

## Canine Genetic Health Certificate™

|                         |                                  |                          |                 |
|-------------------------|----------------------------------|--------------------------|-----------------|
| <b>Call Name:</b>       | Luna                             | <b>Laboratory #:</b>     | 169602          |
| <b>Registered Name:</b> | Brucker Creek Luna's Astra Storm | <b>Registration #:</b>   | DN51027303      |
| <b>Breed:</b>           | Border Collie                    | <b>Microchip #:</b>      | 985113001107037 |
| <b>Sex:</b>             | Female                           | <b>Certificate Date:</b> | April 13, 2021  |
| <b>DOB:</b>             | Sept. 2017                       |                          |                 |

**This canine's DNA showed the following genotype(s):**

| Disease                                                                        | Gene              | Genotype | Interpretation                                  |
|--------------------------------------------------------------------------------|-------------------|----------|-------------------------------------------------|
| Chondrodystrophy with Intervertebral Disc Disease Risk Factor (CDDY with IVDD) | <i>CFA12 FGF4</i> | WT/WT    | Normal (Clear) - No CDDY or Increased IVDD Risk |
| Collie Eye Anomaly                                                             | <i>NHEJ1</i>      | WT/WT    | Normal (clear)                                  |
| Degenerative Myelopathy                                                        | <i>SOD1</i>       | WT/WT    | Normal (clear)                                  |
| Exercise-Induced Collapse                                                      | <i>DNM1</i>       | WT/WT    | Normal (clear)                                  |
| Hyperuricosuria                                                                | <i>SLC2A9</i>     | WT/WT    | Normal (clear)                                  |
| Intestinal Cobalamin Malabsorption (Border Collie Type)                        | <i>CUBN</i>       | WT/WT    | Normal (clear)                                  |
| Multidrug Resistance 1                                                         | <i>ABCB1</i>      | WT/WT    | Normal (clear)                                  |
| Myotonia Congenita (Australian Cattle Dog Type)                                | <i>CLCN1</i>      | WT/WT    | Normal (clear)                                  |
| Neuronal Ceroid Lipofuscinosis 5 (Australian Cattle Dog/Border Collie Type)    | <i>CLN5</i>       | WT/WT    | Normal (clear)                                  |
| Sensory Neuropathy (Border Collie Type)                                        | <i>FAM134B</i>    | WT/WT    | Normal (clear)                                  |
| Trapped Neutrophil Syndrome                                                    | <i>VPS13B</i>     | WT/WT    | Normal (clear)                                  |

WT, wild type (normal); M, mutant; Y, Y chromosome (male)



**Blake C Ballif, PhD**  
Laboratory & Scientific Director



**Christina J Ramirez, PhD, DVM, DACVP**  
Medical Director

Paw Print Genetics® performed the tests listed on this dog. See the Laboratory Report for interpretation and recommendations based on these findings. The genes/diseases reported here were selected by the client. Normal results do not exclude inherited mutations not tested in these or other genes that may cause medical problems or may be passed on to offspring. These tests were developed and their performance determined by Paw Print Genetics. This laboratory has established and verified the tests' accuracy and precision. Because all tests performed are DNA-based, rare genomic variations may interfere with the performance of some tests producing false results. If you think these results are in error, please contact the laboratory immediately for further evaluation. In the event of a valid dispute of results claim, Paw Print Genetics will do its best to resolve such a claim to the customer's satisfaction. If no resolution is possible after investigation by Paw Print Genetics with the cooperation of the customer, the extent of the customer's sole remedy is a refund of the fee paid. In no event shall Paw Print Genetics be liable for indirect, consequential or incidental damages of any kind. Any claim must be asserted within 60 days of the report of the test results. Genetic counseling is available at Paw Print Genetics.

## Coat Color and Trait Certificate

|                         |                                  |                          |                 |
|-------------------------|----------------------------------|--------------------------|-----------------|
| <b>Call Name:</b>       | Luna                             | <b>Laboratory #:</b>     | 169602          |
| <b>Registered Name:</b> | Brucker Creek Luna's Astra Storm | <b>Registration #:</b>   | DN51027303      |
| <b>Breed:</b>           | Border Collie                    | <b>Microchip #:</b>      | 985113001107037 |
| <b>Sex:</b>             | Female                           | <b>Certificate Date:</b> | Feb. 14, 2024   |
| <b>DOB:</b>             | Sept. 2017                       |                          |                 |

### This canine's DNA showed the following genotype(s):

| Coat Color/Trait Test                                                                | Gene              | Genotype                       | Interpretation                                   |
|--------------------------------------------------------------------------------------|-------------------|--------------------------------|--------------------------------------------------|
| A Locus (Agouti)                                                                     | <i>ASIP</i>       | $a^w/a^t$                      | Wolf sable/gray (carries tricolor/black and tan) |
| A <sup>S</sup> Locus (Saddle Tan)                                                    | <i>RALY</i>       | N/A <sup>S</sup>               | Saddle tan/creeping tan (non saddle tan carrier) |
| B Locus (Brown) - $b^a, b^c, b^d, b^s$                                               | <i>TYRP1</i>      | B/B                            | Black coat, nose and foot pads                   |
| Chondrodysplasia (CDPA)                                                              | <i>CFA18 FGF4</i> | cd/cd                          | No Leg Shortening Associated with CDPA           |
| D Locus (Dilute) - $d^1, d^2$                                                        | <i>MLPH</i>       | WT/M                           | Non dilute (carrier)                             |
| E Locus - E <sup>m</sup> (Melanistic Mask)                                           | <i>MC1R</i>       | N/N                            | No melanistic mask                               |
| E Locus - e<br>(Apricot/Cream/Red/Yellow,<br>Common Variant Found in Many<br>Breeds) | <i>MC1R</i>       | E/e                            | Black (carries yellow/red)                       |
| I Locus (Intensity)                                                                  | <i>MFSD12</i>     | I/I                            | Normal intensity                                 |
| K Locus (Dominant Black)                                                             | <i>CBD103</i>     | K <sup>B</sup> /k <sup>y</sup> | No agouti expression allowed (carrier)           |
| M Locus (Merle)                                                                      | <i>PMEL</i>       | m/m                            | Non merle                                        |
| S Locus (White Spotting, Parti, or Piebald)                                          | <i>MITF</i>       | S/S                            | No white spotting, flash, parti, or piebald      |
| SD Locus (Shedding)                                                                  | <i>MC5R</i>       | SD/SD                          | High shedding                                    |

### Interpretation:

This dog carries one copy of **a<sup>w</sup>** and one copy of **a<sup>t</sup>** which results in a "wolf" sable/gray coat color. However, this dog's coat color is also dependent on the E, K, and B genes. The "wolf" sable/gray coat color is only expressed if the dog is also E/E or E/e at the E locus and k<sup>y</sup>/k<sup>y</sup> at the K locus which allows for agouti gene expression. This dog will pass on **a<sup>w</sup>** to 50% of its offspring and **a<sup>t</sup>** to 50% of its offspring.

This dog carries one copy of an **A<sup>S</sup>** allele and one copy of **N**, the wildtype sequence. This combination of alleles is also found in dogs with a saddle tan coat color. However, this dog's coat color is also dependent on the E, A, and K loci. Saddle tan is found only in dogs that are also E/E or E/e at the E locus, k<sup>y</sup>/k<sup>y</sup> at the K locus, and a<sup>t</sup>/a<sup>t</sup> or a<sup>t</sup>/a at the A locus. This dog will pass the **N** allele to 50% of its offspring and the **A<sup>S</sup>** allele to 50% of its offspring, which can produce saddle tan dogs.

This dog carries two copies of **B** at all three of the b<sup>c</sup>, b<sup>d</sup> and b<sup>s</sup> loci making the overall B locus genotype of this dog **B/B**. The overall B locus genotype for a dog is determined by the combination of the genotypes at the b<sup>c</sup>, b<sup>d</sup>,

and  $b^s$  loci. The  $b^c$ ,  $b^d$ , and  $b^s$  variants confer brown coat, nose, and foot pads when at least one of these DNA changes is present on both genes of the dog at the B locus. If the dog has one or no copies of **b** then the dog will have a black coat, nose, and foot pads. However, this dog's coat color is also dependent on the E, K, and A genes. This dog will pass on **B** to 100% of its offspring.

Two genetic mutations are associated with shortened legs in dogs. Both mutations consist of copied sections (duplication) of the canine *FGF4* gene (called an *FGF4*-retrotransposon) that have been inserted into two aberrant locations in the genome; one in chromosome 12 (*CFA12 FGF4*; associated with CDDY and IVDD risk) and one in chromosome 18 (*CFA18 FGF4*; associated with chondrodysplasia [CDPA], but not associated with IVDD). Appropriate breeding decisions regarding dogs which have inherited the *CFA12 FGF4* mutation (WT/M or M/M) need to address both the potential loss of genetic diversity in a population which would occur if dogs with this mutation were prohibited from breeding as well as the loss of the short-legged appearance that is a defining physical characteristic for some breeds. In breeds which inherit both mutations, breeders may use genetic testing results to selectively breed for the CDPA (*CFA18 FGF4*) mutation while breeding away from the CDDY and IVDD risk (*CFA12 FGF4*) mutation to reduce IVDD risk and retain the short-legged appearance. However, the frequency of each mutation varies between breeds and, in some cases, may not be conducive to such a breeding strategy. For example, breeds with extreme limb shortening (e.g. Basset hound, Dachshund, Corgi) typically develop their appearance due to inheritance of both the *CFA12 FGF4* and *CFA18 FGF4* mutations. In addition, depending on the breed, offspring born without either the *CFA12 FGF4* or *CFA18 FGF4* mutations may display longer limbs than cohorts and, therefore, not meet specific breed standards.

This dog carries two copies of the **cd** allele which does not result in leg shortening. However, the actual leg length of the dog is a result of a combination of factors including the mutation associated with CDDY and IVDD risk (*CFA12 FGF4*) as well as variants in other genes. This dog will pass one copy of **cd** to 100% of its offspring.

This dog carries one copy of **D** and one copy of **d** which does not result in the "dilution" or lightening of the black and yellow/red pigments that produce the dog's coat color. The base coat color of this dog will be primarily determined by the E, K, A, and B genes. This dog will pass on **D** to 50% of its offspring and **d** to 50% of its offspring.

This dog carries one copy of **E** and one copy of **e** which allows for the production of black pigment. However, this dog's coat color is also dependent on the K, A, and B genes. This dog will pass **E** on to 50% of its offspring and **e** to 50% of its offspring, which can produce a yellow/red coat (including shades of white, cream, yellow, apricot or red) if inherited with another copy of **e**.

This dog carries two copies of **N** which does not result in a melanistic mask on the muzzle of the dog. This dog will pass on **N** to 100% of its offspring.

This dog does not carry a copy of the *i* mutation and has an I locus genotype of **I/I** which does not result in the lightening of the light, phaeomelanin pigments that produce the dog's coat color in an *e/e* dog. This dog will pass one copy of **I** to 100% of its offspring and cannot produce *i/i* dogs.

This dog carries one copy of **K<sup>B</sup>** and one copy of **k<sup>y</sup>** which prevents expression of the agouti gene (A locus) and allows for solid eumelanin (black pigment) production in pigmented areas of the dog. However, this dog's coat color is also dependent on its genotypes at the E and B genes. This dog will pass on **K<sup>B</sup>** to 50% of its offspring and **k<sup>y</sup>** to 50% of its offspring.

This dog carries two copies of **m**, the non-merle, wild-type allele of the *PMEL* gene, and, therefore, does not have a merle coat color/pattern. This dog will pass on one copy of the **m** allele to 100% of its offspring.

This dog carries two copies of **S** which results in a solid coat with no white spotting, flash, parti, or piebald coat color. This dog will pass on one copy of **S** to 100% of its offspring.

This dog carries two copies of **SD** which has been associated with higher shedding. However, the overall degree of shedding for this dog is dependent on the combination of this dog's genotypes at the SD and IC loci. This dog will pass **SD** on to 100% of its offspring.

Paw Print Genetics® has genetic counseling available to you at no additional charge to answer any questions about these test results, their implications and potential outcomes in breeding this dog.

Paw Print Genetics® performed the testing on the dog listed on this certificate. The genes/traits reported here were selected by the client. Normal results do not exclude inherited mutations not tested in these or other genes that may cause variation in traits, medical problems or may be passed on to offspring. The results included in this report relate only to the items tested using the sample provided. These tests were developed and their performance determined by Paw Print Genetics. This laboratory has established and verified the test(s)' accuracy and precision with >99.9% sensitivity and specificity. The presence of mosaicism may not be detected by this test. Non-paternity may lead to unexpected results. This is not a breed identification test. Because all tests performed are DNA-based, rare genomic variations may interfere with the performance of some tests producing false results. If you think any results are in error, please contact the laboratory immediately for further evaluation. In the event of a valid dispute of results claim, Paw Print Genetics will do its best to resolve such a claim to the customer's satisfaction. If no resolution is possible after investigation by Paw Print Genetics with the cooperation of the customer, the extent of the customer's sole remedy is a refund of the fee paid. In no event shall Paw Print Genetics be liable for indirect, consequential or incidental damages of any kind. Any claim must be asserted within 60 days of the report of the test results.