

Integrated Surface Management for Pipeline Construction: the Mid-America Pipeline Company Four Corners Project

Maria L. Sonett

Abstract—Integrated surface management techniques for pipeline construction through arid and semi-arid rangeland ecosystems are presented in a case history of a 412-mile pipeline construction project in New Mexico. Planning, implementation and monitoring for restoration of surface hydrology, soil stabilization, soil cover, and plant species succession are discussed. Planning phases included baseline survey for native plant community composition and noxious weed populations, seed mixture design, critical area identification, construction specifications for seeding, weed control and erosion controls, and information meetings. Implementation phases included daily inspection of equipment, seed quality and quantity, planting, mulch cover and anchoring, erosion control blankets, water diversion structures, and arroyo stabilization structures. Monitoring commitments for seeding success, noxious weed spread, and condition of erosion controls on public land were established for three years following project completion. Two years of noxious weed monitoring showed that most noxious weed populations appear to have been contained by project-specific weed management. One population of halogeton (*Halogeton glomeratus*) was contained after the first year but increased in area after the second year. Monitoring of seeding success will occur in a one-time assessment three growing seasons after completed seeding (1998).

With adequate time, drastically disturbed lands will heal unassisted by human intervention through successional development of plant communities. The rate of natural recovery in semi-arid environments is sometimes too slow to prevent an accelerated rate of soil erosion (Munshower, 1994). Further, natural recovery of a disturbed site may be arrested in the early stages of succession as first-stage exotic invaders develop into mono-cultures, and compete with desirable seral species for available resources (Richard Lee, personal communication).

Pipeline construction projects are commonly subject to environmental commitments in National Environmental Protection Act (NEPA) documentation. Environmental commitments frequently include requirements for the establishment of protective ground cover in the form of native perennial vegetation within a mandated period of time, often three years or less (Mid-America Pipeline Four Corners Project Environmental Assessment, Plan of Development, 1995). In semi-arid environments, where mean annual precipitation

is low, it is unlikely that these requirements can be met without the help of reclamation science and subsequent surface management.

The role of reclamation science is to augment the critical early stages of natural succession in a plan for re-establishment of a self-sustaining plant community. The plan should include three phases: 1) planning and design, 2) implementation, and 3) monitoring and evaluation. The plan should address the following surficial conditions and processes: 1) plant communities and vegetative cover, 2) surface soil condition and erosion control, and 3) invasive weed control. The success of any project utilizing such a method depends on both the quality of the individual components, and the degree to which these components are successfully integrated. Further, we found that plan integration must also mean that all three phases are integrated into the overall construction project schedule.

Mid-America Pipeline Four Corners Project

The Mid-America Pipeline Four Corners Project provides a case study of a surface reclamation and management effort that was successfully integrated into a well-executed pipeline construction project.

The project, starting at Huerfano, New Mexico and ending in Seminole, Texas, was constructed under a permit from the Farmington District of the United States Department of the Interior Bureau of Land Management. A new 12 inch line was installed into an existing right-of-way. Total project length was 412 miles, including a 10-mile lateral line. Project planning began in December 1994, and construction was completed in December 1995.

Pre-work Measures

Communication about desired goals and planned actions for reclamation and management of surface conditions is a critical component in successful implementation. Pre-job meetings with contractors and inspection personnel were used as a forum to introduce reclamation topics and required actions and to clarify coordination between construction personnel and reclamation personnel. This type of early communication made integration to a larger project easier.

Planning and design began with field reconnaissance to identify plant communities, areas of high erosion potential, and presence of noxious weed infestations (table 1). This information was then used to create reclamation specifications including seed mixtures, seeding techniques and equipment, erosion control techniques, and noxious weed management.

In: Finch, Deborah M.; Whitney, Jeffrey C.; Kelly, Jeffrey F.; Loftin, Samuel R. 1999. Rio Grande ecosystems: linking land, water, and people. Toward a sustainable future for the Middle Rio Grande Basin. 1998 June 2-5; Albuquerque, NM. Proc. RMRS-P-7. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.

Maria L. Sonett is Senior Reclamation Specialist, McCulley, Frick & Gilman, Inc., Albuquerque, NM.

Table 1—Weed species identified for control and management on the Mid-America Pipeline Four Corners Project, 1995. This list is based on a list of candidate species for the New Mexico noxious weed list for New Mexico, from Dr. Richard Lee, New Mexico State University Weed Control Scientist, November 1994.

Common name	Scientific name	Life cycle	Origin
African Rue	<i>Peganum harmala</i>	P	I - North Africa
Camelthorn	<i>Alhagi pseudalhagi</i>	P	I - Asia
Canada Thistle	<i>Cirsium arvense</i>	P	I - Eurasia
Dalmation Toadflax	<i>Linaria genistifolia</i> ssp. <i>dalmatica</i>	P	I - Europe
Diffuse Knapweed	<i>Centaurea diffusa</i>	P	I - Med.
Halogeton	<i>Halogeton glomeratus</i>	A	I - Asia
Jointed Goatgrass	<i>Aegilops cylindrica</i>	A	I - S. Europe
Leafy Spurge	<i>Euphorbia esula</i>	P	I - Eurasia
Malta Starthistle	<i>Centaurea melitensis</i>	A	I - Europe
Musk Thistle	<i>Carduus nutans</i> or <i>Carduus thoermeri</i>	B	I - S. Europe
Perennial Pepperweed	<i>Lepidium latifolium</i>	P	I - S. Europe
Purple Loosestrife	<i>Lythrum salicaria</i>	P	I - Europe
Purple Starthistle	<i>Centaurea calcitrapa</i>	A	I - Europe
Russian Knapweed	<i>Acroptilon repens</i>	P	I - Eurasia
Scotch Thistle	<i>Onopordum acanthium</i>	B	I - Europe
Spotted Knapweed	<i>Centaurea maculosa</i>	P	I - Eurasia
Teasel	<i>Dipsacus fullonum</i>	B	I - Europe
Whitewort or Hoary Cress	<i>Cardaria draba</i>	P	I - Europe
Yellow Starthistle	<i>Centaurea solstitialis</i>	A	I - Europe
Yellow Toadflax	<i>Linaria vulgaris</i>	P	I - Eurasia

"A" - Annual, "B" - Biennial, "P" - Perennial, "I" - Introduced

Revegetation

Seven broad plant community classifications were done after William Dick-Pedie (1993). These included: Plains-Mesa Grassland, Plains-Mesa Sand Scrub, Southern Desert Grassland, Juniper Savanna, Coniferous and Mixed Woodland, Great Basin Desert Scrub, and Northern Desert Grassland. Project seed mixes included native, warm season perennial grasses, cool-season perennial grasses, perennial and annual forbs, and woody species referenced by Dick-Pedie as major plants comprising the selected plant community types. All seeded species were selected for ecological suitability and for palatability as forage or browse.

Revegetation efforts began in the first phase of construction with an operation called "double-ditching". "Double-ditching" is an industry term for topsoil removal during the right-of-way clearing and smoothing. Topsoil was removed and placed to one side of the pipeline trench. The next layer of soil was removed and placed in a separate pile.

Several months later, after the pipe is laid, the soil is replaced in the trench in the same order that it was removed, with the more fertile topsoil on top. These areas were then re-graded to match original site contours, and finish graded with a moto-grader. The moto-grader left a rough, deeply imprinted soil surface that was approved as the seedbed condition. Large soil particles and a rough surface provided excellent water infiltration, and protected the light, fluffy seed from high winds.

Seeding techniques and equipment were recommended based on soil type and slope conditions. The majority of the pipeline area was seeded with a heavy-duty rangeland drill, followed by application of vegetative mulch material such as straw or corn stalk in some areas.

During pre-construction mapping, the observed density of annual and perennial invasive weed species was greater at the edges of the right-of-way, possibly where seeding from previous pipeline construction had not extended into existing vegetation. This may have left a strip of unseeded, disturbed ground that was more susceptible to weed invasion. Seeding and mulching operations therefore were specified to be "knit" into the existing vegetation, in order to assure that no disturbed soil was left untreated.

Quality control was required for all re-vegetation materials. Mulch material was inspected at the producer's fields for weed content. Project requirements specified that materials be purchased from a producer who regularly managed for weeds, and whose fields were located in a designated "weed district," under the supervision of a county weed agent.

A random section of the project seed lots was also sampled for weed seed content. Although required standard testing was done by the seed supplier at certified laboratories, seed was "double-certified" to assure absence of potential problem species. Of the seed lots sampled, invasive weed species were found in two lots. These species were omitted from the seed mixes, and an appropriate replacement was approved by the permitting agency.

Erosion Control

Erosion control for upland areas included mulching with straw or chopped corn stalks, construction of water bars to direct flow off the right-of-way, and installation of erosion control blankets on steep slopes. Areas with slopes of greater than 15 percent were identified as high erosion risk, and were designated for broadcast seeding and application of

erosion control blankets. As the revegetation project progressed, other areas of high erosion risk were identified, and were stabilized with erosion control blankets.

Erosion control for riparian areas began with the preservation of existing riparian vegetation for habitat and bank stabilization. Three large rivers, the Rio Grande, the Rio Puerco, and the Pecos River, were crossed by a directional drilling method that minimizes impacts to the river channel and eliminates impacts to riverbank vegetation. The directional drill begins several hundreds of feet back from one bank, angles down and under the river bed, and re-emerges several hundred feet back from the opposite bank.

Where riparian vegetation was removed, banks were stabilized with rip-rap and seeded with native grass species. Riparian restoration included pole plantings of willow and cottonwood, at a replacement ratio of 10:1.

Ephemeral arroyo systems of sufficient magnitude to warrant concern about erosion were stabilized with small grade control structures made from either gabion baskets, or by native rock mined during trench excavation. Gabion baskets were placed following formal engineering designs, and rock was generally placed in smaller arroyos by informal field design.

Noxious Weed Management

Noxious weed management was intended to reduce or eliminate the spread of noxious weeds through earth-disturbing construction activities. Management included pre-construction mapping, chemical treatment of target weed populations, specifications requiring equipment cleaning, soil management during construction, and post-construction monitoring.

Four populations of noxious weed species were identified during pre-construction mapping. These populations are listed in table 2.

A mixture of Garlon (triclopyr) and 2,4-D was applied by a licenced applicator. Chemical application techniques varied according to the size and density of weed infestations. In some areas, target weed populations had not crowded out all other vegetation, so a spot spray was used to help conserve surrounding vegetation. In other areas, dense infestations that had out-competed desirable vegetation required a broadcast spray.

The small colony of musk thistle was removed by hand. Plants were placed in a sealed container, allowed to dry

within that container, and were subsequently burned in a 50-gallon drum by blow torch.

To limit the potential of weed spread by seed-infested soil on equipment, soil to a depth of 6"-8" was scraped and stockpiled at the edge of the working area. Stockpiled soils were flagged to prevent their re-location and to prevent access by vehicular traffic.

Equipment used for soil removal was cleaned immediately after use. Cleaning was performed by hand, and took place in the same general location as the stockpiled soils. Hand cleaning by brush and scraper was approved by the permitting agency as an alternative, cost-effective method for the bulldozer used in weed areas. The tracks and blade of the bulldozer were brushed off by hand-held brooms, and caked dirt was scraped off with a hand-held scraper blade. This method took an average of one-half hour per location.

Both plant and soil removal was planned to limit the distribution of seed by equipment into un-infested areas of the right-of-way.

Post-Construction Monitoring and Management

Post-construction monitoring for noxious weeds and for erosion control was carried out for three growing seasons following job completion.

Seeded stand success appeared promising in many areas after two growing seasons. In other areas, livestock utilization, lack of precipitation, and poor soils were noted as the probable causes of poor stand success. Final monitoring for seeded stand success will be carried out in 1998 by Bureau of Land Management range staff.

Prevention of noxious weed spread on the right-of-way was successful for Russian knapweed (*Acroptilon repens*) for all three years, and these populations were successfully eliminated by the third year. The population of halogeton (*Halogeton glomeratus*) was apparently contained for the first year after construction, but increased in area in the second year. Since the direction of population spread was opposite that of the direction of construction, livestock rather than equipment may be the agent of spread. The small colony of the biennial, musk thistle (*Carduus nutans*), was hand removed in the second year following construction and did not reoccur in the third year.

Table 2—Weed species identified on the Mid-America pipeline right-of-way during pre-construction survey, July-August, 1995.

Scientific name	Common name	Approximate size of infestation	Approximate density of infestation
<i>Halogeton glomeratus</i>	Halogeton	scattered colonies over 100-200 acres	1-5/ft ²
<i>Carduus nutans</i>	Musk thistle	4000 ft ²	15-20 individuals
<i>Acroptilon repens</i>	Russian knapweed	720 ft ²	1/ft ²
<i>Acroptilon repens</i>	Russian knapweed	3 scattered colonies of approx. 3000 ft ² over 3 acres	2.5/ft ²

Erosion control measures (erosion blanketed slopes and grade control structures) were assessed by air survey. Areas showing erosion or damaged measures were reported to an on-call contractor, who carried out repairs.

Conclusions

Integrated surface management provides a comprehensive method to assist early stages of natural plant community succession and site stabilization. An integrated approach includes three phases: 1) pre-construction measures, such as coordination, site survey, and design of seed mixtures and erosion control requirements; 2) implementation of plans and designs during construction; and, 3) post-construction monitoring and adjustment of non-satisfactory areas.

The term “integrated” applies to the integration of three closely related surficial processes: 1) soil erosion; 2) plant

community dynamics; and 3), control of exotic invasive plant species. It also applies to the integration of the reclamation effort into the overall construction project, particularly in terms of scheduling and cooperation of different construction phases.

References

- Bureau of Land Management, Environmental Assessment for the Mid-America Four Corners Pipeline Loop Project. June 1995. Volume 1
- Dick-Pedie, William A. 1993. New Mexico vegetation, past present and future. University of New Mexico Press, Albuquerque, New Mexico.
- Munshower, Frank F. 1994. Practical Handbook of Disturbed Land Revegetation. CRC Press, Inc. pp. 2-4.
- Lee, Richard Personal Communication, 1995. New Mexico State Cooperative Extension Service Weed Scientist, New Mexico State University, Las Cruces, New Mexico.