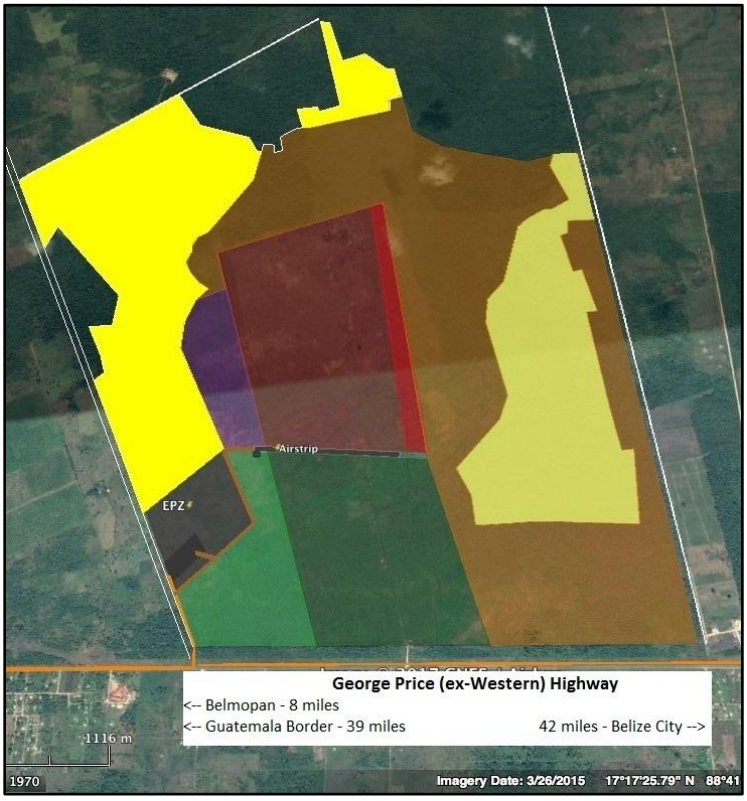
Belize Sustainable Agriculture, Ltd.
Farming Report – November 6th, 2017

This is the **Ninth** Farming Report for BSA's 2017 Summer (Wet) season. Its main objectives are to inform readers about BSA's farming activities by season and crop; to provide data on climactic conditions, agricultural pests, and market conditions; as well as detailed data on BSA's farming methodologies.



Field 2: Subsoiled & Leveled	106 Ha	Mix Plow / Subsoil in progress	270 Ha
Field 2: Leveled / No Subsoil	13 Ha	Windrow / Work in Progress	173 Ha
Field 2N: Plowed / Some subsoil	23 Ha	Chained – No further work	109 Ha
Field 1: Leveled / No Subsoil	79 Ha	EPZ – Total Area	24 Ha
Field 1N: Plowed & Subsoiled	36 Ha	EPZ – Finished	2 Ha

BSA is only farming at the Cayo One Estate in the Summer 2017 season; it is situated some 8 miles east of Belmopan near the village of Cotton Tree in the Cayo District, and is ~39 miles east of the Belize-Guatemala border at Melchor de Mencos.

Weather Summary: October was an exceptionally wet month after September's unusual dryness. Early heavy rains were followed by a dry period and then another wave of very heavy rain. Rainfall data for October was 267% of the long-term average! Tropical cyclone activity did thankfully abate as the month progressed. We are now exiting the historically active cyclone period, although Mother Nature should never be tempted.

Cayo One - Belmopan Precipitation Data (mm per month) – 2017 Season YTD Data through November 6th													
	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Total
2016/17	345	96	55	74	126	10	263	237	210	148	696	0	
2000-2016	129	139	65	49	32	124	271	256	236	230	260	232	2039

You can follow Belize's weather on: http://www.hydromet.gov.bz/observations/radar/radar-images

We also use the US NOAA Hurricane Center weather radar network which monitors the Caribbean basin, and recommend:
http://www.nhc.noaa.gov/ https://www.wunderground.com/q/zmw:00000.1.WMGMM

Cayo One: ~ 201 Hectares (100% non-irrigated)

The exact acreage to be planted during the Summer 2017 season has now been determined, which is comprised of Fields 1 and 2. Most of Field 2 has been subsoiled, and, as the discussion and photographs during this season have demonstrated, we continue to be well pleased with the early indications of the benefits of subsoiling.

Weather Analysis

After September's unusually dry total of 148 mm of rain (vs. 230 mm 17-year average), October brought rain back in buckets, with the highest rainfall recorded for October in the Cayo District in over 20 years: 696 mm vs the 260 mm 17-year average. While this did not reach the extreme of November 2015 (1113 mm!), it was a very wet month indeed. The rains came in two massive downpours, 285 mm between October 1st and 6th and 371 mm between October 19th and 26th.

Sufficient soil moisture to carry the crop through to harvest was obviously not an issue, quite the contrary. The very wet conditions in October could have caused numerous issues, notably with wind. However, we were fortunate not to experience high winds during that period, as this might have caused some lodging (corn stalks falling down) where soil was insufficiently drained. Thankfully, winds remained relatively calm and we have seen almost no instances of lodging.

Temperatures moderated considerably to an average (30° C / 86°F) but relative humidity remained extremely high at an average of almost 99%.

We are approaching the end of a very active Tropical Cyclone season, with another 3 weeks during which further cyclone activity might occur, based on historic patterns. Given our new targeted harvest date of November 27th, we are crossing our fingers that no further cyclone activity will threaten Belize. As of November 6th, there are no reported tropical depressions as far as the west coast of Africa. However, that does not yet provide certainty; this will only occur once our grain is in silo! As we have repeated throughout the season, predicting Tropical Cyclone activity and landfalls is extremely difficult and we continue to rely on long term (100+ year) data that indicate that a tropical cyclone is not likely to impact Cayo One more than once a decade.

Land Preparation

There are two components to CSA's Land Preparation activities in 2017: Land Development and Farmland Preparation.

Land Development

A detailed discussion of CSA's Land Development activities was provided in the June 19th, 2017 Farming Report, which is available upon request.

As of November 6th, 2017 the status of BSA's fields is:

Field 1 (79 Ha): was planted July 17th – 18th
Field 2 (122 Ha): was planted July 15th – 17th

We hope to have an informative and useful ability to compare the impact of subsoiling, as a small section of Field 2 (13 Ha) was not subsoiled, and Field 1 was not subsoiled. Evidence throughout the season continues to show that Field 2 drains far faster and better than Field 1, and that, subject to comments below, subsoiling (and underground drainage!) is a necessity for all of Cayo One's fields.

Seed Selection, Planting, and Crop Development

Seed Selection

Acreages planted so far are:

- Syngenta Impacto® – 197 Ha / 482 acres (Field 2 and most of Field 1) @ ~70,000 seeds/Ha or ~28,340 seeds/acre
- Pioneer® 4226 – 4 Ha / 10 acres (a small part of Field 1) @ ~70,000 seeds/Ha or ~28,340 seeds/acre

A detailed discussion of these two non-GMO hybrids is in the June 19th, 2017 Farming Report, which is available upon request.

Both plant varieties continue to develop well, but field surveys identified some noticeable differences in ear development. We have not yet performed a comparative kernel analysis between the two varieties.

Impacto® has shown very satisfactory plant growth and maintenance all the way through the ~110 days of this year's corn cycle. All Cayo One corn suffered from the high afternoon temperatures during the pollination phase, leading to the upper section of most ears not filling properly. Impacto® ears achieved an average 425 kernel count versus a goal of 550/575 in our September 26th field survey. We continue to be impressed with the number of viable ears which formed and are fully developing. Our Sept. 26th survey, supported by later more anecdotal evidence, recorded about 74,740/30,260 viable ears per Ha/Acre. We have still not included in our ear count an additional large number of underdeveloped ears which may yield small amounts (20-50) of viable kernels.

The principal remaining variable to be able to estimate yield is kernel size/weight. Impacto® typically has larger kernels than the DeKalb® 7088 planted at Cayo One in previous years. The latter's kernel size would average 394-413/100gm (100,000-105,000/Bu). A November 6th summary field survey showed Impacto®, currently at ~31% moisture, averaging 292/100gm (74,200/Bu). Adjusting this number to a 14% moisture content (20% weight loss) would increase the count to 365/100 gm (92,800/Bu). However, we believe that this is too optimistic a number, and are targeting a harvest weight between 378 and 390 / 100gm (96,000 to 99,000 / Bu).

We had an extensive field day with the new Syngenta Technical Representative on October 19th. He was very complimentary about the health of our crop, its absence of worm/insect damage, and the cleanliness of our fields. After a detailed examination of both of our fields, he felt that the major challenges facing us in terms of higher yields would be drainage and organic matter. Moreover, he pointed out that one of the inevitable consequences of (very necessary!) subsoiling was that the topsoil on our fields was disturbed, which affected organic matter distribution. This in turn affected nutrient uptake. So, we must be ready to make an ongoing investment in adding organic matter to our fields after subsoiling (manure, anyone?!), and expect the first few years post subsoiling to negatively impact yields until organic matter could be increased and re-balanced. That being said, if we can achieve 7.0-8.5 mt/Ha in a freshly subsoiled field with pollination issues, then we look forward to some very exciting future yields as these issues are resolved…

Pioneer® 4226 has mostly caught up on its growth lag versus Impacto®, although we still conclude that it is somewhat more disease prone than Impacto®. 4226 had the same pollination issues as Impacto®, with the upper portion of the ears not pollinating properly. 4226 ears achieved an average 400 kernel count versus a goal of 500/525. 4226 is a variety known for lower kernel counts but substantially larger kernel sizes. Ear count did not reach the absolute levels of the Impacto® variety, with an ear count per Ha/Acre of 69,424/28,107 versus a plant count of 65,920/26,690 viable ears. We have not yet performed a field survey of Pioneer ears.

We have not been visited by the DuPont / Pioneer Technical Representative.

Planting Analytics

Planting Analytics were generally very encouraging, and the data obtained from our Seed Sense FieldView™ software has been very edifying. Singulation, spacing, and ride were all at >99%, and compaction very slight, averaging <2%. The information gleaned will help us further improve our planting next season, but we believe the combination of excellent (but improvable) planting techniques plus vigorous, high-quality seed, helped ensure the outstanding plant population seen on both Field 1 and Field 2.

A detailed report on Planting Analytics, with excerpts of computer printouts from our Seed Sense planting software, was provided in the July 17th Farming Report which is available upon request.

Crop Development

As of November 6th, the corn crop is at straddling the R5 "Dent" and R6 "Physiological Maturity" phases, and has made only limited progress since the October 9th Report. We believe that the crop's maturity has been meaningfully delayed by October's very heavy rainfall.

The R6 stage is about 55 days after midsilk *(occurred between September 10-20 at Cayo One)*. All kernels have attained maximum dry weight *(We may still get some dry weight increase during this week)*. The starch line has advanced completely to the kernel tip and a brown or black layer is present; the black layer progresses on the ear from the tip kernels to the basal kernels in about 10 days *(we believe this process will begin by November 10-15)*. While harvest for silage can be done now or slightly earlier, grain harvest will require more drying. Husks and many of the leaves are no longer green, but the stalk may be green. At black layer, the average kernel moisture is 30 to 35 percent, varying with hybrids and environmental conditions *(Field 2 corn tested at 31% on November 6th)*.

Once corn is fully in the R6 stage, it should take 7-10 days to dry down from 30% to 25% moisture, and another 9-10 days to dry down from 25% to the 20-22% moisture level at which we would look to begin harvesting

Once again, at this stage of the crop, the only remaining variable is the size/weight of kernels. We are encouraged by today's summary field survey and we expect kernel size to average 378-390/100gm (96,000-99,000/Bu). Impacto® represents over 95% of the 2017 corn crop.

As we near the 2017 Harvest start, we are excited by the prospect of Cayo One's best ever corn crop!

Field Survey Results

A follow-up field survey was performed on September 26th, 2017 in which the previously surveyed sixteen random, geo-mapped sections were re-surveyed for a "viable ear" count. Each section containing 16 segments that each measured approximately 1/1000th of an acre [17'6"], so in total we counted the ears on well over 7,000 corn plants! Below is a brief synopsis of the survey:

September 26, 2017 Field Survey	Plant Count		Viable Ear Count		Kernels per Ear
	Ha	Acre	Ha	Acre	
Impacto®	69,640	28,200	74,737	30,258	425
Pioneer® 4226	65,920	26,690	69,424	28,107	401

- Both Impacto® and Pioneer® 4226 pollination was affected by early September's afternoon heat, leading to 20-25% kernel loss. This is partially offset by excellent results on viable ear formation.

Fertilizer Program

BSA has set a goal of a minimum average yield of 7 mt/Ha (112 bushels/acre) for its Summer 2017 corn crop.

However, CSA is fertilizing for a 9.4 mt/Ha (150 bushel/acre) yield, assuming a minimum fertilization rate of 110% of maintenance levels (the level at which the crop neither adds nor depletes to the soil's fertility).

We leveraged our access to low cost aerial applications throughout the season to increase the number of aerial fertilizer applications, and we made a final urea application to Fields 1 and 2 (total of 4 in each) on September 1st, following our corn's surprisingly rapid biological development.

Despite pollination issues due to afternoon heat in early September, we are pleased to see the high number of viable ears which formed. Our November 6th Survey indicates that our continued investment in (pre-planting) P and K is helping to ensure strong kernel development.

The following summary table provides an overview of our initial plant nutrition program.

Fertilizer Application (lbs./acre)	N	P	K
Base	44	110	78
Liquid (fast uptake)	11	7	3
Urea	152	0	0
Foliar	0	0	0
Total	**207**	**117**	**81**
150 Bushels/Acre Maintenance (lbs./acre):	*188*	*66*	*42*
Fertilizer Build / Draw (lbs./acre):	**19**	**51**	**39**
110% Fertilization requirement surplus:	**0**	**44**	**34**

The June 19th, 2017 Farming Report has a detailed discussion of our fertilizer program; it is available upon request.

Following our discussions with the Syngenta Technical Representative, we continue to believe that our nutrition program is thoroughly vindicated. We consider that the health and resilience of our crop is strongly correlated to a generous nutrition program. Going forward, the challenge will be to create post subsoiling conditions (more organic matter, more evenly distributed) that encourage greater nutrition uptake by our corn plants. This would provide a further boost to final yields!

Adjusting for a 20-25% reduction in 2017 ear size due to pollination issues, we believe that 2017 Cayo One yields will demonstrate that we can reach or exceed, in years of reasonable weather, yields of 9.4 mt/Ha (150 Bu/Acre) on rainfed ground that is drained, subsoiled, and has sufficient organic matter. These yields would fully vindicate our major investment in crop nutrition.

Insects

As a reminder, our own experience and anecdotal reports throughout the region confirm that insect pressure has been high throughout this season in Belize. This was further confirmed by the Syngenta Technical Representative who had just completed an extensive tour of fields in Belize and Neighboring Peten; he complimented us on having among the very best looking fields he had seen throughout the region.

We consider that our aggressive insect management program has been effective thanks to a very proactive approach, which included the following applications:

- Initial our corn seed treatment (Syngenta's Fortenza®)
- Post planting insecticide application (DuPont Coragen®)
- Syngenta Karate®: (just registered in Belize; a suitable alternative to DuPont Coragen®)
- Syngenta Engeo® 247SC along with a phtyonomic oil as an additional suffocation agent.

We will continue to monitor insect activity closely during the final weeks of our crop, but we should be out of the "danger zone" and do not expect significant insect risk during the last three weeks prior to harvest.

Funguses and Bacteria

We began our fungus/bacteria management program using Syngenta's Amistar® in an initial prophylactic application on September 1st, during a simultaneous application with the insecticide Karate®. A second application took place on September 28th.

As expected, continued heavy rains during October did indeed increase the risk of aflatoxin and other diseases. Some Cayo farmers have reported fungus/bacteria issues, which immediately precludes their crop from being considered for Food Grade use.

We have detected no fungus/bacteria issues at Cayo One, and examined corn from the November 6th field survey closely for this issue!

We will continue to monitor this issue as the crop enters its final few weeks, although we have already done everything that can be done to mitigate its risks.

While the cost of our Fungus and Bacteria prevention program was high (~$45/acre), the reduction in crop value of $180-$220/acre if corn has to be sold as animal feed clearly supports the investment.

Weeds

This year's weed control program combined proactive spraying of glyphosate during periods when fields were not cultivated, adequate field preparations, and post-planting application of Syngenta's Calaris®.

Again, the Syngenta Technical Representative complimented us on the relative cleanliness of our fields. Understandably, with October's rains, and as we come into the final phase of the crop when the corn plants begin to dry down and provide more light to the soil, we have seen some weed development. We would not expect these weeds to unduly impact the corn crop or its harvest.

Harvest

Despite the corn crop's rapid development from July through September, October's heavy rains and their impact on the crop's final development have caused us to postpone our estimate for the start date for the harvest to the week of November 27th. We would now not expect this date to fluctuate unless excess rains make field access impracticable. As seen in the pictures below, our harvest equipment has been fully serviced and is ready to go!

Data from our field surveys on September 26th and November 6th confirm our expectation that, despite the pollination issues with this year's crop, overall yields from Cayo One will average between 7.0 and 8.5 mt/Ha (110 – 135 Bu/Acre). We will be particularly interested to review data from our yield monitors to understand where soil topography and condition, drainage, and nutrients impact final yields.

Cayo One Day 111 Field 2 Impacto®: – Nov 6, 2017
Section where plants still have some life

Cayo One Day 111 Field 2 Impacto®: – Nov 6, 2017
Ears are somewhat lower than sypical for this variety

Cayo One Day 111 Field 2 Impacto®: – Nov 6, 2017
Two good examples of 500+ kernel ears

Cayo One Day 111: Impacto® kernels – Nov 6, 2017
Very healthy but somewhat smaller than normal kernels
They still portend very good dry test weight

Cayo One Day 111: Field 1 – Nov 6, 2017
Corn Plant almost finished; ears still getting some nutrients
What a difference a week of no rain makes!

Cayo One Day 104 Field 1 – Oct 31, 2017
Corn Plant still has plenty of life
Zoom in to compare color differences

Cayo One Field 1+2 Northwesterly view – Nov 1, 2017
700mm of October rain left everything wet

Cayo One Field 1+2 Northeasterly view – Nov 1, 2017
Subsoil drainage to relieve excess water flow is clearly needed!

Cayo One Day 111 Field 2 Impacto®: – Nov 6, 2017
Small section of Field 2 where corn has moved into R6 Dry-down

Cayo One - Combine ready to go! – Nov 6, 2017
Equipment serviced and ready – we now wait for corn to dry

Banana Bank (10 mi West of Cayo One) - Nov 8, 2017
Pre Harvest Test Run - Grain Cart from Guatemalan Trucking Co.
They will be moving our 45+ 25mt loads in 4-5 weeks

Inside Grain Cart – Nov 8, 2017
Grain Cart means gentler and cleaner handling
Important for Food Grade Corn

Market Conditions and Conclusion

Corn

Global corn prices continue to be steady around their recent lows, with Gulf Ports prices at ~$148/mt for US #2 Feed Grade corn. This equates to ~$188/mt FOB Puerto Quetzal (Guatemala) and $245/mt CIF Melchor (Belize-Guatemala border crossing). The breakeven duty paid CIF Belize price would be ~$350/mt, or BZD 31.75/cwt

Domestic Belize prices, however, continued their weakening trend, as the 2017 harvest season is in full swing, and significant amounts of corn are downgraded to feed grade due to aflatoxin issues. Prices have fallen further to the $200-$220/mt range (BZD 18.00-20.00/cwt) for Feed Grade corn. This still compares favorably to the FOB Puerto Quetzal price, but would theoretically indicate that Belize either has an oversupply problem or farmers have inadequate storage/financing to hold onto crops.

We have in fact received anecdotal reports that Belize farmers with storage have cleared out all of their old crop corn inventories and have sold or presold their 2017 production in a near desperate attempt to raise cash, after three very difficult years (2014-2016). We will therefore watch with interest price behavior in the coming six months to see if local dealers nudge them back up as local supply moves entirely under their control.

We are sending a trial load of corn to Guatemala on November 8th to make sure all of our loading, hauling, border control, and delivery procedures are tested and functional ahead of shipping our 2017 crop in 4weeks

Edible Beans

Global prices for beans continue to trade erratically, with black beans remaining as low as $700/mt FOB China, while Mexican CIF prices remain steady in a much higher $1,150-$1,200/mt range. US Dealer prices, with the 2017 crop in, have slipped to just below $800/mt FOB. Belize has no activity ahead of new season plantings.

Soybeans

Global prices remain remarkably steady, with Gulf Ports traded unchanged around ~$368/mt, which equates to ~$408/mt FOB Puerto Quetzal and $472/mt CIF Melchor border crossing. The breakeven duty paid CIF price (Belize delivery) would be ~$665/mt, or BZD 60.00/cwt

Domestic Belize prices once again remain steady, as they have for an extended period of time, with Grade #1 soybean prices being quoted in the $560-$580/mt range (BZD 50-52.00/cwt), although there is little activity.

We are hopeful that the 2017 Hurricane season is now over and that Belize will have been spared any meaningful impact, unlike in 2016.

We continue to be encouraged by the appearance of our crop, and all field surveys point in the right direction. We are now at week 16 of a slighlty extended 19-20 week crop cycle, and are entering the final "drying down" phase of our crop's development. Although we were somewhat disappointed by the impact of high afternoon heat in September on pollination levels, barring last minute weather issues, we expect to harvest Cayo One's best ever crop!

Thanks! - Abram Dyck, John Peters, and the Farming Report Editorial Team

Grower	Location	Field #	Ha/ Acres	Irr ?	Soil Type	Crop	Seed Variety (count/Ha) (count/acre)	Plant Date	Stand Date	Fertilizer Program *(For full details of applications, refer to Lot Records)*	Comments
BSA	Cayo One	1	75/ 185	N	Black	Corn (Yellow)	Syngenta Impacto 70,000 28,340	July 17-18	July 20	Base 12-24-12 330lbs/acre 0-46-0 85lbs/acre 0-0-60 68lbs/acre 40-0-0-5.6 (S) 100lbs/acre 40-0-0-5.6 (S) 70lbs/acre 40-0-0-5.6 (S) 68lbs/acre 40-0-0-5.6 (S) 70lbs/acre	Near ideal seedbed and planting conditions. Stand emerged and established by July 20. Stand is Uniform and Vigorous at Day 11 – July 31 V-6 to V-7and healthy although slight signs of water stress – Aug 14 Solid growth thanks to less rain and generous fertilizer: V-11 to V-12 at Aug 28. Continued solid growth and early R-1 at Sep 11. Promising Crop well into R5 at Oct 9. After surviving heavy rains, promising crop about to enter R6 at Nov 6
BSA	Cayo One	1a	4/ 10	N	Black	Corn (Yellow)	Pioneer 4226 70,000 28,340	July 18	July 20	Base 11.1-28.6-20.2 385lbs/acre 40-0-0-5.6 (S) 100lbs/acre 40-0-0-5.6 (S) 70lbs/acre 40-0-0-5.6 (S) 68lbs/acre 40-0-0-5.6 (S) 70lbs/acre	Western side of Field 1. Near ideal seedbed and planting conditions. Stand emerged and established by July 20. Stand is Uniform and Vigorous at Day 11 – July 31 V6 to V7 and healthy although slight signs of water stress – Aug 14 Solid growth thanks to less rain and generous fertilizer, but higher evidence of illnesses: V-11 to V-12 at Aug

											28. Continued solid growth and early R-1, with no worsening of illness patterns at Sep 11. Promising Crop well into R5 at Oct 9. After surviving heavy October rains, a good crop about to enter R6 at Nov 6
BSA	Cayo One	1N	34/ 83	N	Black	Corn (Yellow)	Syngenta Impacto 70,000 28,340	TBD	TBD	Base	Decision made not to plant on August 15th. Insufficient time to complete landworks.
BSA	Cayo One	2	122/ 301	N	Black	Corn (Yellow)	Syngenta Impacto 70,000 28,340	July 15-17	July 18	Base 11.1-28.6-20.2 385lbs/acre 40-0-0-5.6 (S) 100lbs/acre 40-0-0-5.6 (S) 70lbs/acre 40-0-0-5.6 (S) 68lbs/acre 40-0-0-5.6 (S) 70lbs/acre	Near ideal seedbed and planting conditions. Uniform emergence within 60-72 hours of planting Stand emerged and established by July 18. Stand is Uniform and Vigorous at Day 13 – July 31 V8 and healthy across the field with little to no signs of water stress – Aug 14 Impressive growth with healthy plants at V12 to V-14: August 28. Continued vigorous growth and mid R-1 at Sep 11. Promising Crop well into R5 at Oct 9. After surviving heavy October rains, a very promising crop about to enter R6 at Nov 6

Lot Records for Fields 1 and 2 (Zoom in to see details)

A new Lot Record is (still!) in development and will be provided in following reports