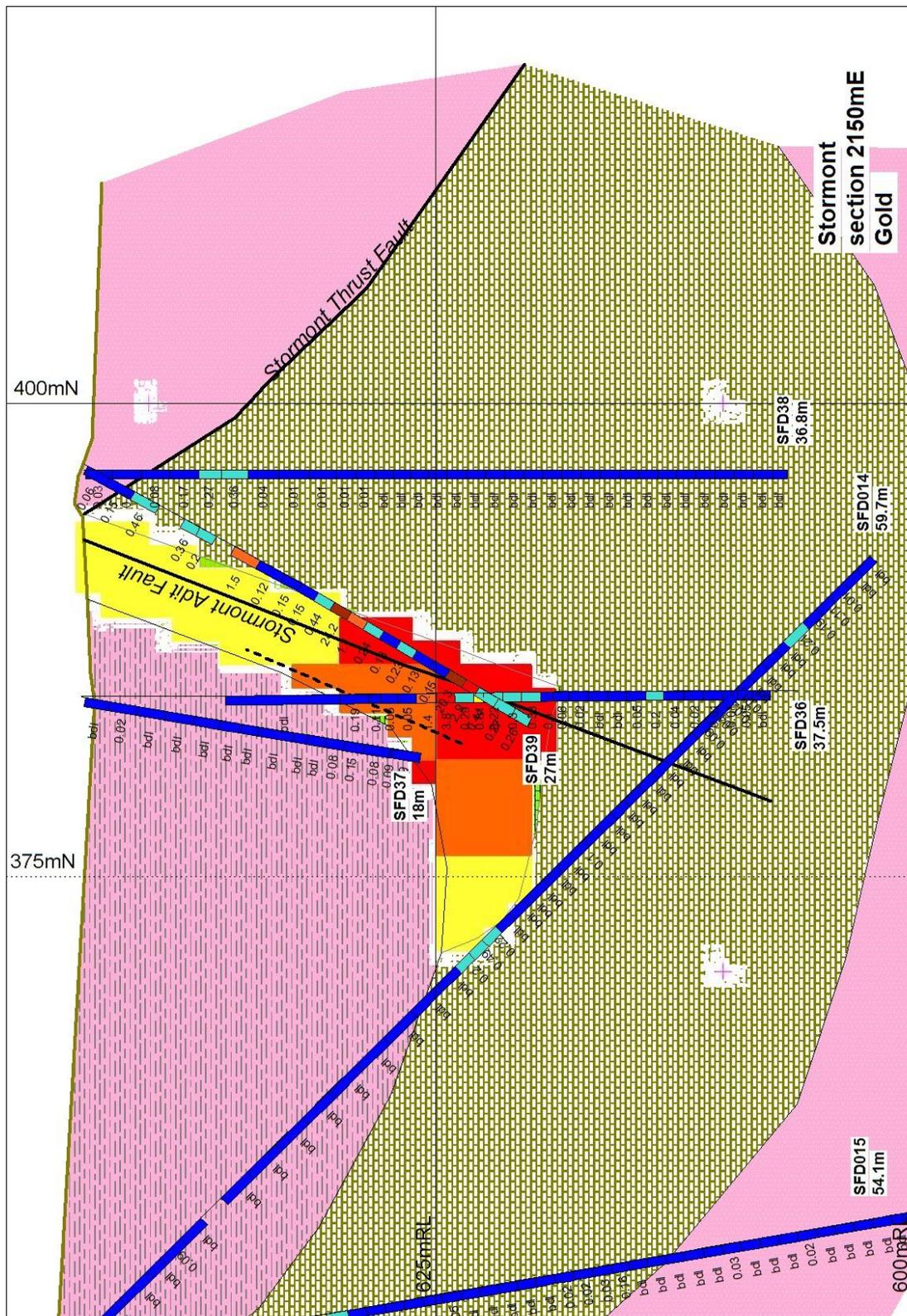
Figure 10.15: Section 2150mE +/-6.25m, downhole gold grades superimposed on (same) gold colour coded slice of block model.
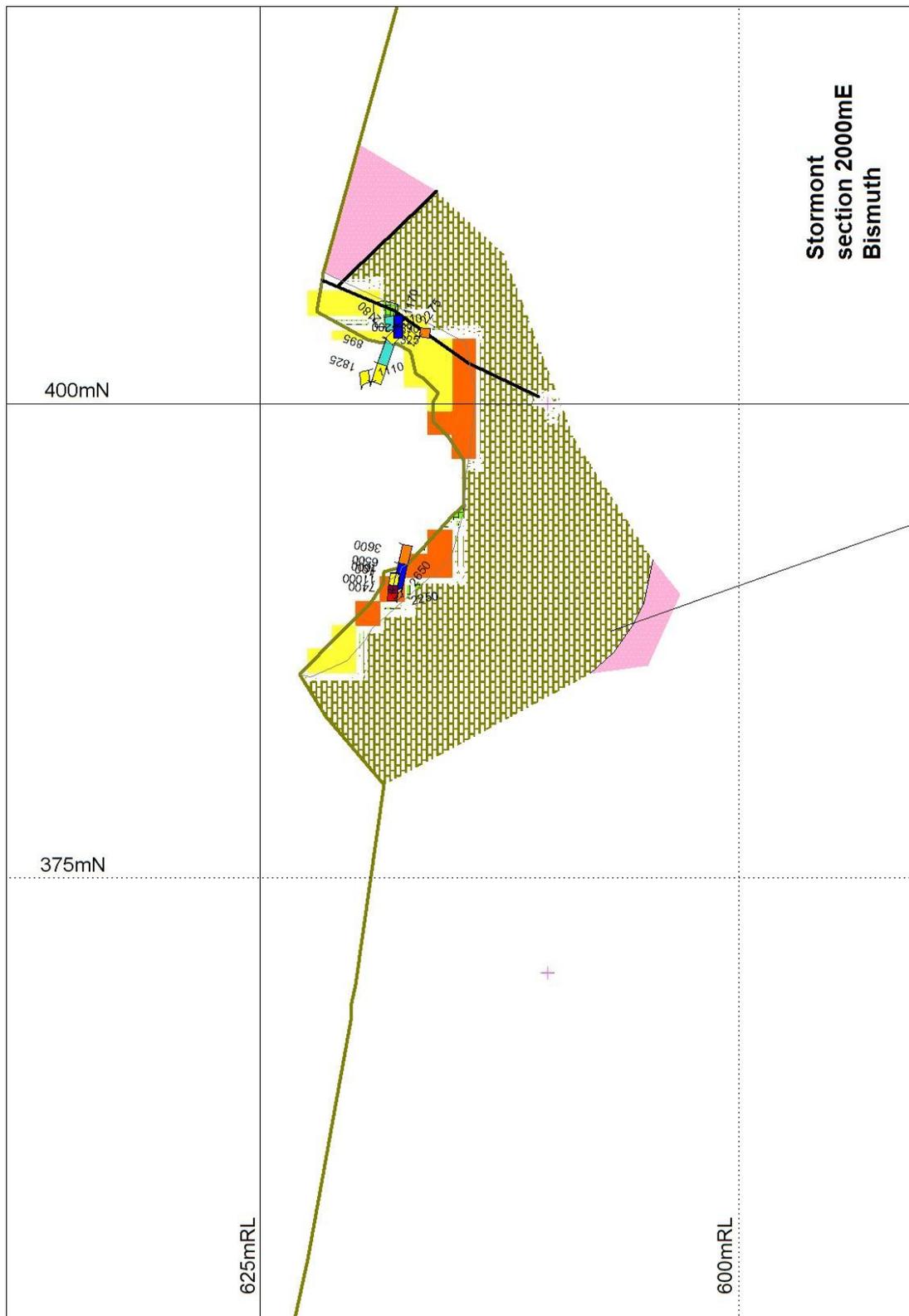
Figure 10.16: Section 2000mE +/-6.25m, downhole bismuth grades superimposed on (same) bismuth colour coded slice of block model.
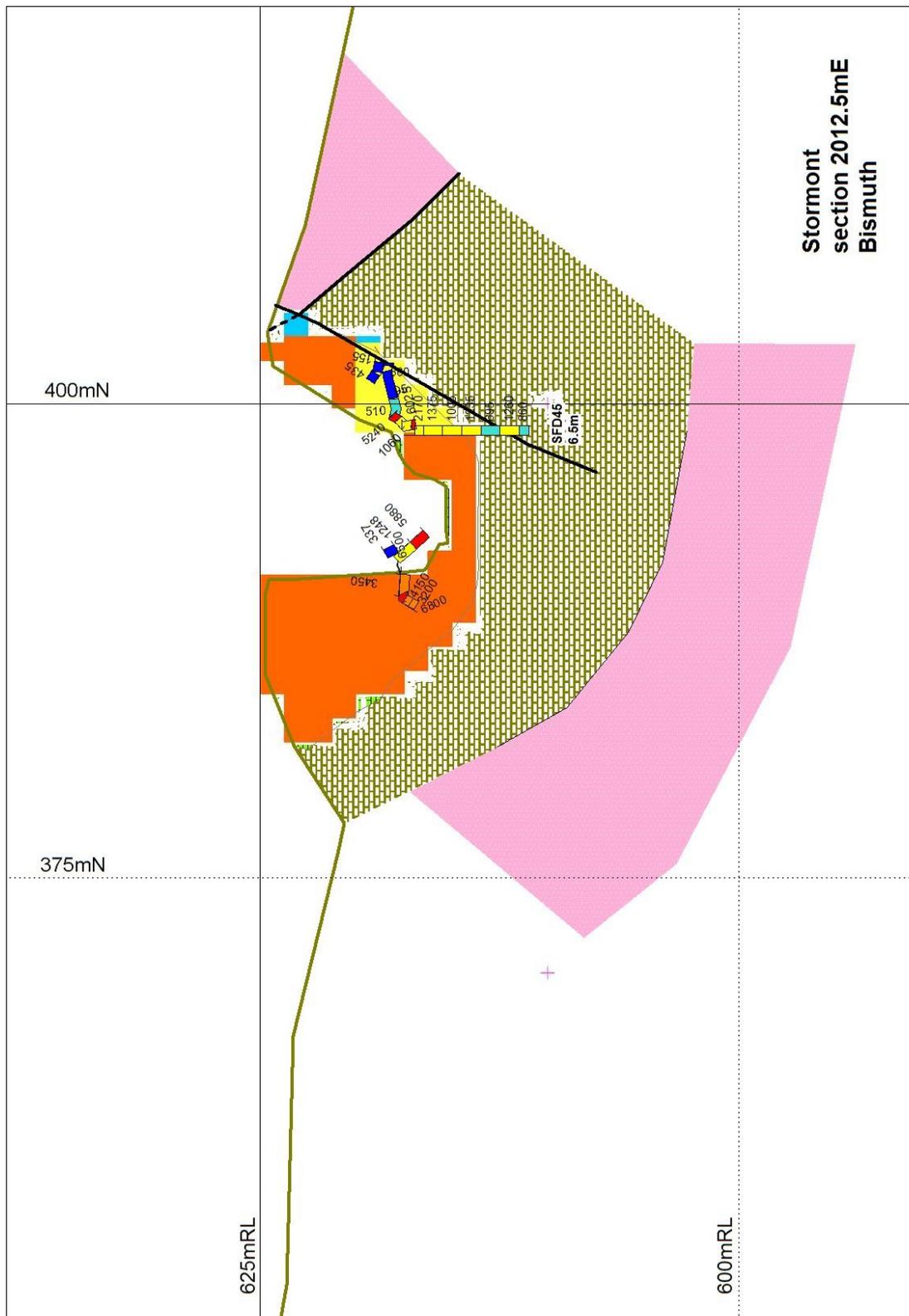
Figure 10.17: Section 2012.5mE +/-6.25m, downhole bismuth grades superimposed on (same) bismuth colour coded slice of block model.

Figure 10.18: Section 2025mE +/-6.25m, downhole bismuth grades superimposed on (same) bismuth colour coded slice of block model.

Figure 10.19: Section 2037.5mE +/-6.25m, downhole bismuth grades superimposed on (same) bismuth colour coded slice of block model.

Figure 10.20: Section 2050mE +/-6.25m, downhole bismuth grades superimposed on (same) bismuth colour coded slice of block model.

Figure 10.21: Section 2062.5mE +/-6.25m, downhole bismuth grades superimposed on (same) bismuth colour coded slice of block model.
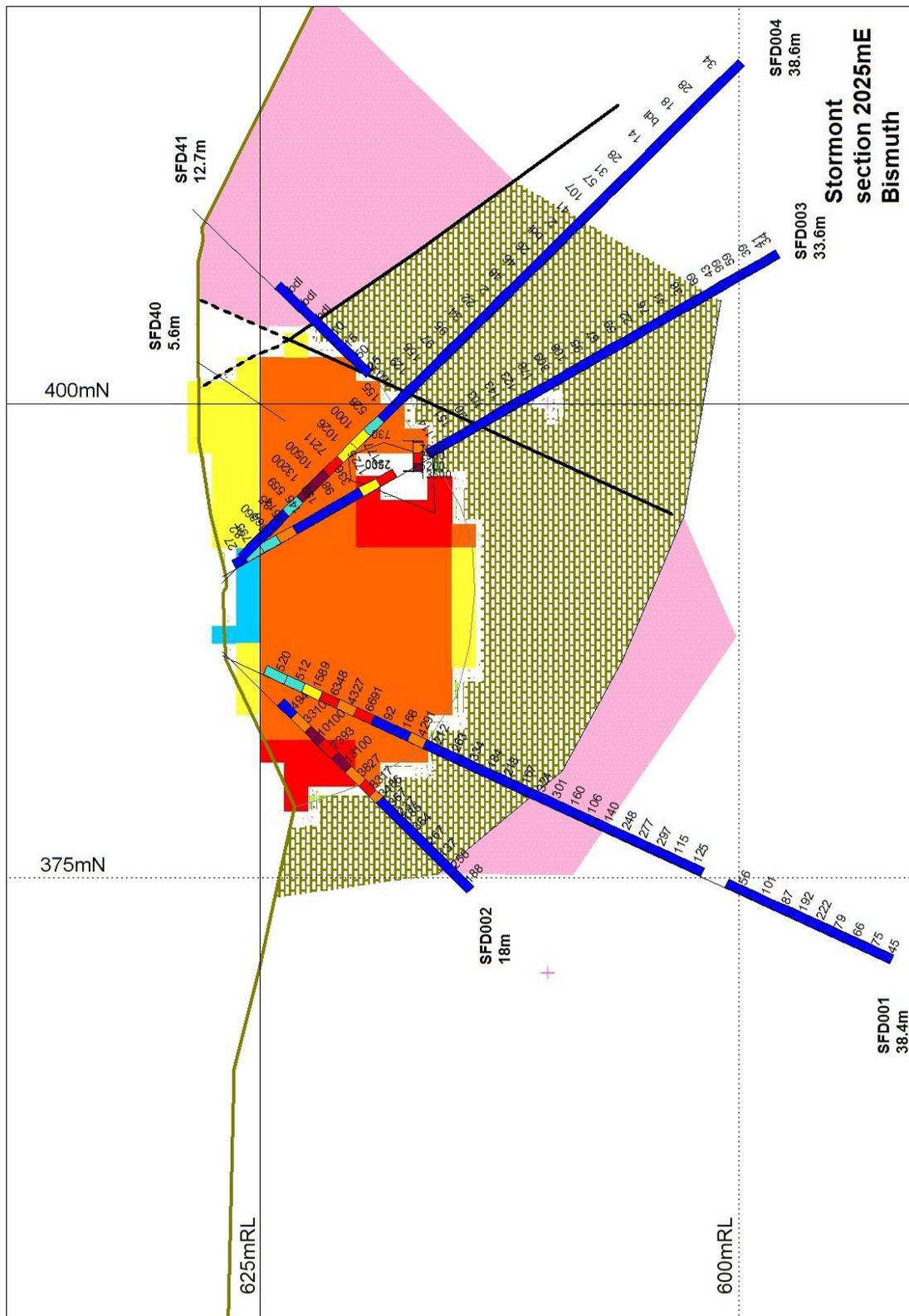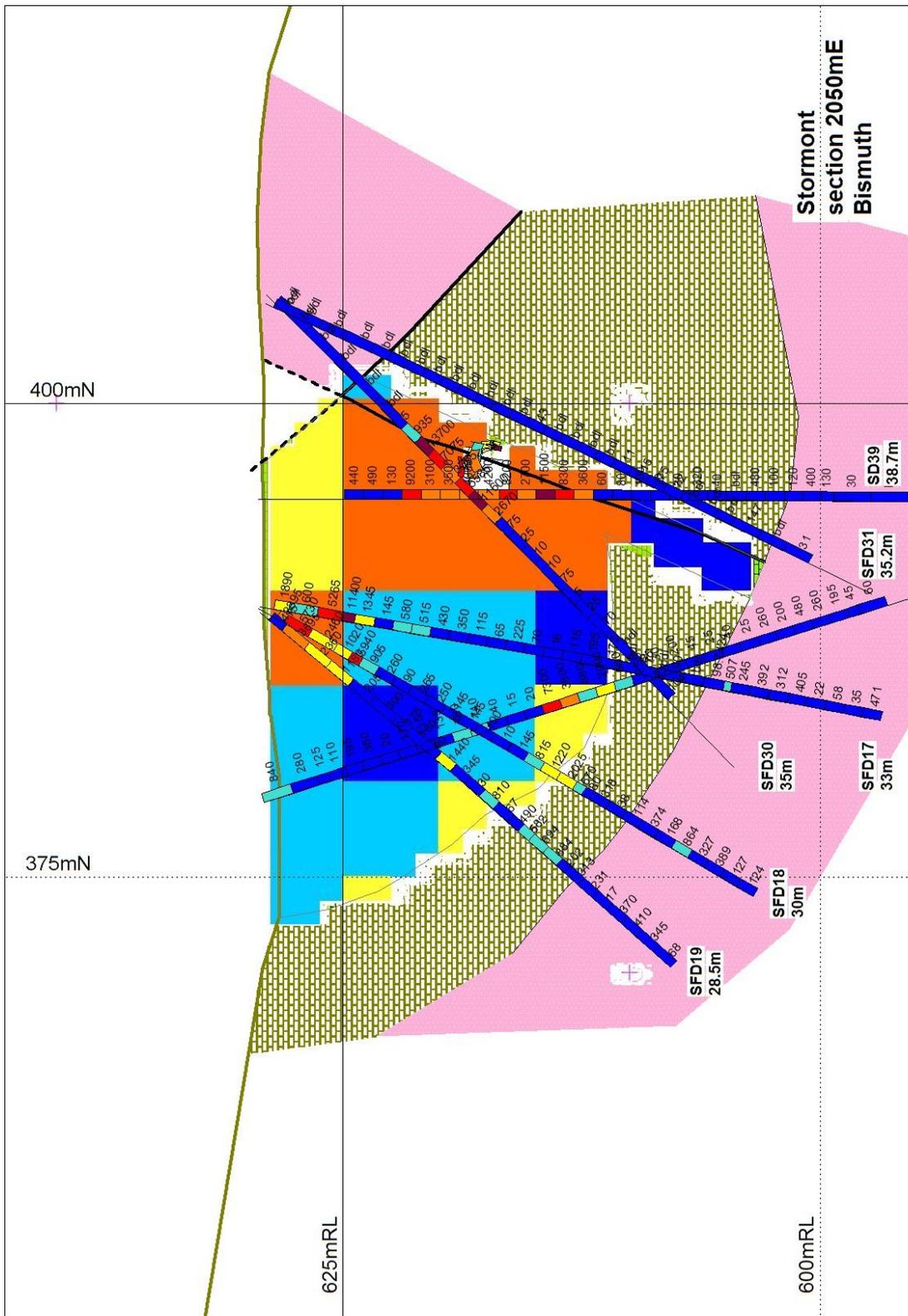
Figure 10.22: Section 2075mE +/-6.25m, downhole bismuth grades superimposed on (same) bismuth colour coded slice of block model.

Figure 10.23: Section 2087.5mE +/-6.25m, downhole bismuth grades superimposed on (same) bismuth colour coded slice of block model.

Figure 10.24: Section 2100mE +/-6.25m, downhole bismuth grades superimposed on (same) bismuth colour coded slice of block model.

Figure 10.25: Section 2112.5mE +/-6.25m, downhole bismuth grades superimposed on (same) bismuth colour coded slice of block model.
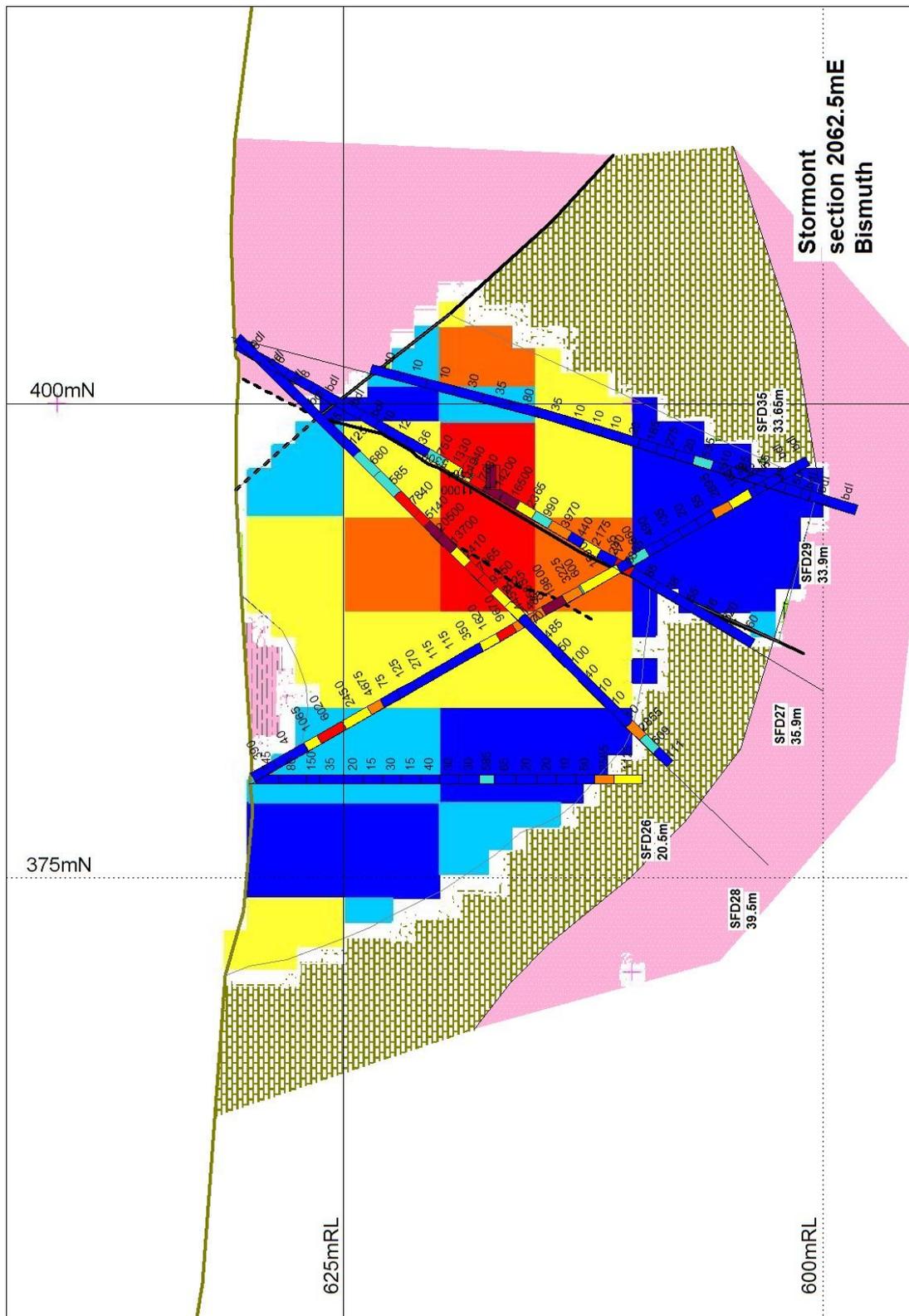
Figure 10.26: Section 2125mE +/-6.25m, downhole bismuth grades superimposed on (same) bismuth colour coded slice of block model.

Figure 10.27: Section 2137.5mE +/-6.25m, downhole bismuth grades superimposed on (same) bismuth colour coded slice of block model.
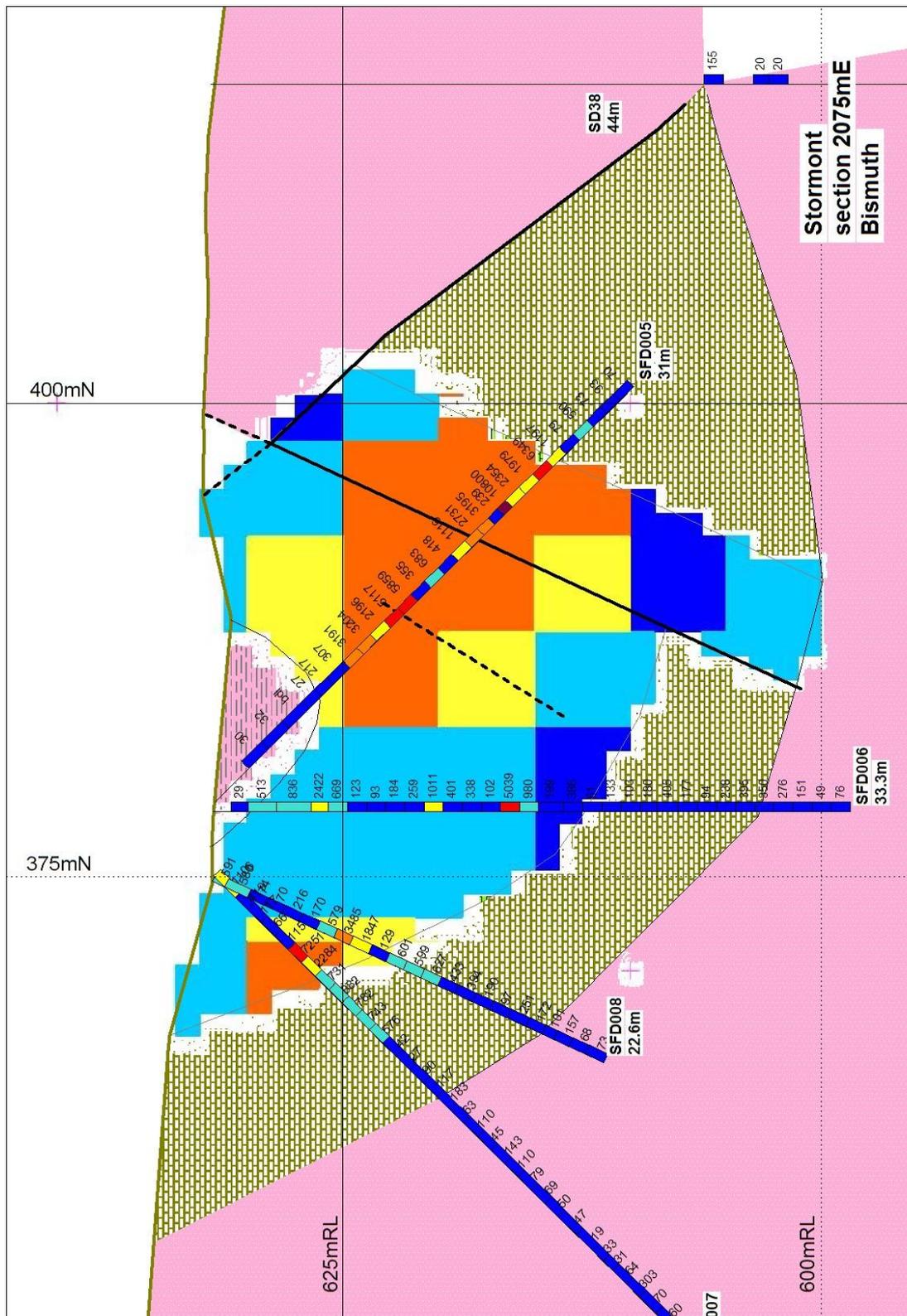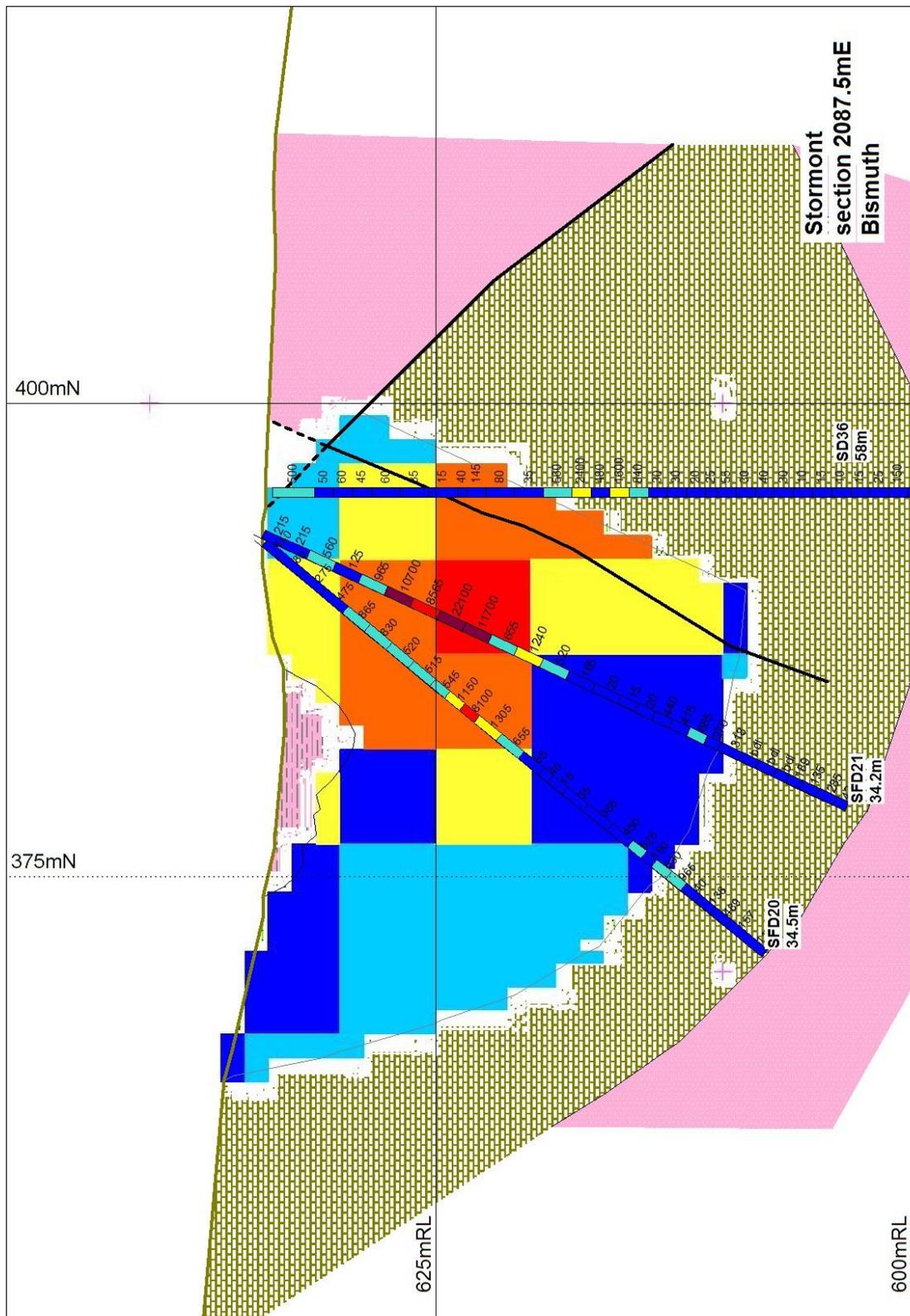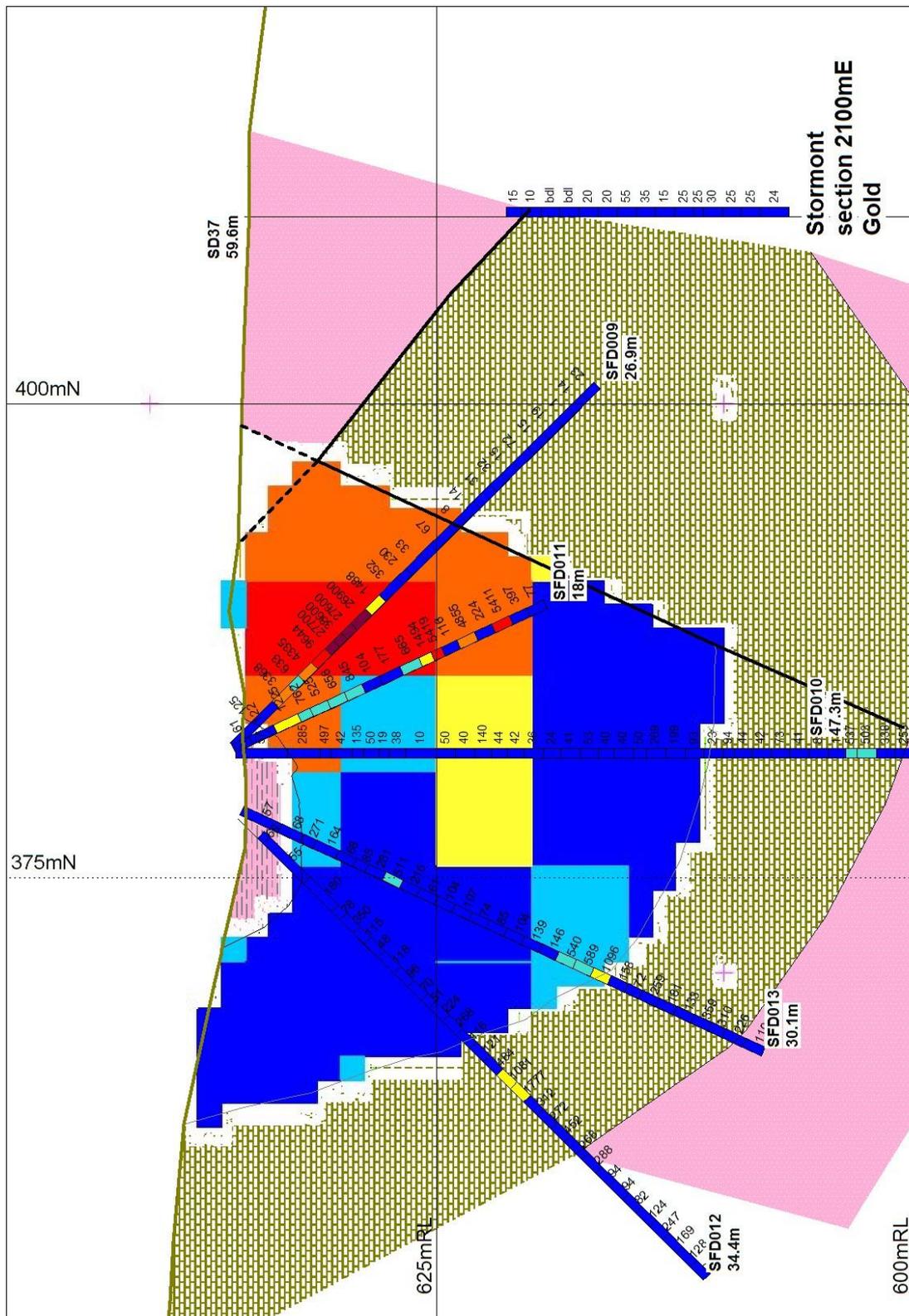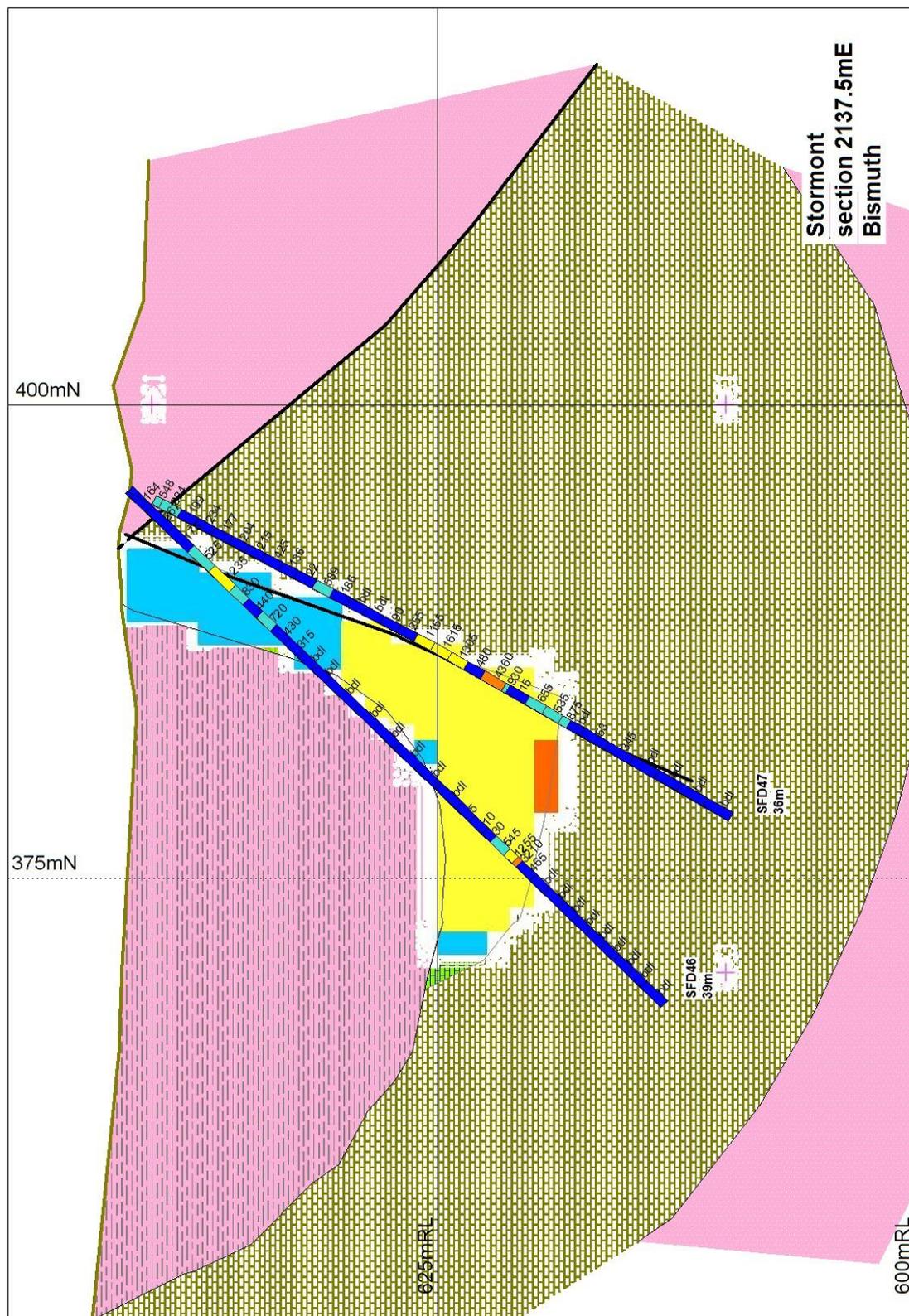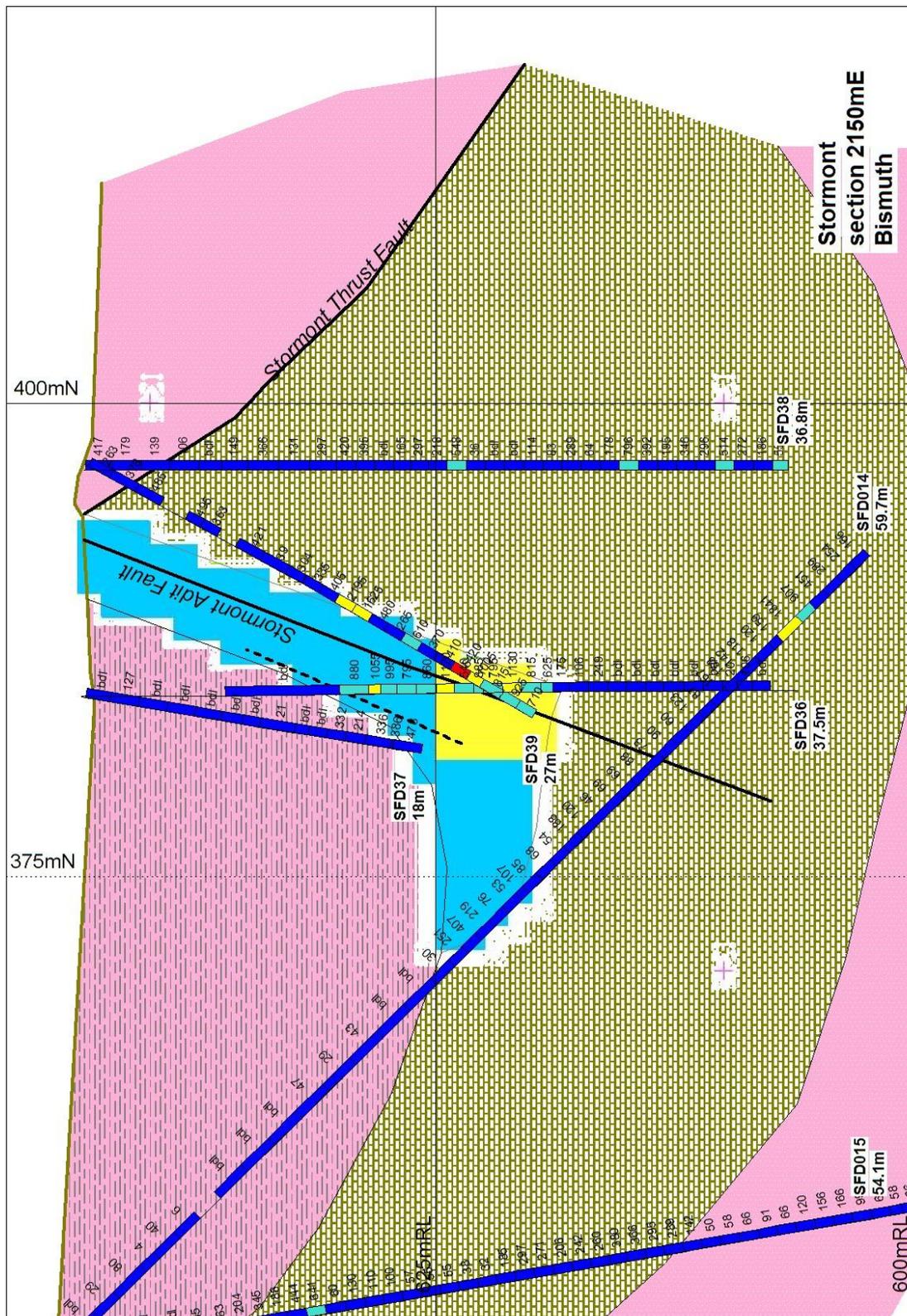
Figure 10.28: Section 2150mE +/-6.25m, downhole bismuth grades superimposed on (same) bismuth colour coded slice of block model.
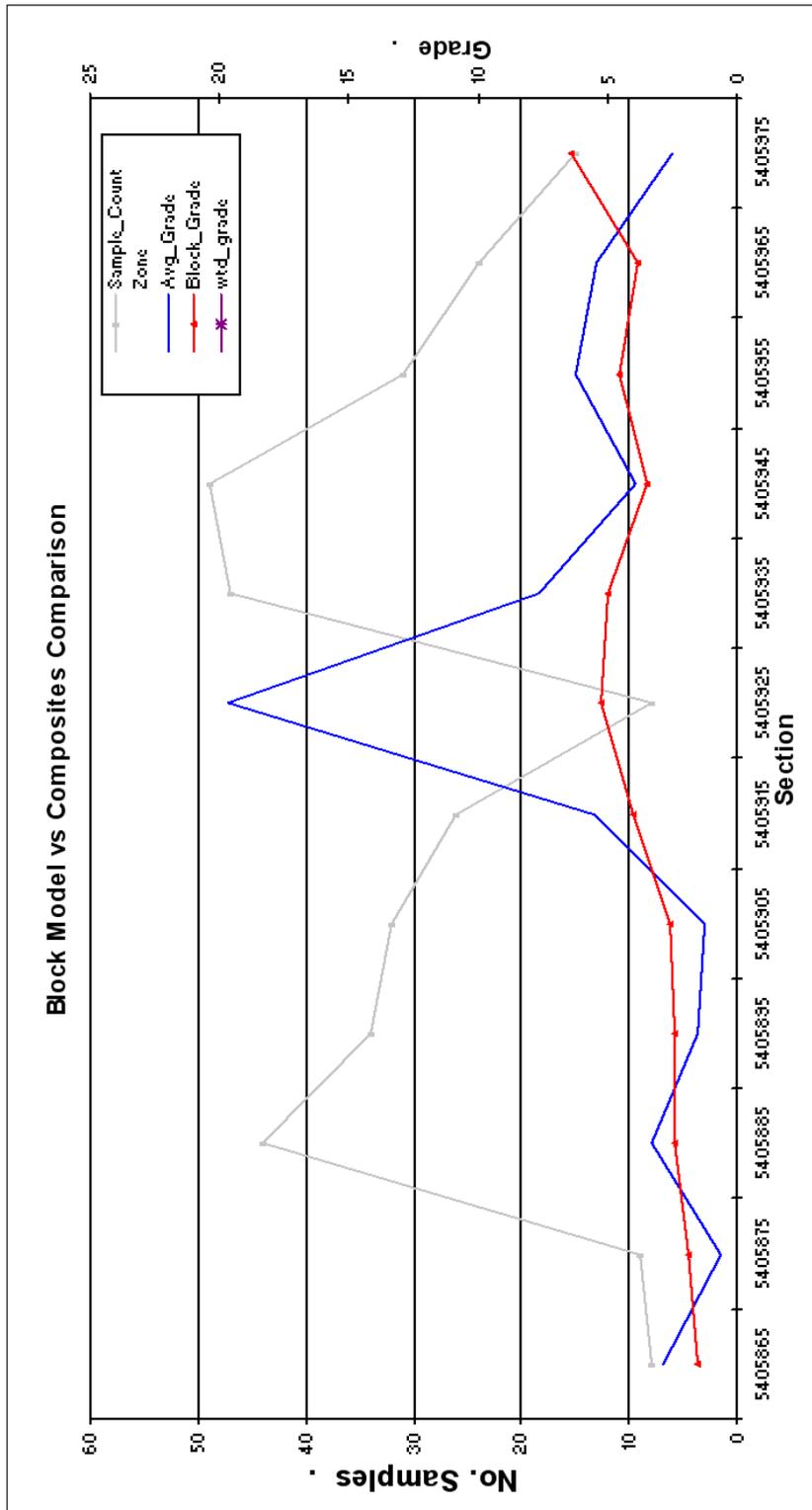
Figure 10.29: Stacked Northing Transects – Block Model and Composite Grade Comparison
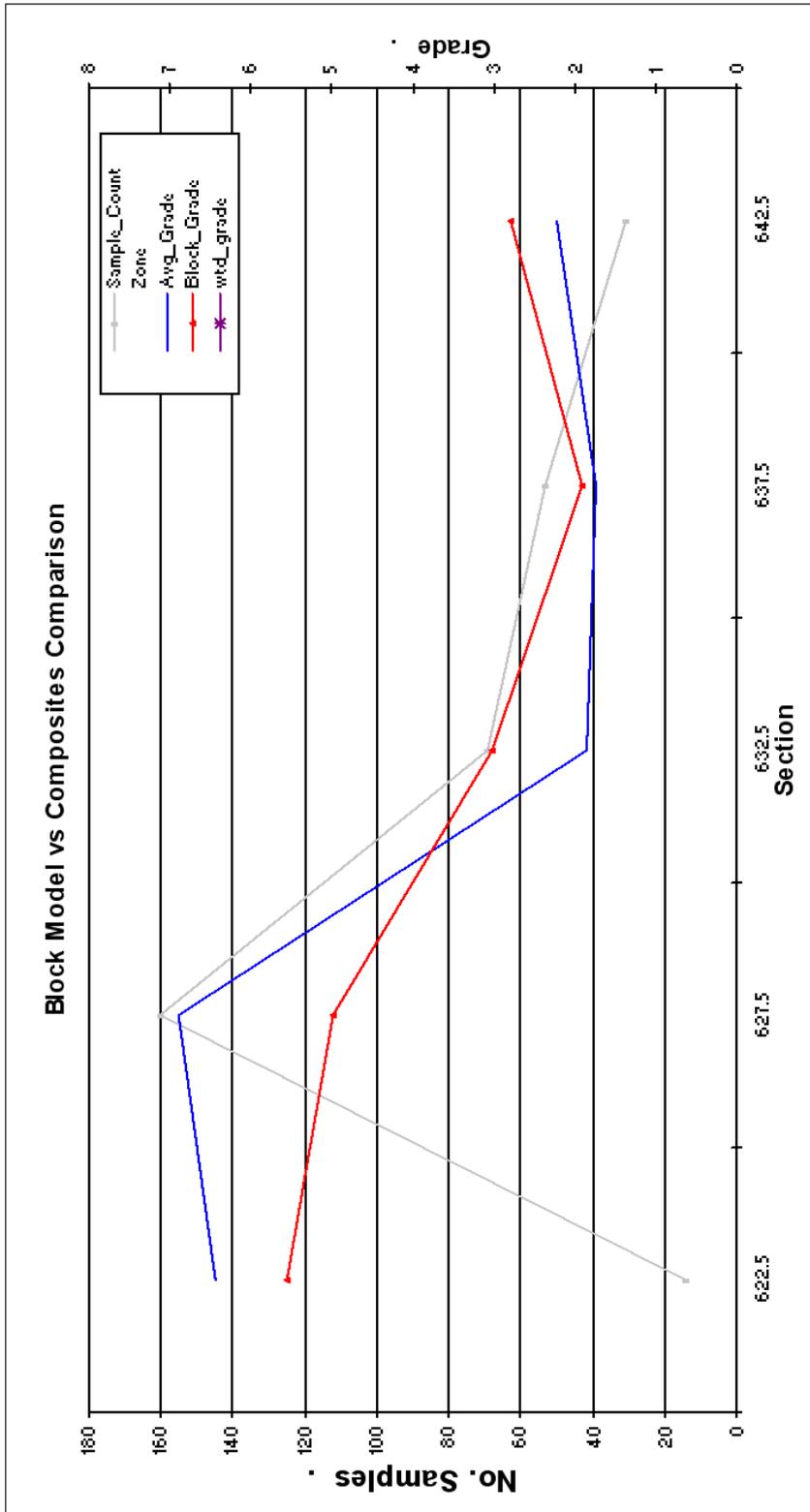
Figure 10.30: Stacked Elevation Transects – Block Model and Composite Grade Comparison

10.7 Resource Reporting

The resource estimate for the Stormont gold and bismuth deposit has been classified as Indicated Mineral Resources in accordance with guidelines as set out in the Joint Ore Reserves Committee (JORC) Code (2004). The Resource category has been defined using definitive criteria determined during the validation of the grade estimates, with detailed consideration of the JORC Code categorisation guidelines.

The resource categorisation has been based on the robustness of the various data sources available, including:

- Geological knowledge and interpretation.
- Variogram models and the ranges of the first structure in multi-structure models.
- Drilling density.
- Estimation statistics

The confidence levels of the key criteria that were considered during resource classification are presented in Table 10.2.

Table 10.2: Key Criteria Confidence Levels		
Item	**Discussion**	**Confidence**
Drilling/channelling techniques	Industry standard diamond drilling and channels	high
Logging	Capable geologists with generally consistent approach.	moderate/high
Drill sample recovery	Generally good with exception of top 4.5m of SD1	high
Sub-sampling techniques and sample prep.	Industry standard	high
Quality of assay data	Very good for gold, good for bismuth, poor for silver	moderate/high
Verification of sampling and assaying	Umpire checks, re-assays and more thorough QA/QC in recent work	moderate
Location of sampling points	Most sample points conventionally surveyed. Downhole surveys less confident	moderate
Data density and distribution	12.5m spaced sections for most of deposit	high
Database integrity	Quite thorough audit in this work	high
Geological interpretation	Geology well understood	high
Estimation and modelling techniques	OK with well defined variography	high
Mining factors or assumptions	not applicable	N/A
Tonnage factors	Numerous measurements used as overall average	moderate/high

10.8   Grade Tonnage Report

The Mineral Resource, reported at various lower cutoff grades, as of April 2009 is presented in Table 10.3. The grade tonnage curve is presented in Figure 10.31.

| Table 10.3: Mineral Resource Summary - Ordinary Kriging Grade Estimates								
Au cut off (g/t)	Volume(m3)	Mass (t)	Au g/t	Bi %	Ag g/t	oz Au	t Bi	oz Ag
0	54188	157144	2.78	0.168	3.77	14047	264	19049
0.5	51990	150772	2.89	0.1699	3.82	14011	256	18519
1	40869	118521	3.47	0.1929	4.06	13224	229	15473
1.5	29150	84536	4.38	0.2331	4.48	11906	197	12178
2	22605	65556	5.15	0.2607	4.74	10856	171	9991
2.5	19055	55259	5.69	0.2784	5	10110	154	8884
3	16357	47437	6.17	0.2952	5.21	9411	140	7947
3.5	13762	39909	6.72	0.3164	5.39	8623	126	6917
4	12301	35672	7.07	0.3134	5.48	8109	112	6286
4.5	10379	30099	7.59	0.325	5.53	7346	98	5352
5	7990	23172	8.45	0.3429	5.71	6296	79	4254
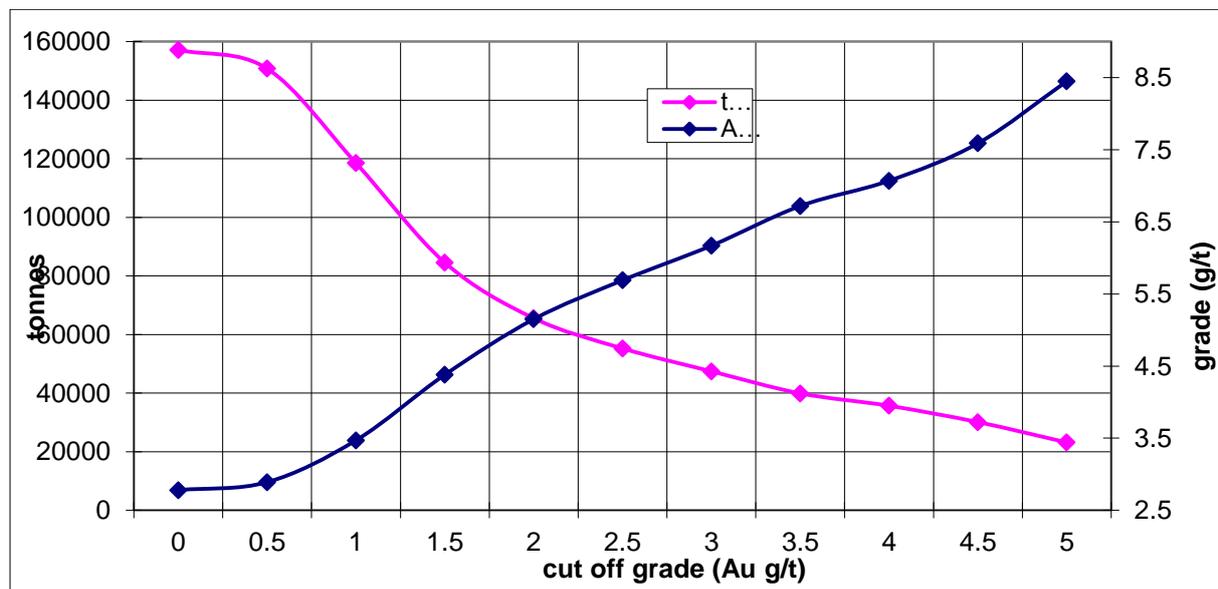
Figure 10.31: Grade Tonnage Curves

11.0 Conclusions and Recommendations

The body of work completed is considered more than sufficient to allow classification of the Stormont gold+bismuth resource as Indicated status.

Further work which will improve the understanding of the resource is listed;

- Further silver umpire assaying is required to resolve the discrepancy between AMDEL and Intertek silver assays and allow the silver component of the resource to be upgraded to indicated status. Further investigation of Bi and Au check assays may be warranted,

- Trenching and sampling across the projected southwestern margin of the deposit will improve confidence in the placement of the ore boundary on this side.

- Trenching, sampling and further shallow drilling along the northeastern margin of the deposit where the wedge of unattributed rock between the projections of the Stromont Adit and Stormont Thrust Faults, will help resolve whether the material is mineralised and clarify the structural uncertainty.

- Domaining the deposit into oxidised and fresh material and then estimating density into the block model will improve the tonnage estimation.

- Infill drilling (grade control) may allow domaining into Upper High Grade, Low Grade, L:ower High Grade and Fault domains to be modelled with sufficient confidence.

- Further petrology and some detailed check re-logging may provide further insights into the macroscopic visual recognition of higher grade material to optimise "high grading" the +1.5g/t Au cutoff material.

12.0   References

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Scott, J.B. (1929) Mt Stormont Mine, Moina *Unpub. Rept. Mines Dept. Tasm.* UR1929_018_19

Appendix A

List of abbreviations used in text

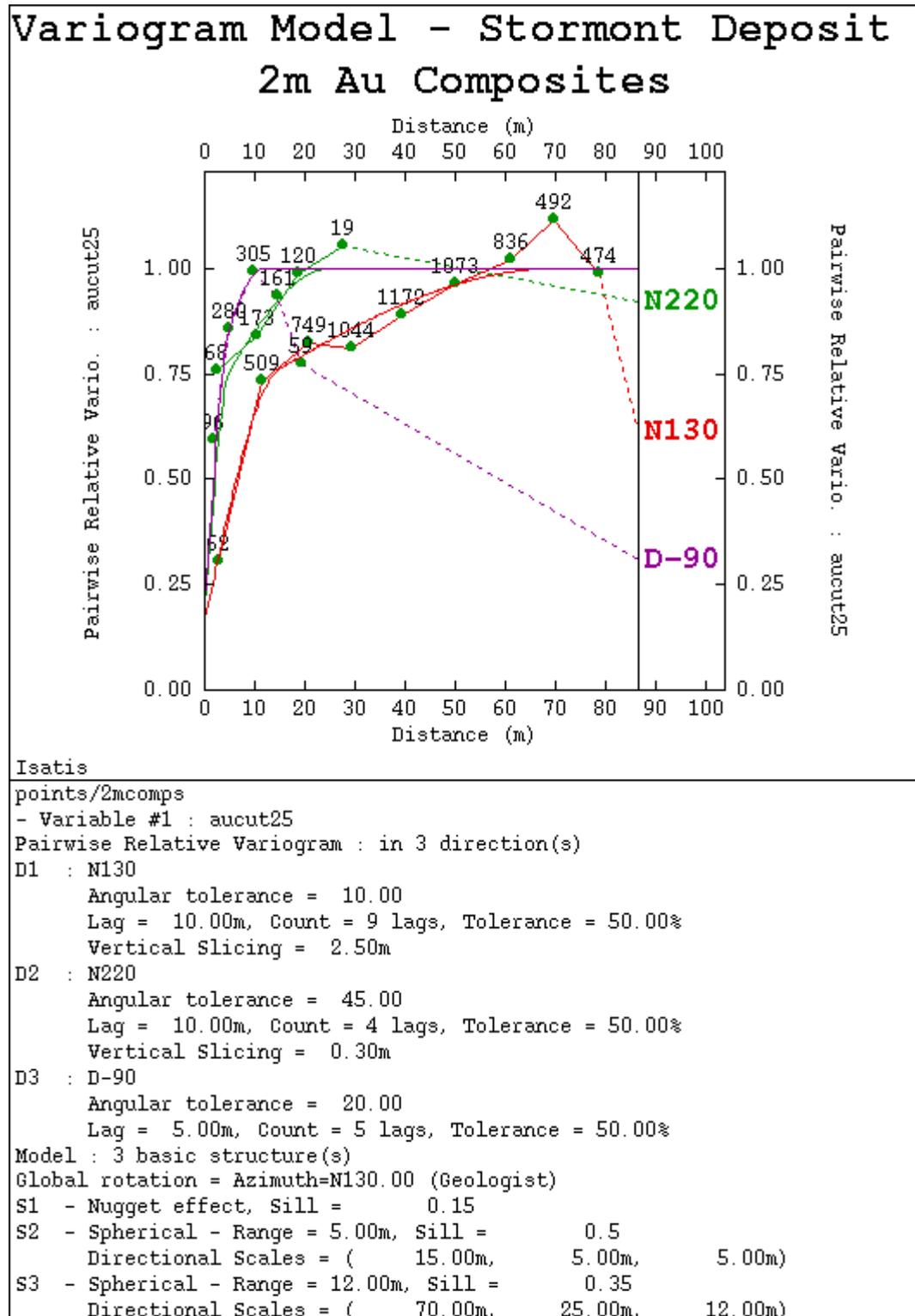| Abbreviation	Descriptions
2D	two dimensional
3D	three dimensional
3DM	SURPAC term to describe three dimensional solid
Ag	silver
AMG	Australian Map Grid
Au	gold
Bi	bismuth
Comalco	Comalco Limited
.dtm	SURPAC file type/term to describe three dimensional shape which is not a solid
DTM	Digital terrane model
Frontier	Frontier Resources Ltd
g/t	grams per tonne (is equivalent to ppm)
GFEL	Gold Fields Exploration Pty. Limited
Goldstream	Goldstream Mining N.L.
GPS	Global positioning system
HQ	diamond drill core size = 63.5mm diameter
Jervois	Jervois Mining N.L.
m	metre
m.a.s.l.	meters above sea level
NQ	diamond drill core size = 47.6mm diameter
NTW	diamond drill core size = 56.0mm diameter
OK	ordinary kriging
p.a.	per annum
ppm	parts per million (is equivalent to g/t)
RGC	Renison Goldfields Consolidated
RL	Relative level
Titan	Titan Resources N.L.
v.m.	vertical metre

Appendix B

2m composite statistics
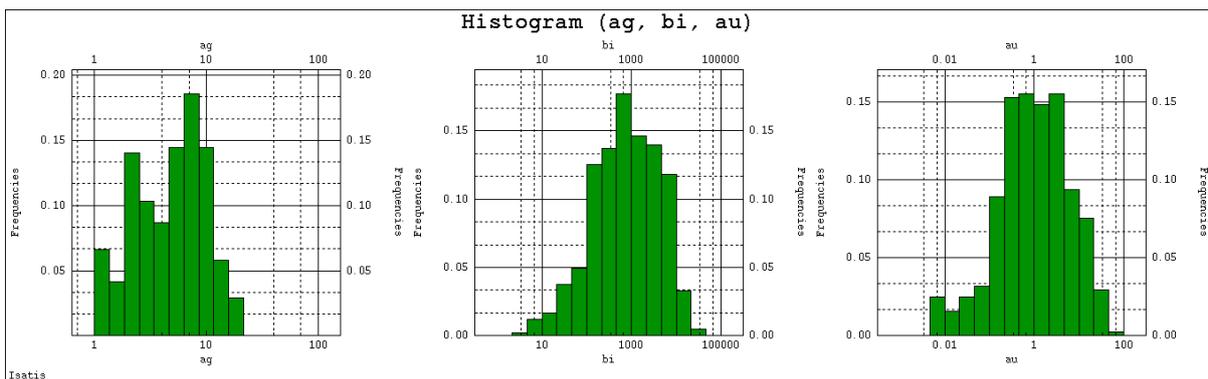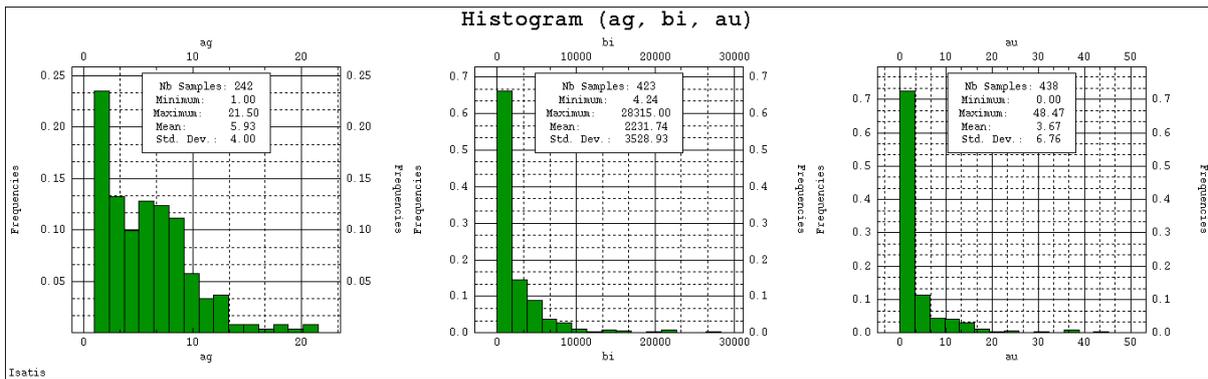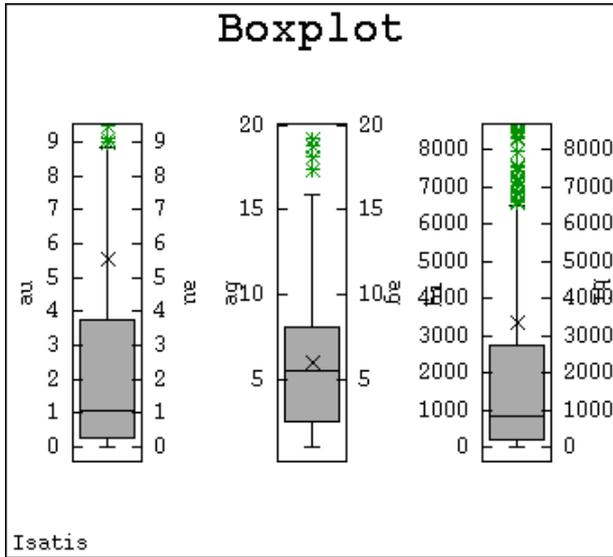
Variogram model


```
Variogram Model - Stormont Deposit
           2m Au Composites
```

```
Isatis
points/2mcomps
- Variable #1 : aucut25
Pairwise Relative Variogram : in 3 direction(s)
D1  : N130
      Angular tolerance =  10.00
      Lag =  10.00m, Count = 9 lags, Tolerance = 50.00%
      Vertical Slicing =  2.50m
D2  : N220
      Angular tolerance =  45.00
      Lag =  10.00m, Count = 4 lags, Tolerance = 50.00%
      Vertical Slicing =  0.30m
D3  : D-90
      Angular tolerance =  20.00
      Lag =  5.00m, Count = 5 lags, Tolerance = 50.00%
Model : 3 basic structure(s)
Global rotation = Azimuth=N130.00 (Geologist)
S1  - Nugget effect, Sill =        0.15
S2  - Spherical - Range = 5.00m,  Sill =        0.5
      Directional Scales = (     15.00m,       5.00m,       5.00m)
S3  - Spherical - Range = 12.00m, Sill =        0.35
      Directional Scales = (     70.00m,      25.00m,      12.00m)
```

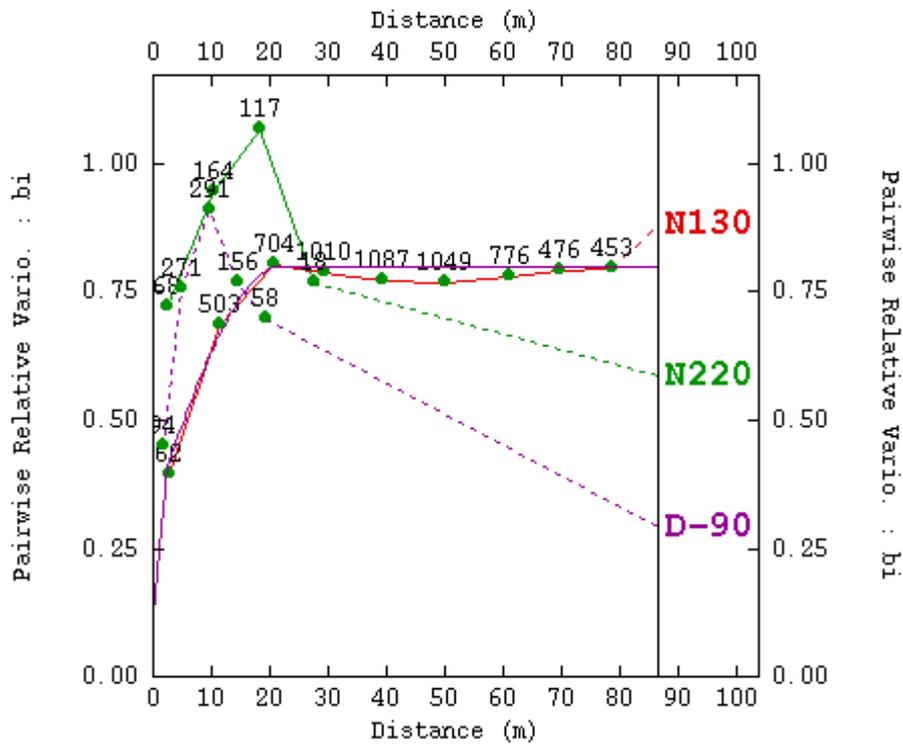**Variogram Model – Stormont Deposit**
2m Bi Composites

Isatis

```
points/2m_comps_all_elements
- Variable #1 : bi
Pairwise Relative Variogram : in 3 direction(s)
D1  : N130
      Angular tolerance =  10.00
      Lag =  10.00m, Count = 9 lags, Tolerance = 50.00%
      Vertical Slicing =  2.50m
D2  : N220
      Angular tolerance =  45.00
      Lag =  10.00m, Count = 4 lags, Tolerance = 50.00%
      Vertical Slicing =  0.30m
D3  : D-90
      Angular tolerance =  20.00
      Lag =  5.00m, Count = 5 lags, Tolerance = 50.00%
Model : 3 basic structure(s)
S1  - Nugget effect, Sill =        0.07
S2  - Spherical - Range = 3.00m, Sill =        0.26
S3  - Spherical - Range = 22.00m, Sill =        0.47
```

Appendix D

Digital data