Agrigenomic Solutions
for Breeding & Improvement
GeneSeek, Inc. a Neogen Company, was founded in 1998 and has developed into a comprehensive agricultural biotechnology service provider. GeneSeek’s corporate headquarters are in a large custom-built laboratory facility within the Technology Park in Lincoln, Nebraska.

GeneSeek provides comprehensive agrigenomic solutions for research and development and commercial applications. Let our experience, expertise and infrastructure help you in creating successful outcomes in a competitive environment.

With our technical platforms we can handle any project, from a few SNPs (single nucleotide polymorphism) on thousands of samples to a million SNPs on a few samples. We can process any sample type including hair, blood, tissue and more. We also provide clinical veterinary diagnostics for trait and disease markers, and for pathogen detection using quantitative real-time PCR and ELISA.

Neogen Corporate Profile

In business since 1982, Neogen Corporation has grown to more than 600 employees in multiple domestic and international locations developing, manufacturing and marketing a diverse line of products dedicated to food and animal safety. The company’s more than 200 diagnostic test kits are easier to use, and provide greater accuracy and speed than other diagnostic methods currently employed.

The company’s Neogen Europe subsidiary, based in Ayr, Scotland, provides Neogen better access to the European Union, and allows better service to its customers and distributors throughout the EU. The expansion of Neogen Europe’s responsibilities in Germany, new subsidiaries in Mexico and Brazil, and its expanding R&D efforts geared toward worldwide markets, have added to the brick and mortar international presence that Neogen began with the establishment of sales and distribution offices in Shanghai, China.

Neogen’s success has gained increased notice outside the testing industry. Neogen has been named to NASDAQ’s Global Select Market (its top tier of companies; NASDAQ: NEOG), and repeatedly named as one of Forbes Magazine’s 200 Best Small Companies in America.
GeneSeek’s solutions products and services are customized solutions that address needs in the areas of SNP (single nucleotide polymorphism) profiling, marker-assisted selection, disease diagnostics, and identity management. These solutions can start with a research and development program initiated at GeneSeek by the customer or with existing information that the customer provides. GeneSeek’s advantage is the ability to combine many of our genotyping platforms in a synergistic manner to meet customers’ needs and provide useful and cost-effective solutions in high throughput and at a very high level of quality. GeneSeek adheres to internationally accepted standards and quality procedures and some of our methods and tests are ISO:17025 accredited through the American Association of Laboratory Accreditation.

**Animal Species**
(see pages 2-9)
- Alpaca
- Cattle
- Canine
- Goat
- Horse
- Swine
- Sheep
- More available

**Plant Species**
(see page 10)
- Maize
- Rice
- Soybean
- Wheat
- More available

**Contract Research & Bioinformatics**
(see page 2)
- Consultation
- Project Management

**Sample Management**
(see page 9)
- Sample Collection
- Sample Preparation

**SNP Profiling**
(see page 3)
- Illumina Infinium

**Marker Assisted Selection**
(see pages 4-5)
- Sequenom SNP Panels
- Illumina Goldengate

**Identity & Diagnostics**
(see pages 6-8)
- Microsatellites
- qPCR
- ELISA
- Sequenom Low SNP

**Rigorous Quality Control**
GeneSeek strives to create an open and collaborative environment that provides efficient and cost-effective solutions that allow customers to respond to market needs in a timely fashion.

**Basic and Applied Research Solutions**

GeneSeek has a talented group of researchers led by six Ph.D.-level scientists. With expertise in immunology, molecular genetics, biochemistry, molecular biology, genomics, protein chemistry, quantitative genetics and virology, the company is able to provide comprehensive research services to customers. From simple assay development to comprehensive multi-year research projects, the company can provide turnkey solutions that meet customer needs.

**Bioinformatic Services**

Recognizing the growing need for bioinformatic services, GeneSeek is beginning to offer custom informatic tools and services that will save time and money for customers by integrating our data generation capabilities with data analysis, data warehousing and data mining capabilities.

- Data reformatting services for data generated by GeneSeek for seamless integration into customers’ data management systems
- Data analysis and evaluation — PLINK, BLUP Analysis
- Inquire about additional bioinformatic services
GeneSeek is a leader in offering Illumina’s Infinium BeadChip Service. The chips were developed by leading agricultural researchers and thousands of SNP markers that have been validated throughout the agricultural industry. The chips offer a >99% average call rate and 99.9% reproducibility.

The BeadChips offer cost-effective genotyping and are suitable for whole-genome association studies and other applications such as:

- Genome-wide selection
- Determination of genetic merit
- Identification of quantitative trait loci (QTL)
- Comparative genetic studies

Available Illumina Genotyping Assays

- Bovine 3K Net Merit Panel – 3072 SNP panel
- Bovine SNP50 BeadChip – 54,609 informative SNP markers
- BovineHD – High density genotyping with greater than 777,000 SNP markers
- CanineHD – High density genotyping with greater than 170,000 SNP markers
- PorcineSNP60 BeadChip – 62,163 informative SNP markers
- OvineSNP50 BeadChip – 54,241 informative SNP markers
- EquineSNP50 BeadChip – 54,602 informative SNP markers
- Maize SNP50 BeadChip – 56,110 informative SNP markers
- Mouse Custom 9K BeadChip: Inquire!

Inquire about custom BeadChip development services

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Email: genesseekinfo@neogen.com  Website: www.neogen.com
GeneSeek taps the power and precision of mass spectrometry-based genotyping. GeneSeek provides routine genotyping services using flexible and customized panels (1-400 SNPs) and unlimited sample sizes for aiding programs using genetic information in selection and breeding. Whether samples have to be genotyped daily, weekly or monthly, GeneSeek is able to provide flexible turnaround time and data quality needed for any application. These types of applications are routinely used in the agricultural industry to make selective breeding decisions (e.g. marker-assisted selection), and GeneSeek has several platforms that it can use to provide flexible solutions including ultra high throughput applications.

Sequenom® Panels
Up to a 40-SNP plex in a single reaction, allowing low-cost and high-volume analysis.

Sequenom MassARRAY® Next Generation Genetic Analysis System
GeneSeek utilizes four Sequenom MassARRAY analyzers, including the new MassARRAY Analyzer 4 system. The system provides high throughput, faster time-to-results, and the ability to cost effectively run from tens to thousands of samples.

Key Features and Benefits
- Mass spectrometry-based detection system for sensitive, accurate, and rapid analyses
- 384 and 96-well options for high- and low-throughput research applications
- Easy-to-use multiplexed assay design and optimization software saves research time and helps maximize efficiency

Illumina GoldenGate
Utilizing universal BeadChips, Illumina GoldenGate allows higher-content customized SNP panels (384-3072) which can be designed for any species and with user-defined content. GoldenGate provides a greater than 99% data return and is very cost effective for larger sample volumes. GeneSeek is a CSPro-certified provider of the GoldenGate platform.
Marker-assisted selection (MAS) is the most widely-used application of genomics in agrigenomics. Once genetic traits have been mapped and a closely linked marker is identified, it is possible to screen large numbers of samples for rapid identification of progeny that carry desirable characteristics to advance your genetic improvement program.

Using markers for trait selection has numerous advantages when compared to conventional selection and breeding, including:

- **Speed** – DNA can be extracted from tissue early in development and trait information can be discovered with markers prior to breeding.
- **Consistency** – Markers remove the impact of environmental effects that often complicate traditional phenotypic evaluation.
- **Biosafety** – Using genetic markers in screening for disease resistance means not having to introduce the pathogen into breeding populations, which is particularly important for livestock breeding.
- **Efficiency** – Screening progeny early in the process allows elimination of those with poor genetics and makes more efficient use of resources.
- **Complex traits** – Most multigenic traits, or QTLs, are very difficult to manage through conventional plant breeding. The statistical chance of getting the required allele at each of a number of loci is very low. Markers allow you to manage the whole genome and do genomic selection vs. trait selection.

Overall genetic performance of a breeding population will follow a bell curve distribution.

Markers allow breeders to find individuals in the elite group more quickly, with greater consistency.

**GeneSeek** can assist you in developing custom panels of trait-linked markers to improve the genetic performance of your population. The genetic markers of choice are SNP (single-nucleotide polymorphism) based and can be run very efficiently in multiplexes allowing for screening of many traits at an affordable cost. To achieve the greatest gains in marker-assisted selection, GeneSeek can create economic MAS panels for your different genetic stocks and improve these panels over time. SNP marker panels with less than 100 SNPs can typically be tested in large volumes for less than $7 per animal genotyped.
Porcine Trait Management
GeneSeek is now offering validated porcine performance trait DNA marker testing utilizing information from seven unique genes that impact:

- Feed Intake/Conversion
- Weight Gain
- Lean Growth
- Fat Content
- Meat Quality
- Litter Size – Estrogen Receptor
- Litter Size – Erythropoietin

Additionally, single-gene DNA diagnostic tests are available that can identify carriers of known detrimental alleles.

- Porcine Stress Syndrome (HAL) Genetic Test
- RN (NAPOLE) Genetic Test
- *E. coli F4ab/ac Resistance Genetic Test

Bovine Trait Management

- Curly calf (AM) Arthrogryposis Multiplex
- PHA Pulmonary Hypoplasia with Anasarca
- OSTEO Osteopetrosis
- Slick coat
- Coat color
  - Black
- DL* Silver
- TH Tibial Hemimelia
- NH Neuropathic Hydrocephalus
- IE Idiopathic Epilepsy
- CHONDRO Chondrodysplasia
- Dunn Dunn Color
- Man Mannosidosis
- Fawn Calf* Contractural Arachnodactyly

*Available late 2010

Li-Cor DNA Sequence Analyzer
For more than a decade, GeneSeek has utilized Li-Cor’s infra-red technology. During that time, we have had the opportunity to perfect our abilities and overall usage of the equipment. With the Li-Cor genotyping platform, GeneSeek has the ability to aid farmers, ranchers, researchers, industry and breed associations with everything from single gene tests, parentage and identification, and large fragment analysis projects.
SeekSire™

Parentage and Sire Identification Program for Cattle, Swine, Sheep and Goats

SeekSire is created for ranchers, breeders and breed associations who need to manage their herds’ pedigrees in a highly accurate and cost-effective manner. SeekSire can help maintain herd books, facilitate retrospective genetic improvement, and manage herd performance and quality. Additionally, when all sires and dams used in a herd are known and identified through DNA, it is possible to identify all progeny, thereby creating full traceability. GeneSeek’s newer technology platforms make SeekSire very affordable.

SeekTrace™

Traceability Program for Beef and Pork

SeekTrace can address traceability needs across the entire production to consumer pipeline. SeekTrace enables management of the origin, movement and identity of each animal through the entire supply, demand and consumption chain. A powerful set of DNA markers are used to identify a unique sample, and in conjunction with date of processing, facility or premise ID, any animal can be traced with the help of custom informatic solutions. While traceability has been a desirable solution for many years, high DNA testing costs have limited widespread adoption. But now, for the first time, new advances in DNA technology allow geneseek to provide SeekTrace for a fraction of the end value of each animal.
Identity & Diagnostics
Veterinary Diagnostics

Real-time PCR Detection
The speed and specificity of real-time PCR detection has allowed GeneSeek to provide quality diagnostic data in short turnaround times. Real-time technology also allows GeneSeek to provide contract research and development for improved pathogen detection and validation. We have assisted beef and pork producers in making quality animal health decisions for many years.

Swine Diagnostics
GeneSeek offers real-time PCR based detection of both PRRSV and PCV2 viruses. ELISA tests are also available for both PRRSV and M. hyopneumoniae. GeneSeek’s swine diagnostic testing combines fast (same day PCR turnaround) and reliable data with the highest quality of customer service.

- PRRSV
- PCV2
- M. hyopneumoniae

Bovine Diagnostics
GeneSeek offers both real-time PCR and ELISA detection for BVDV. We accept a multitude of sample types for testing including whole blood, blood spotted on cards, serum, and tissue. We also have the ability to run additional genomic or diagnostic tests from a single submitted sample. Diagnostic testing can now be performed from hair follicle submissions.

- BVDV

Development and Validation
GeneSeek provides quality contract research and development for all your diagnostic needs. PCR design and sample validation for improved pathogen detection are just two areas in which GeneSeek has made an impact in the veterinary diagnostic field.
GeneSeek accepts a multitude of sample types from the many species we work with on a daily basis. We accept whole blood, blood spotted on cards, serum, and tissue samples (including ear tag samples) from all animals. For our plant genotyping customers, we can work with plant leaf, seed, and root tissue and have a unique plant collection device (see page 10). We are also glad to accept purified DNA pending it meets our quality specifications. GeneSeek has the unique ability to run BOTH genetic tests and veterinary diagnostics from the same sample, including hair follicle submissions (detailed collection instructions below).

Instructions for Hair Sample Collection from Cattle
Hair samples should be collected and placed in the GeneSeek sample collection device.

1. Hair samples should be collected from the tail switch (end of tail) of a restrained animal. The hair follicles found at the tail switch region are ideal for DNA extraction.
2. Clean the tail area using a comb or brush so as to remove any extraneous matter such as manure or straw. Sometimes it may be necessary to wash the hair prior to collection.
3. Check that the ID written on the collection device perfectly matches the ID of the animal (see Figure 1).
4. Grasp a clump of hair (as thick as a ball point pen) using your hand or a pair of pliers. Pull the hair samples out with a sudden movement so as to get a clean tuft of hair with follicles (see Figure 2a). The hair follicles are found at the end of the hair that is embedded in the tissue.
5. Examine the hair closely. Make sure the hair follicles are present on 20 to 40 strands (see Figure 2b). Note that DNA is found only in the hair follicles and not in the hair itself. If sufficient follicles are not available, make a second attempt at pulling hair.
6. Place pulled hair in the GeneSeek hair collection device (see instructions that come with the device).
7. Carefully trim excess hair from the sides of the collector using a pair of sharp scissors.
8. Place hair sample collection device in resealable plastic bag for shipping to GeneSeek.
Plant Genotyping

Whether it is whole genomic DNA or plant tissue of any type, GeneSeek can provide genotyping services for quality control, transgene analysis, whole genome scans or marker assisted selection.

GeneSeek has developed new methods and systems for collection, storage, DNA extraction and genotyping from plant samples that allow high throughput genotyping at very low cost. From one or two small leaf disc punches, we are able to analyze your target of interest using standard PCR, real-time PCR, SNPs or microsatellite markers. Our collection devices allow identification, long-term storage and shipping of samples. High throughput screening of plants can now be done efficiently and at very low cost.

Figure shows GeneSeek sample archiving system with leaf sample being punched into a 96-well plate for DNA extraction followed by genotyping on different platforms that include PCR and non-PCR based methods.
### Products & Services List

#### Illumina® Services

<table>
<thead>
<tr>
<th>Code</th>
<th>Product Description</th>
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<tbody>
<tr>
<td>1000</td>
<td>Bovine 3K Net Merit Panel</td>
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<tr>
<td>1020</td>
<td>Bovine SNP50 BeadChip</td>
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<tr>
<td>1040</td>
<td>Bovine High-Density BeadChip</td>
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<td>Canine High-Density BeadChip</td>
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<td>Porcine SNP60 BeadChip</td>
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<td>Mouse Custom 9K BeadChip</td>
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<td>1250</td>
<td>Maize SNP50 BeadChip</td>
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<tr>
<td>1150</td>
<td>Illumina chip - Hyb/scan (regular chip)</td>
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<tr>
<td>1160</td>
<td>Illumina chip - Hyb/scan (HD Chip)</td>
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</table>

*Other BeadChips available; please inquire*

#### Custom SNP genotyping panels

Custom SNP panel development and validation
Sequenom SNP panel genotyping services

#### Trait Analysis, Parentage, and Veterinary Diagnostics

##### Sample Collection

<table>
<thead>
<tr>
<th>Code</th>
<th>Sample Type</th>
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<tbody>
<tr>
<td>2000</td>
<td>Hair cards</td>
</tr>
<tr>
<td>2010</td>
<td>Blood cards</td>
</tr>
<tr>
<td>2020</td>
<td>Plant specimen cards</td>
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</tbody>
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##### Porcine Specific

- 2290 SeekSire™ - Porcine parentage
- 2410 SeekTrace™ - Porcine
- 2430 SeekGain™ - Porcine panel
- 2510 Porcine Stress Syndrome (HAL)
- 2520 Napole - RN
- 2530 F4 E. coli - PEC
- 2540 Insulin growth factor 2 (IGF2)
- 2550 Swine litter size (SLS)
- 2560 Porcine swine growth and feed efficiency
- 2570 Meat quality
- 2580 Porcine gain, growth and meat quality
- 2620 Hamp and HAL and RN
- 2630 Hamp and RN
- 2640 Hamp and HAL

##### Sheep/Goat Specific

- 3030 SeekSire™ - Sheep/Goat parentage

##### Bovine Specific

- 2500 SeekTrace™ - Bovine
- 3040 SeekSire™ - Cattle parentage
- 3110 Curly calf (AM)
- 3130 PHA
- 3160 OS
- 3180 Slick coat
- 3200 Coat color
- 3210 DL
- 3220 TH
- 2460 NH
- 2470 IE
- 2480 CHONDRO
- 2490 Dunn

#### Veterinary Diagnostic Testing

##### Swine

- 4000 PRRSV - PCR screening
- 4070 Circo virus (PCV2) - PCR
- 4020 PRRSV ELISA

##### Bovine

- 4080 Mycoplasma hyopneumoniae - ELISA
- 4040 Bovine BVDV - PCR
- 4060 BVDV ELISA

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