

Budget Justification

Mid-scale RI-1 (M1:IP): A Deep Soil Ecotron facility to explore belowground communities and ecosystem processes.

University of Idaho PI: Michael Strickland

Per Chapter II.C.2.g(i)(a), of the current PAPPG (Senior Personnel Salaries & Wages Policy), the Regents of the University of Idaho have determined the definition of salary year to be based on a calendar year.

Basis of estimate: University of Idaho arrived at the cost estimates described in this budget justification by using a variety of data elements, as described here. For salary and fringe, the university uses the approved base pay rate for the personnel and the appropriate fringe rate as shown in our federally approved consolidated fringe rates. The pay rate and fringe benefits are calculated based on person-months effort per year. For other direct costs, the University of Idaho uses historical data on costs for similar items or work, published pricing from vendors, vendor quotes (equipment and services, specifically), and a comparative of cost estimates with colleagues who have experience with similar work or cost types. For travel, we use GSA published per diem rates for intended destinations, destination hotel averages, and flight averages. Tuition and fees are based on the approved rate structure and posted University of Idaho tuition rates and fees for the academic year. Future years are escalated at a standard 3% annual increase to account for tuition increases at rates similar to past increases at our institution. Our F&A (indirect) cost rate is consistent with the work location and type and is based on our federally approved indirect cost agreement, as approved by our cognizant agency DHHS. Our costing policy and accounting standards are compliant with GAAP standards.

A. Senior Personnel

1. Principal Investigator (Michael Strickland) at the University of Idaho will serve as Principal Investigator (PI) of the project and will coordinate and direct the overall Deep Soil Ecotron (DSE) Project. Strickland will commit 1 person month (PM) each summer in Years 1-5. Strickland will also work with the lead at each of the subaward institutions. He will co-supervise one senior technician, two Ph.D. graduate students, and one postdoctoral research associate (Years 4-5 only) in the Soil & Water Systems Department working on the project. Requested salary is (\$10,159 in Year 1; \$10,362 in Year 2; \$10,569 in Year 3, \$10,781 in Year 4; \$10,996 in Year 5). Salary includes a 2% annual increase starting in Year 1.

2. Co-Principal Investigator (Zachary Kayler) at the University of Idaho will serve as co-director of the DSE Project. Kayler will commit 1 (PM) each summer in Years 1-5. Kayler will also be directly involved in the interfacing and installation of the EcoUnits and userbase development. He will co-supervise one senior technician, two Ph.D. graduate students, and one postdoctoral research associate (Years 4-5 only) in the Soil & Water Systems Department working on the project. Requested salary is (\$8,384 in Year 1; \$8,552 in Year 2; \$8,723 in Year 3, \$8,897 in Year 4; \$9,075 in Year 5). Salary includes a 2% annual increase starting in Year 1.

B. Other Personnel

1. Postdoctoral Research Associate. Funds are requested for one postdoctoral research associate for 12 PM/year in Years 4-5. The postdoctoral associate will participate in all aspects of the DSE commissioning process and develop skills outlined in the postdoctoral mentoring plan. Requested salary is (\$50,390 in Year 4; \$51,398 in Year 5). Postdoctoral salary is based on NIH suggested rates. Salary includes a 2% annual increase starting in Year 5.

2. Senior Research Technician. Funds are requested for 12 PM/year in Years 1-5 The research technician will serve as the DSE's technical lead and will be responsible for operation and maintenance associated with the facility. Requested salary is (\$62,000 in Year 1; \$63,240 in Year 2; \$64,505 in Year 3; \$65,795 in Year 4; \$67,111 in Year 5). Salary includes a 2% annual increase starting in Year 2.

3. Graduate Students (Ph.D.). Funds are requested for two full-time Ph.D. graduate student stipends in Years 1-5. The graduate students will participate in all aspects of this project and receive training in project management as outlined in the Broader Impacts. Per student stipends are (\$28,000 in Year 1; \$28,560 in Year 2; \$29,131 in Year 3; \$29,714 in Year 4; and \$30,308 in Year 5). Stipends include a 2% annual increase starting in Year 2.

C. Fringe Benefits

The University of Idaho's Federally negotiated fringe rate is 29.4% for faculty, 40.8% for staff, and 3% for students.

D. Equipment

Funds for the following equipment are requested in support of the project. All costs are based on quotes received by the PIs (see supplementary documents).

1. EcoUnits (Total cost for 24 units = \$6,264,944). This cost includes project management associated with EcoUnit construction and installation.
2. Cavity Ringdown Mass-Spectrometers (CRDS; Picarro G2201-i, G5131-i, and L2130-i) to monitor the flux of $^{13}\text{CO}_2$, $^{13}\text{CH}_4$, $^{15}\text{N}_2\text{O}$, $^2\text{H}_2^{18}\text{O}$ in each EcoUnit. We request funds for 14 carbon analyzers (14 units x \$100,747.50 per unit = \$1,410,465), 2 N_2O analyzers (2 x \$147,200 per unit = \$294,400), 8 water analyzers (8 x \$64,584 per unit = \$516,672), and 8 continuous water samplers (8 x \$26,312 per unit = \$210,496). We request a service package for each unit (24 x \$6,240 per unit = \$149,760) and consulting services (\$2,365). With peripherals (dry gas kits, isotope standards, training and shipping) the total requested is \$2,212,956.
3. Multi-component Fourier transform infrared (FTIR) gas analyzers (Gasmeter) for the simultaneous measurement of up to 50 gases (4 units x \$62,006 per unit = \$248,024). With power supply and shipping the total cost is (\$254,980).
4. A multiplex system (Eosense) to enable Ecotron users to interface their own equipment and/or sensor prototypes with multiple EcoUnits (12 units x \$10,240 per unit = \$122,880). With the accessory kits, teflon tubing, and 6-day site visit the total cost is (\$147,120).
5. For each EcoUnit, 2 gas trace analyzers for measuring concentrations of N_2O , CH_4 , CO_2 , and H_2O at regular intervals are requested. Each EcoUnit will be outfitted with a Li-7820, LI-7810, an 8-port multiplexer, supportive materials, and extended warranties at a cost of \$128,423 per EcoUnit and a total cost of (24 units x \$128,423 per unit = \$3,082,152).
6. Minirhizotrons systems that include cameras (6 units x \$19,500 per unit = \$117,000), acrylic tubing (48 6' lengths x \$155 per unit = \$7,440), and a 3-year warranty (6 x \$5,670 = \$34,020). These will be used for monitoring root growth and architecture at multiple soil depths in each EcoUnit. The total cost is \$158,460.
7. A universal data logger system that monitors and records data from all sensor devices and instruments. The system will coordinate sampling valves of the multiplexers, provide a single time-date stamp, flag data as out-of-sensor-range, indicate purge events, and send data to a central command CPU. A quote from Campbell Scientific provides the cost and number of data loggers, software, supplies, training, and programming (\$355,383).

8. Three nitrogen generators to supply N₂ carrier gas for analyzers (3 units x \$16,776 per unit + special handling \$3.98 = \$50,330).

9. Two floor cranes to efficiently move the EcoUnits and stack the 0.6m belowground sections (2 units x \$28,975 per unit = \$57,950).

E. Travel-Domestic

Cross-institute travel: In Years 1, 3, and 5 we are requesting \$14,760 per year to support travel for cross-institute training for graduated students in the Strickland and Kayler labs. Travel expenses include per diem for 3 personnel for 30 days (3 personnel x 30 days x \$51 = \$4,590), lodging for 3 personnel for 30 days (3 x 30 x \$93 lodging per night = \$8,370), and airfare for 3 personnel (3 x \$600 airfare = \$1,800). Per diem and lodging for this meeting are based on Federal GSA travel rates. Airfare cost estimates were determined via kayak.com.

Professional conference travel: We are requesting \$5,280 per year in Years 2-5 to present research findings and promote the DSE at national and regional meetings including annual meetings of ESA (Ecological Society of America), AGU (American Geophysical Union), SSSA (Soil Science Society of America), and SES (Soil Ecology Society). Travel expenses include per diem for 4 personnel for 5 days (4 personnel x 5 days x \$51 = \$1,020), lodging for 4 personnel for 5 days (4 x 5 x \$93 lodging per night = \$1,860), and airfare for 4 personnel (4 x \$600 airfare = \$2,400). Per diem and lodging for this meeting are based on Federal GSA travel rates. Airfare cost estimates were determined via kayak.com.

G. Other Direct Costs

1. *Materials and supplies:* We are requesting \$5,315 per year in Years 1-5 to support activities associated with the Broader Impacts (e.g., for purchase of consumables associated with the graduate student project management program, and the middle school education program; Total = \$26,575). We are requesting \$50,000 in Years 3-5 (Total = \$150,000) to support EcoUnit and instrumentation supplies (e.g., stainless tubing, fittings, heat-tracing, regulators, flowmeters, pumps, etc.). In Year 3, we are requesting \$9,400 for DSE computation supplies, which include computers to interface with the EcoUnits and instrumentation, a local back-up server, and battery back-ups for these systems. We are requesting \$23,000 for standard gases for DSE instrumentation calibration (Year 3 \$4,500, Year 4 \$9,000, Year 5 \$9,500). We are requesting \$37,000 for the purchase of stable isotopes (e.g., ¹³CO₂, ¹⁵N₂) for testing DSE systems during the commissioning phase (Years 4-5, \$18,500 per year). We are requesting \$50,000 for stable isotope analyses associated with equipment parameterization during the commissioning phase (Years 4-5, \$25,000 per year). We are requesting \$12,500 for soil analyses (e.g., pH, soil moisture, total soil C and N) to assess change in soil conditions during the commissioning phase (Years 4-5, \$6,250 per year).

2. *Publication costs:* Funds are requested for publication costs associated with page and/or open access charges (\$3,000 in Year 5).

3. *Consultant/Contractor fees:* We are requesting funds for POWER Engineers, Inc., for assistance in the development of a Project Execution Plan (PEP) and to provide Project Management assistance during the lifecycle of the DSE (\$126,896 in Year 1; \$99,091 in Year 2; \$101,072 in Year 3; \$103,093 in Year 4; and \$105,155 in Year 5).

5. *Subawards:* We are requesting funds for the following subcontracts for graduate student support to participate in the DSE Project Management Program, for travel of co-PIs and Senior Personnel serving on the DSE leadership team, and student travel for conferences and cross-institution travel.

- University of Hawaii-Manoa (\$391,386)

- University of Delaware (\$339,141)
- North Dakota State University (\$239,758)
- University of Colorado-Boulder (\$412,348)
- University of Wyoming (\$383,102)
- US Department of Energy Pacific Northwest National Laboratory (PNNL) (\$284,000)

6. Other

6a. Tuition/Fees: Two Ph.D. graduate students will be supported on this project in Years 1-5, with \$62,531 allocated per graduate student (2 students = \$125,062). Costs include tuition and the mandatory student health insurance program in Years 1-5 (2020/21 base rate is \$11,778 per year with a 3% annual increase starting in Year 2).

6b. Advisory Board Member Travel: In Years 1, 3, and 5 we are requesting \$6,550 per year to support travel for advisory board members to the initial DSE Kick-off meeting, and subsequent Ecotron Workshops/Status Meetings in Moscow, ID. Travel expenses include per diem for 5 personnel for 5 days (5 personnel x 5 days x \$49 = \$1,225), lodging for 5 personnel for 5 days (5 x 5 x \$93 lodging per night = \$2,325), and airfare for 5 personnel (5 x \$600 airfare = \$3,000). Note, the rationale for budgeting for only 5 members is that we expect at least half of the advisory board will attend these meetings virtually. Per diem and lodging for this meeting are based on Federal GSA travel rates. Airfare cost estimates were determined via kayak.com.

6c. Northwest Knowledge Network: In Years 1-5, we are requesting \$70,000 for services provided by the University of Idaho Northwest Knowledge Network to develop the DSE's cyberinfrastructure. Specifically, this will include storage and a dedicated virtual server for data, developing the DSE's relational data model and database, developing and supporting an interactive data portal (e.g., data access, visualization, filtering, subsetting, API), developing and supporting the DSE mobile app and website, and access to high performance computing.

6d. University of Idaho J.W. Martin Laboratory Upgrades. We are requesting \$1,134,525 for laboratory upgrades in Years 1-3 including architectural renovations (i.e., reinforcement of the existing floor slab to support the EcoUnits, catwalks for access to the EcoUnits, any necessary and required seismic bracing, and miscellaneous architectural finishes); installation of a stand-alone, closed loop, chilled water production and distribution system for temperature control of the EcoUnits; and installation of a generator, associated distribution panels and the requisite load transfer switch to provide back-up power for the DSE (\$233,500 in Year 1; \$567,025 in Year 2; \$334,000 in Year 3 = \$1,134,525). Specific construction costs are provided in the supplementary documents and are exempt from indirect costs.

H. Indirect Costs

Indirect costs are calculated using the University of Idaho federally negotiated indirect cost rate of 47.5% for on-campus research applied to Modified Total Direct Costs (MTDC), which excludes participant support costs, equipment >\$5,000, tuition, subaward amounts in excess of the first \$25,000, and the University of Idaho laboratory upgrade costs.