Improvement of the National Hydrography Dataset for Parts of the Lower Colorado Region and Additional Areas of Importance to the DLCC

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Executive Summary

This project represented a partnership between USGS, the US Fish and Wildlife Service (on behalf of the Desert Landscape Conservation Cooperative, DLCC), and CSUN. All work was conducted by the Center for Geographical Studies (CGS) located on the CSUN campus. The purpose of this project was to improve the National Hydrography Dataset (NHD) for parts of the Lower Colorado River Region and additional areas on the California/Arizona border of the importance to the DLCC. Emphasis was given to the addition and/or improvement of five NHD categories: lines, flowlines, points, area and waterbody features at a 1:24,000 scale (or at 1:15,000 where necessary). This entailed three major work tasks.

The first task, involved adding/improving the NHD flowlines, lines, areas, and waterbodies features. The study area covered the extent of HUC8 15030104, which is approximately 3,700 square miles (Figure 1). In the second task, the NHD springs database created by Sky Island Alliance (a non-governmental organization that works to protect and restore biodiversity and natural heritage) for the Sky Island Region of Arizona, near Nogales, and within the Lower Colorado River Region was assessed for inaccuracies, and edits were made to the existing NHD springs, as well as adding springs from the database. The springs database covered several HUC-8 subbasins in the southeastern area of the Lower Colorado River Region. The third task, consisted of making improvements to additional NHD HUC-8 watersheds. The NHD improvements would provide an invaluable scheme for the conception of hydrologic models required to address effects of climate change, and would support the specific DLCC objectives and needs.
Figure 1. Study area for ‘task 1’, located along the Lower Colorado River Region (HUC 8 - 15030104).
Project Objectives

The focus of this project was to update the hydrography data for the Lower Colorado River Region in accordance to the DLCC protocols. Three tasks were originally set out for this project, however as part of this experiential learning internship, only task one was carryout. Task two and three, will be completed in the near future.

My original career pathway was rather broad, encompassing the disciplines of agricultural, environmental, and water management. However, after an extensive period of working on this project, I was able to narrow my scope of interest and choose a career pathway that best tailored to my future goals. The career pathway I am refereeing to is that of a USDA ‘Geologist’. Whilst working on this project, I knew that there was great potential for conjoining my Geographic Information Science (GIS) skills with my fervent interest for water conservation. It was those two components along with my newly attained skills and knowledge in assessing landscape characteristics (particularly surface water features) that I realized that the USDA Geologist entry level job corresponded, to some extent, to my work experience, interest, and education.

Project Approach

Part 1 – USGS NHD Update Tools Training

Prior to commencing this project, I attended two USGS NHD web-based training sessions, where I was trained to use the NHD Update tools necessary to carry out the edits of the NHD data in ArcMap platform.

Part 2 – Internal (CGS) NHD Training

I underwent additional, more in-depth, training at CGS for a few weeks. The training consisted of learning the mapping and editing business rules (to standardize processes and ensure data integrity); understanding the NHD Update tool editing process, and watching NHD video editing demos via the USGS NHD portal; aerial image interpretation (in order to be better able to detect surface water features); and making practice edits to the NHD training job (a replica of data).
Part 3 – Preparing the NHD Data for Production

All data was checked out (downloaded) from the USGS NHD production database and initial Quality Control (QC) checks were processed to identify errors in our dataset (Figure 2). First and foremost, ‘Invalid Geometry Checks’ were run before completing other QC checks, since the Data Reviewer (i.e. the window that displays the QC results) requires clean geometry in order to check for other errors accurately. After ‘Invalid Geometry Checks’ were fixed, the remainder of the QC checks (i.e. Feature to Feature Rule Checks, Spatial Checks, Database Integrity Checks, and other pertinent checks) were administered and resolved as well.

![Figure 2. Initial Quality Control (QC) checks processed on the NHD Job.](image)

Part 4 – NHD Feature Updates & Improvements (Task 1)

Once the NHD data was unblemished of errors, a comprehensive assessment of the NHD features was scrutinized against the most up-to-date National Agriculture Imagery Program (NAIP) for Arizona and California, respectively. Two copies derived from the true color NAIP imagery were created, and for each, their band properties were altered to render a variation of the true color NAIP imagery. The first copy was modified to display as a Color Infrared (CIR) imagery, which was really useful in vegetated areas, as it produces a bright pink for healthy vegetation, and darker shades to indicate soils and waterbodies. As for the second copy, the symbology was inverted to yield imagery that made stream beds/carvings and...
vegetation more pronounce at times, making it very useful. Additional collateral datasets like Bing, Google, and Google Earth Pro imagery, as well as the USGS Topographic Map, were employed to assist me better formulate cognizant decisions about what NHD features needed to be updated and/or improved. The latter collateral dataset was very useful in helping me determine the directional flow of rivers and streams, when visual interpretation of the landscape was too ambiguous to formulate prudent judgments. By looking at the shape of the contour lines, which show elevation and the shape of the terrain, I was able to derive a river’s flow directionality. For instance, CLOSE contour lines that form a “V” shape (or U-shaped where they cross a stream) mean STEEP terrain, indicating rivers/streams trend up valleys; while contour lines that are father apart mean FLAT terrain (Figure 3). Bing and Google satellite imagery, on the other hand, offered higher resolution imagery, which facilitated the identification and/or classification of water related features; whereas Google Earth Pro gave the capability of viewing the terrain in 3D, useful for assessing the elevation of the terrain.

![Figure 3. USGS Topographic Map illustrating contour lines.](image)

**Part 6 – Submitting NHD Work**

Upon completion, a final QC check was processed to verify all errors were resolved. Once resolved, the updated NHD Job was effectively transferred back to the USGS National Database for check-in.
Project Outcome

For the most part, the work I produced dealt with adding ephemeral streams (have water in them only during and immediately after a rainstorm) and intermittent streams (have flow only during the wet season), as well as washes (dry portion of a stream bed that contains water only during or after a rainstorm). Washes were predominately found in the arid environment, so specific business rules were produced to standardize their mapping. In accordance to our business rules set forth for this project, a threshold of 1,000 meters was implemented. All ephemeral stream flowlines longer 1,000 meters were added, while any shorter 1,000 meters were disregarded. Artificial paths or connectors were added to establish a known, but non-specific (unseen) connection between two NHD features. Additional work entailed realigning water features over the NAIP aerial imagery to match properly. Erroneous water features (e.g. incorrect usage of NHD features – lines, flowlines, points, areas or waterbodies, as well as attribution information) were modified and corrected, and in some instances, deleted were warranted (e.g. where water features no longer existed in the NAIP and collateral datasets). In some instances, NHD features were split/merged to improve the accuracy of features that had changed over-time. Marshes (i.e. wetlands) and canals/ditches were also modified, added, or deleted where applicable.

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See Figures 4 – 7 in the ‘Appendix’ section for examples of before and after the NHD feature updates & improvements.
Conclusions

To conclude, a comprehensive update and improvement of NHD features was carried out, in accordance to DLCC standards, throughout the duration of the internship for parts of the Lower Colorado River Region, along the CA/AR border. This greatly improve the accuracy of NHD features against the most current NAIP imagery available. However, further research is need in the classification of washes in arid regions, similar to this project. Future findings can prove to be essential, in that, it can add to or even modify, the business rules for accurately classifying washes. This would greatly help NHD editors in the future. Nevertheless, this experiential learning internship has help me learned a lot regarding aerial interpretation and the classification of NHD features. Furthermore, this internship has help me confine my career goals, and opt to pursue a career in the USDA as a ‘Geologist’.
Figure 4. Intermittent streams, marshes, canals, and a wash were added to the NHD, and existing water features were modified/deleted where needed.
Figure 5. Intermittent, ephemeral, and artificial streams, washes, marshes, and canals were added to the NHD, and existing water features were modified where needed.
Figure 6. Intermittent, ephemeral, and artificial streams, and washes were added or modified.
Figure 7. Intermittent, ephemeral, and artificial streams, and washes were added or modified (Note: The gray polygons indicate HUC-12 subbasins that were completed by another colleague).