

Technical Reviewers' Rating Summary

Proposal Number Application Title Submitted By Request For Total Project Costs

Section A. Scoring

Statement	Weighting Factor	G-51-08A	G-51-08B	G-51-08C	Average Weighted Score
1. Objectives	9	3	4	5	36
2. Achievability	7	3	3	4	21
3. Methodology	8	3	4	5	32
4. Contribution	8	3	4	3	24
5. Awareness / Background	5	4	4	4	20
6. Project Management	3	2	4	3	9
7. Equipment / Facilities	2	2	4	3	6
8. Value / Industry - Budget	4	3	4	5	16
9. Financial Match - Budget	4	3	3	3	12
Average Weighted Score		150	189	204	181

Total: 50

250 possible points

OVERALL RECOMMENDATION

FUND X X
 FUNDING TO BE CONSIDERED X
 DO NOT FUND

Section B. Ratings and Comments

- The objectives or goals of the proposed project with respect to clarity and consistency with North Dakota Industrial Commission/Oil and Gas Research Council goals are:

The goals align with Mr. Helms memorandum to advancing the use of aerial imagery and analytics. It also aligns with the Governor's request for us of technology. Additional, the objectives to generate information and knowledge, and to attract new oil and gas investment to the state. If the outcome become a standard protocol for reclamation assessment, an increase on the demand for professional to operate the several phases of the process can be expected.

- Reviewer: G-51-08A

- Rating: 3

The objectives and goals of this proposal align very well with those of the OGRC. The specific goals most in alignment include: - Promote efficient, economic, and environmentally sound exploration, development, and use of North Dakota's oil and gas resources. -Encourage, and promote the use of new technologies and ideas that will have a positive economic and environmental impact on oil and gas exploration, development, and production in North Dakota. -Improve the overall suitability of the oil and gas energy industry in North Dakota through the development of new environmental practices that will help to reduce the footprint of oil and gas activities -Develop baseline information that will lead to other projects, processes, ideas, and activities.

- Reviewer: G-51-08B

- Rating: 4

The proposal clearly defined the goals of the project, and mapped a direct overlap to OGRP goals.

- Reviewer: G-51-08C

- Rating: 5

SolSpec has designed this proposal with great consideration of the input and feedback received from the NDIC and OGRC.

- Applicant

- With the approach suggested and time and budget available, the objectives are:

The most time consuming part appears to be model development. I should not take much time to fly the project sites.

- Reviewer: G-51-08A

- Rating: 3

The project timeline appears aggressive given the scope work to include data collection, data "clean up", model development, testing, validation, and creating a friendly user experience. As proposed, the budget is adequate for the timeline, but if additional time and resources are required at any step, the budget may not prove sufficient.

- Reviewer: G-51-08B

- Rating: 3

It is difficult to predict the progress of analytics algorithm development. SolSpec is recognized as a more-than-competent developer of analytical approaches for oil & gas. The budget seems a bit low, but likely relies upon prior related development work performed by SolSpec.

- Reviewer: G-51-08C

- Rating: 4

As mentioned by Reviewer C, the process of model development and training can be unpredictable due to the iterative nature of identifying the right combination of variables and analytics to achieve the model outputs and accuracy levels. SolSpec believes that the timeline (16 months) described is sufficient for executing the proposed project within a moderate budget due to the ability to build upon some prior related development work that will inform the efforts of this project.

- Applicant

3. The quality of the methodology displayed in the proposal is:

I was vague on what the automation is and how the end user will access and employ the tool. It was clear on where the data used in the model will come from and how it will be gather.

- Reviewer: G-51-08A

- Rating: 3

The methodology outlined in the application was very detailed and clear on the steps required to reach the proposed objectives.

- Reviewer: G-51-08B

- Rating: 4

The methodology presented in the proposal is logical and detailed. The methodology acknowledges the research aspect of the work, but balances it with optimism toward commercial development progress.

- Reviewer: G-51-08C

- Rating: 5

Automated data processing is the creation and implementation of technology that automatically processes data once it is received. The SolSpec platform can store, manipulate, prepare and distribute data without human intervention. The purpose of automated data processing is to quickly and efficiently process large amounts of information with minimal human interaction. The end user will access and employ the toolkit through the secure, web-based, open-source platform and viewer, from which the user can download data outputs in various formats for integration into other software, if desired.

- Applicant

4. The scientific and/or technical contribution of the proposed work to specifically address North Dakota Industrial Commission/Oil and Gas Research Council goals will likely be:

The development of an automated tool package that can be used to assess well site reclamation status is truly a bold goal and would improve the state agency capabilities, and at the same time could potentially be cost efficient to the industry. Remote sensing technology is key especially for the vegetation health but also for a timely, cost-effective, objective, and repeatable process (Lausch et al 2018).

- Reviewer: G-51-08A

- Rating: 3

The project proposed could prove to be very beneficial for both the industry and regulatory officials. It has been proven that UAV's are capable of being deployed on data capturing missions in the oilfields, but major challenges remain for the timely processing and practical application of the data sets. If an automated, or near-automated system, is developed to better manage and process the data, it could be a major step forward for all stakeholders.

- Reviewer: G-51-08B

- Rating: 4

The scope of work proposed would definitely contribute to the back end of oil & gas development phases. As such, it is consequential work. This reviewer could not rate it higher because it does not directly contribute to responsible production, thereby contributing directly to oil & gas development, but it does address responsible reclamation of wellsites after P&A operations, which is also important to responsible harvesting of North Dakota's inventory of natural resources.

- Reviewer: G-51-08C

- Rating: 3

In response to comments from Reviewer C: Reclamation is often considered an important attribute of responsible production, and SolSpec shares this perspective. At the Interstate Oil and Gas Compact Commission 2019 Annual Meeting in Medora, ND on Aug. 26, Gov. Doug Burgum quoted past ND Gov. Art Link (1973) on the importance of reclamation in the oil and gas development process: "And when we are through with that and the landscape is quiet again [...], let those who follow and repopulate the land be able to say, our grandparents did their job well. The land is as good and in some cases, better than before. Only if they can say this, will we be worthy of the rich heritage of our land and its resources."

- Applicant

5. The background of the principal investigator and the awareness of current research activity and published literature as evidenced by literature referenced and its interpretation and by the reference to unpublished research related to the proposal is:

they all seem to be well qualified and SMEs for this technology. I do have some concerns about the project. Remote sensing analyzes from aerial image are recognized to be able to identify facilities and equipment even when the source is coarse resolution like the National Agricultural Imagery Program (NAIP, 60 cm). Therefore, the proposed automated tool set can easily classified the reclamation status for facilities and equipment component. Vegetation indices, like Normalized Difference Vegetation Index (NDVI)

developed based on NAIP images can be an appropriated reference for assessing reclamation condition on agricultural land because these indices are powerful to identify land cover differences, bare soil level, and vegetation productivity (Hunt et al 2003, He et al 2015). On rangelands the North Dakota Administrative Code 43-02-03-34.1 requires that the well site must be “revegetated with native species or according to the reasonable specifications of the appropriated government land manager or surface owner”. Two areas with different suite of vegetation species can present similar vegetation index values. Therefore, vegetation indices are not the appropriated tool to assess the vegetation species composition (Lawrence and Ripple 1998, Lausch et al 2018). Vegetation species composition is an important metric of the vegetation health and restoration success, consequently, vegetation indices exclusively might not be used as the indicator of restoration success. Analyzes from NAIP images can be useful but they have limitations. Remote sensing with a multispectral sensor coupled with the well-established method like stepwise regression, or the modern stepwise quadratic differentiation analysis (QDA) are more indicated because they allow all bands from the spectra to have a chance to become a predictor, further the model is reduced making possible the identification of vegetation community status and probably individual species (Lawrence and Ripple 1998, Buitrago et al 2018). Another possibility is the traditional human-based field inventory to discriminate species composition which has been pointed as expensive and dependent on the surveyor ability to species identification.

- Reviewer: G-51-08A

- Rating: 4

The PI and support staff appear to have all the required skill sets, experience, and tools to adequately perform the proposed work.

- Reviewer: G-51-08B

- Rating: 4

SolSpec has an established and noted reputation in this space. The narrative offered subtly highlighted SolSpec’s knowledge of published literature and awareness of complementary research.

- Reviewer: G-51-08C

- Rating: 4

SolSpec recognizes that remote sensing alone cannot isolate individual plant species or communities without additional in situ (field-based surveys), high resolution spectral and temporal information. Therefore, the objective of this study is not to identify discreet plant species or communities, but to evaluate how similar a well pad is to a reference condition based on a statically robust method. This evaluation will incorporate in situ sampling, high resolution (2 to 5 cm) and temporally relevant drone-based imagery to develop an analytic platform that assesses reclamation success based on a nonparametric test of equality between the well pad and reference condition. This equality test will provide content (spatial and tabular data) to regulators and operators that will streamline the reclamation inspection process. The development of this platform will utilize published vegetation indices along with 3D plant structure (shape/height) data that then will be iteratively evaluated to find the based fitting covariates for the equality comparison test. The iterative process will be evaluated and refined based on the vegetation information collected in the field. Currently, SolSpec has built out a conceptual model to do this but requires the field-based observation to test and validate it. Reviewing the Lausch et al., 2018 paper we agree with the general thesis that vegetation monitoring programs via remote sensing platforms requires an integration of field-based and remotely sensed information in a temporally relevant time frame that is evaluated using data science methods. SolSpec’s approach to this is to develop vegetation spectral and structural indexes that provide the greatest comparison between well pads and reference conditions for the Bakken basin in North Dakota. This approach will provide an analytic platform that is scalable, cost-effective, and provides statistically robust information that will streamline the reclamation close out process for both regulators and operators.

- Applicant

6. The project management plan, including a well-defined milestone chart, schedule, financial plan, and plan for communications among the investigators and subcontractors, if any, is:

The milestones were loosely bucketed with no clear explanation on what exactly will be delivered. The proposal does identify reporting to the Department but at least on status report will be presented before and deliverables are expected based on the schedule. I am puzzled by the financial plan. Cost share is expected but the budget shows: Whiting at \$41,600.00 for site management - I don't feel this is an accurate number. Insite is charging \$20,000.00 just to mobilize. It would be good to provide more clarity on what these activities are.

- Reviewer: G-51-08A

- Rating: 2

The proposal contained a very clear and concise management plan. The methodology, timelines, and financial planning was well documented.

- Reviewer: G-51-08B

- Rating: 4

A believable schedule is presented with inferable milestones. There is a bit of uncertainty in the budget numbers presented. More detail on what factors affect the anticipated applicant’s share (in-kind) would have been helpful. As it stands, the OGRC must take the proposer at their word regarding these numbers because little detail is offered. With the brief mention of “sprints,” the reviewer was a bit surprised to not see a sentence or two on how the results of the sprints would be communicated among team members for effective team cohesion. The reviewer also wondered about communications between iSight, Duraroot, and SolSpec.

- Reviewer: G-51-08C

- Rating: 3

In response to comments from Reviewer A: The key milestones represent steps in the analytic tool development and validation process toward the final goal of producing a statistically validated, automated aerial reclamation inspection toolkit. The toolkit consists of the following digital analytic algorithms programmed, accessible to, and fully functional for end users within the SolSpec platform: 1) Vegetative Continuity Comparison; 2) Infrastructure Identification; 3) Problematic Surface Hydrology Identification; 4) Topographic Contouring Assessment; and 5) Volumetric Measurement. Quarterly status reports will communicate progress made

toward these final deliverables. Deliverables to the OGRC and project partners will include project data, comprehensive study results, and access to the fully operational remote reclamation assessment toolkit. Whiting incurs an hourly cost of approximately \$80/hour to cover the staff time associated with site supervision during field data collection and validation efforts. Whiting assumes it will spend an average of 3 staff hours, and another \$80 in vehicle and fuel expenditures, accompanying each project site visit. Given these numbers, 130 site visits will pose a cost of about \$41,600 to Whiting, which it donates in-kind. iSight's mobilization costs that they provide as in-kind contributions of \$20,000 include travel, lodging, fuel, and per diem to cover the aerial data collection of 100 sites consisting of approximately 30 acres each and distributed across the western half of the state. These rates are standard and not out of the norm. In response to comments from Reviewer C: SolSpec is contributing its team members' labor at-cost, averaging \$80/hour. SolSpec measured its in-kind contributions by estimating how many labor hours each project phase would likely require of SolSpec's employees and multiplying those numbers by the average of \$80/hour. The calculations for each project phase are as follows: Model Development: 438 labor hours at \$80/hour = \$35,000 in-kind Model Automation: 220 labor hours at \$100/hour = \$22,000 in-kind Model Validation: 131.25 labor hours at \$80/hour = \$10,500 in-kind Model Refinement: 139 labor hours at \$90/hour = \$12,500 in-kind Project Management and Reporting: 156.25 labor hours at \$80/hour = \$12,500 in-kind It is customary to consider the use of existing facilities and equipment as in-kind contributions. There will be no new purchasing of facilities or equipment by SolSpec for this project. The use of existing facilities and equipment was not factored into SolSpec's in-kind contributions, but the items were listed as incidental contributions to the project. In the Agile Development Method, a sprint refers to a single time-boxed unit of development during which specific work must be completed and then communicated to team members during a review at the end of the sprint period. Sprint reviews serve to maintain team cohesion and synchronous momentum. Following a sprint review, the team will decide upon the work to be completed during the next sprint, and the cycle repeats itself. The SolSpec development team dedicated to this project will organize project efforts into two-week sprint cycles. Communications among SolSpec, iSight, and Duraroot will occur as needed to effectively plan for, coordinate, and execute project work. As the managing project partner, SolSpec will coordinate project communications, activities, and reports among the partners.

- Applicant

7. The proposed purchase of equipment and the facilities available is:

The budget doesn't state what the equipment is or how it will be used Why is the purchase of this equipment key to the success of the project.

- Reviewer: G-51-08A

- Rating: 2

The aerial data acquisition, equipment, and facility expenses outlined in the proposal appear well justified for the proposed scope of work.

- Reviewer: G-51-08B

- Rating: 4

A clear story about purchase of equipment was not presented. The text did not elaborate on equipment purchases, but the budget indicated in brief notes that equipment might be purchased. What equipment? For which team partner? An early statement in the proposal indicated that most of the work would be accomplished with existing distributed computing resources at SolSpec's office in Denver.

- Reviewer: G-51-08C

- Rating: 3

It is customary to consider the use of existing facilities and equipment as in-kind contributions. There will be no new purchasing of facilities or equipment by SolSpec for this project. The use of existing facilities and equipment was not factored into the in-kind contributions, but the items were listed as incidental contributions to the project. SolSpec employees will be performing project labor using the facilities and equipment that SolSpec has previously purchased or currently leases. Thus, the company donates these "expenses" to the project.

- Applicant

8. The proposed budget "value"¹ relative to the outlined work and the commitment from other sources is of:

This is hard to judge due to limits previously stated.

- Reviewer: G-51-08A

- Rating: 3

The applicant's partnerships with Whiting, Duraroot, and iSight is very encouraging. The oilfield knowledge and experience provided by the partners should be very beneficial as the applicant works to create a platform that is adequately tested and practical to end users.

- Reviewer: G-51-08B

- Rating: 4

The proposed budget is a relatively small budget, when compared with other funded work by OGRP. It seems appropriate, but small. The work potentially accomplished would be meaningful relative to the modest financial ask.

- Reviewer: G-51-08C

- Rating: 5

9. The "financial commitment"² from other sources in terms of "match funding" have been identified:

I struggle to understand how the Partners' Share is justified.

- Reviewer: G-51-08A

- Rating: 3

Proposal does slightly exceed the 50% match minimum. It is encouraging that 23% of total funding will come from industry partners with experience operating in North Dakota.

- Reviewer: G-51-08B

- Rating: 3

SolSpec is asking OGRP to fund a little less than 50% of the project. As such, this is an average ask. It meets minimum requirements.

- Reviewer: G-51-08C

- Rating: 3

Response to Reviewer A comments provided in response to #6.

- Applicant

1 “value” – The value of the projected work and technical outcome for the budgeted amount of the project, based on your estimate of what the work might cost in research settings with which you are familiar. A commitment of support from industry partners equates to a higher value.

2 “financial commitment” from other sources – A minimum of 50% of the total project must come from other sources to meet the program guidelines. Support less than 50% from Industrial Commission sources should be evaluated as favorable to the application; industry partnerships equates to increased favorability.

General Comments

Merits: The use of aerial imagery is limited by the ability to process and analyze big data. Automated data analytics is key to successful and sustainable use of this data. These combined would assist Regulators and Industry operate more efficiently. Flaws: Vegetation roughness and height are important components for soil condition and sediment transport, however should not be the only parameters to represent vegetation community composition. Definitely not for rangeland vegetation community composition. What/how will the end user have access to and training on the automation tool? What QA/QC program is available or should be? How will the results of this project be disseminated to Industry?

- Reviewer: G-51-08A

The proposed project was well documented and clearly addresses the current challenge of efficiently turning large UAV acquired data sets into usable information. Both the industry and government stand to benefit greatly from the development of such software solutions. One key concern is whether or not the applicant will be able to complete the full scope of work in the timeline proposed, in particular the validation portion of the model. Additional information would be helpful as to how software/model updates will be handled in the future as technology or data collection evolves. In conclusion, I recommend funding the proposal as the potential benefits of the work outweigh the concerns.

- Reviewer: G-51-08B

The proposal was very professionally-written, and presented a logical methodology. The budget seemed aggressive in that it is a lot of work for the proposed amount of money budgeted. SolSpec's credentials are recognized. It is likely that they will achieve some measure of success for what seems a relatively modest investment. This reviewer is aware of several companies pursuing similar development efforts. If SolSpec is successful, it may pave the way for a number of possible service providers. If successful, this work would significantly assist DMR and NDDEQ in assessing completion of adequate reclamation efforts. It would also assist oil & gas producers in efficiently closing out wellsites and reclaiming bonds. Overall, this technology has the potential to positively impact the efficiency of this whole process for both regulators and industry.

- Reviewer: G-51-08C